GGSRDN
Educational Services Private Limited
9th, 10th, NEET, JEE(Main/Advanced)
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GGSRDN

DPP

FOR CLASS 12th

Set Your Target and Keep Try in Until You Reach It.

DPP 1 TO 43

PHYSICAL / INORGANIC CHEMISTRY

DPP
DAILY PRACTICE PROBLEMS

DPP No. 1

Total Marks : 33

Max. Time : 34 min.

Topic : Solution Colligative Properties

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.4	(3 marks, 3 min.)	[12, 12]
Multiple choice objective ('–1' negative marking) Q.5 to Q.6	(4 marks, 4 min.)	[8, 8]
Subjective Questions ('–1' negative marking) Q.7	(4 marks, 5 min.)	[4, 5]
Comprehension ('–1' negative marking) Q.8 to Q.10	(3 marks, 3 min.)	[9, 9]

1. A student was assigned a certain task by his teacher in chemistry lab. During the experiment, student dropped the flask containing 250 ml, 3 molar NaOH solution. Due to this 50 ml of solution out of 250 ml, had fallen on the floor. Thinking that teacher may punish him for this mistake, he replenished the left over solution with 50 ml of water. The new molarity of NaOH solution will be.

(A) 2M (B) 3M (C) 2.5 M (D) 2.4 M

2. **Statement-1 :** N_2 gas present in a closed container along with some H_2O (ℓ) at equilibrium has relative humidity = 100%

Statement-2 : At equilibrium, partial pressure of $H_2O(g)$ is equal to aqueous tension at that temperature.

(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.

(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1

(C) Statement-1 is True, Statement-2 is False

(D) Statement-1 is False, Statement-2 is True

3. A mixture of two immiscible liquids at a constant pressure of 1 atm boils at a temperature

(A) equal to the normal boiling point of more volatile liquid

(B) equal to the mean of the normal boiling points of the two liquids

(C) greater than the normal boiling point of either of the liquid

(D) smaller than the normal boiling point of either of the liquid.

4. For an ideal binary solution with P_A^0 / P_B^0 which relation between X_A (mole fraction of A in liquid phase) and Y_A (mole fraction of A in vapour phase) is correct , X_B and Y_B are mole fraction of B in liquid and vapour phase respectively : (Given : $P_A^0 > P_B^0$)

(A) $X_A = Y_A$ (B) $X_A > Y_A$

(C) $\frac{X_A}{X_B} < \frac{Y_A}{Y_B}$ (D) X_A, Y_A, X_B and Y_B cannot be correlated

5.* The vapour pressure of a dilute solution of a solute is influenced by :

(A) Temperature of solution (B) Mole fraction of solute

(C) M.pt. of solute (D) Degree of dissociation of solute

6.* In which of the following cases van't Hoff factor is greater than three

(A) $AlCl_3$ if $\alpha = 0.8$. (B) $BaCl_2$ if $\alpha = 0.9$.

(C) Na_3PO_4 if $\alpha = 0.9$ (D) $K_4[Fe(CN)_6]$ if $\alpha = 0.7$.

7. Mixture of volatile components A and B has total vapour pressure (in Torr) $p = 265 - 130\ x_A$, where x_A is mole fraction of A in mixture. Hence p_A^0 and p_B^0 are (in Torr). Calculate sum of the vapour pressure of pure component A and B. Report your answer as $\frac{1}{100}$ th part of the original sum.

Comprehension # (Q. 8 to Q. 10)

Read the following comprehension regarding *Completely Immiscible Liquids : Steam Distillation* carefully and answer the questions (8 to 10).

It is probably true that no two liquids are absolutely insoluble in each other, but with certain pairs, eg., mercury and water and carbon disulfide and water, the mutual solubility is so small that the liquids may be regarded as virtually immiscible. For systems of this type, each liquid exerts its own vapour pressure, independent of the other, and the total vapour pressure is the sum of the separate vapour pressures of the two components in the pure state at the given temperature. The composition of the vapour can be readily calculated by assuming that the gas laws are obeyed; the number of moles of each constituent in the vapour will then be proportional to its partial pressure, that is to say, to the vapour pressure of the substance in the pure state. If p_A^0 and p_B^0 are the vapour pressures of the pure liquids A and B, respectively, at the given temperature, and n'_A and n'_B are the numbers of moles of each present in the vapour, the total pressure P at the same temperature is given by

$$P = p_A^0 + p_{B,}^0 \qquad (1)$$

and the composition of the vapour by $\frac{n'_A}{n'_B} = \frac{p_A^0}{p_B^0}$ (2)

To express the ratio of A to B in the vapour in terms of the actual weights w_A and w_B, the numbers of moles must be multiplied by the respective molecular weights M_A and M_B ; hence,

$$\frac{w_A}{w_B} = \frac{n'_A M_A}{n'_B M_B} = \frac{p_A^0 M_A}{p_B^0 M_B} \qquad (3)$$

A system of two immiscible liquids will boil, that is, distill freely, when the total vapour pressure P is equal to the atmospheric pressure. The boiling point of the mixture is thus lower than that of either constituent. Further, since the total vapour pressure is independent of the relative amounts of the two liquids, the boiling point, and hence the composition of the vapour and distillate, will remain constant as long as the two layers are present.

The properties just described are utilized in the process of steam distillation, whereby a substance that is immiscible, or almost immiscible, with water, and that has a relatively high boiling point, can be distilled at a much lower temperature by passing steam through it. The same result should, theoretically, be obtained by boiling a mixture of water and the particular immiscible substance, but by bubbling steam through the latter the system is kept agitated, and equilibrium is attained between the vapour and the two liquids. The mixture distills freely when the total pressure of the two components is equal to that of the atmosphere.

It is seen that chlorobenzene, which has a normal boiling point of 132°C, can be distilled with steam at a temperature about 40° lower, the distillate containing over 70 percent of the organic compound.

An examination of the calculation shows that the high proportion by weight of chlorobenzene in the steam distillate is due largely to the high molecular weight of this substance, viz., 112.5 as compared with that of water. In addition this case is a particularly favorable one because chlorbenzene has a relatively high vapour pressure in the region of 90° to 100°C. In order that a liquid may be distilled efficiently in steam, it should therefore be immiscible with water, it should have a high molecular weight, and its vapour pressure should be appreciable in the vicinity of 100°C. A liquid which is partially miscible with water, such as aniline, may be effectively distilled in steam, provided the solubility is not very great. In calculating the composition of the distillate, however, the pressures p_A^0 and p_B^0 in equation (3) would have to be replaced by the actual partial pressures. Attention may be called to the fact that equation (3) can be employed to determine the approximate molecular weight of a substance that is almost immiscible with water. This can be done provided the composition of the steam distillate and the vapour pressures of the two components are known.

8. The hydrocarbon terpinene was found to distil freely in steam at a temperature of 95°C, when the atmospheric pressure was 744 mm; the vapour pressure of pure water at this temperature is 634 mm.
The distillate contains 55 per cent by weight of terpinene; calculate its molecular weight.
(A) 127 (B) 121 (C) 132 (D) 120

9. Which of the following cannot be efficiently steam distilled ?
(A) ethanol (B) chlorobenzene (C) aniline (D) *o*-nitrophenol

10. Following is the variation of vapour pressure with temperature for (1) water and (2) a substance to be steam distilled. At what temperature will the mixture of water and that substance boil under a pressure of 740 mm Hg?

T(°C)	p°_{water} (mm Hg)	$p^\circ_{substance}$ (mm Hg)
98	707.27	7.62
98.5	720.15	7.80
99.0	733.24	7.97
99.5	746.52	8.15
100.0	760.00	8.35

(A) 98.45°C (B) 98.95°C (C) 99.25°C (D) 99.75°C

that is immiscible, or almost immiscible, with water, and that has a relatively high boiling point, can be distilled at a much lower temperature by passing steam through it. The same result should, theoretically, be obtained by boiling a mixture of water and the particular immiscible substance, but by bubbling steam through the latter the system is kept agitated, and equilibrium is attained between the vapour and the two liquids. The mixture distills freely when the total pressure of the two components is equal to that of the atmosphere.
It is seen that chlorobenzene, which has a normal boiling point of 132°C, can be distilled with steam at a temperature about 40° lower, the distillate containing over 70 percent of the organic compound.

PHYSICAL / INORGANIC CHEMISTRY

DPP
DAILY PRACTICE PROBLEMS

DPP No. 2

Total Marks : 41

Max. Time : 45 min.

Topic : Solution Colligative Properties

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.3	(3 marks, 3 min.)	[9, 9]
Multiple choice objective ('–1' negative marking) Q.4 to Q.7	(4 marks, 4 min.)	[16, 16]
Subjective Questions ('–1' negative marking) Q.8 to Q.9	(4 marks, 5 min.)	[8, 10]
Match the Following (no negative marking) Q. 10	(8 marks, 10 min.)	[8, 10]

1. A certain quantity of a gas occupied 100 ml when collected over water at 15°C and 750 mm pressure. It occupies 91.9 ml in dry state at NTP. Find the V.P. of water at 15°C

(A) 20 mm (B) 13.2 mm (C) 18 mm (D) none

2. Mixture of volatile components A and B has total vapour pressure (in Torr) $p = 254 - 119\ x_A$, where x_A is mole fraction of A in mixture. Hence p_A^0 and p_B^0 are (in Torr)

(A) 254, 119 (B) 119, 254 (C) 135, 254 (D) 119, 373

3. Two liquids X and Y are perfectly immiscible. If X and Y have molecular masses in ratio 1:2, the total vapour pressure of a mixture of X and Y prepared in weight ratio 2:3 should be (P_X^0 = 400 torr, P_Y^0 = 200 torr)

(A) 300 torr (B) 466.7 torr (C) 600 torr (D) 700 torr

4*. Which of the following are true for ideal solutions :

(A) $\Delta V_{mix} = 0$ (B) $\Delta H_{mix} = 0$ (C) $\Delta S_{mix} = 0$ (D) $\Delta G_{mix} = 0$

(E) Raoult's law is obeyed for entire concentration range and temperatures.

5*. Two liquids A and B form an ideal solution. The solution has a vapor pressure of 700 Torr at 80°C. It is distilled till 2/3rd of the solution is collected as condensate. The composition of the condensate is $x'_A = 0.75$ and that of the residue is $x''_A = 0.30$. If the vapor pressure of the residue at 80°C is 600 Torr, which of the following is/are true?

(A) The composition of the original liquid was $x_A = 0.6$. (B) $P_A^0 = \frac{2500}{3}$ Torr.

(C) The composition of the original liquid was $x_A = 0.4$. (D) $P_B^0 = 500$ Torr.

6*. 1 M of glucose ($C_6H_{12}O_6$) solution (density = 1.18 g/ml) is equivalent to which of the following solution

(A) % w/w = 18% (solution)

(B) 180 g solute per litre solution

(C) % w/v = 18% (solution)

(D) 1 molal solution

7*. Which of the following molarity values of ions in a aqueous solution of 5.85 % w/v NaCl, 5.55% w/v $CaCl_2$ and 6% w/v NaOH are correct [Na = 23, Cl = 35.5 , Ca = 40, O = 16]

(A) $[Cl^{-1}] = 2M$

(B) $[Na^+] = 1M$

(C) $[Ca^{2+}] = 0.5$ M

(D) $[OH^-] = 1.5$ M

8. Three vessel X, Y and Z are of capacity 1.5, 2.5 and 4 litre respectively. Vessel X contains 1.0 gm of N_2 gas at a pressure of 400 mm of Hg, vessel Y contains 1 gm of gas at 208 mm of Hg and vessel Z contains a gas at 160 mm of Hg pressure. calculate the pressure in vessel Z in mm of Hg if gases of X and Y are completely transferred to vessel Z. Assume that all vessels are at same temperature before and after the transfer.

9. If 20 ml of 0.5 M Na_2SO_4 is mixed with 50 ml of 0.2 M H_2SO_4 & 30 ml of 0.4 M $Al_2(SO_4)_3$ solution, calculate. $[Na^+]$, $[H^+]$, $[SO_4^{2-}]$, $[Al^{3+}]$. Assuming 100% dissociation.

10.

Column (I)	**Column (II)**
(A) 50 ml of 3M HCl + 150 ml of 1M $FeCl_3$	(p) 1.85 m
(B) mole fraction of NaCl in aqueous solution of NaCl is 0.1 then molality of the solution is	(q) $[Cl^-] = 3$ M
(C) 10%(w/w) propanol (C_3H_7OH) solution has molality	(r) $[H^+] = 0.75$ M
(D) 10.95% (w/v) HCl	(s) 6.1 m

PHYSICAL / INORGANIC CHEMISTRY

DPP
DAILY PRACTICE PROBLEMS

DPP No. 3

Total Marks : 38

Max. Time : 41 min.

Topic : Solution Colligative Properties

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.6	(3 marks, 3 min.)	[18, 18]
Multiple choice objective ('–1' negative marking) Q.7 to Q.8	(4 marks, 4 min.)	[8, 8]
Subjective Questions ('–1' negative marking) Q.9	(4 marks, 5 min.)	[4, 5]
Match the Following (no negative marking) Q. 10	(8 marks, 10 min.)	[8, 10]

1. In which case van't Hoff factor is maximum ?

(A) KCl, 50% ionised

(B) K_2SO_4, 40% ionised

(C) $SnCl_4$, 20% ionised

(D) $FeCl_3$, 30% ionised

2. Solution having osmotic pressure nearer to that of an equimolar solution of $K_4[Fe(CN)_6]$ is:

(A) Na_2SO_4

(B) $BaCl_2$

(C) $Al_2(SO_4)_3$

(D) $C_{12}H_{22}O_{11}$

3. Three solutions are prepared by adding 'w' gm of 'A' into 1kg of water, 'w' gm of 'B' into another 1 kg of water and 'w' gm of 'C' in another 1 kg of water (A, B, C are non electrolytic). Dry air is passed from these solutions in sequence (A $\longrightarrow$ B $\longrightarrow$ C). The loss in weight of solution A was found to be 2 gm while solution B gained 0.5 gm and solution C lost 1 gm. Then the relation between molar masses of A, B and C is :

(A) $M_A : M_B : M_C = 4 : 3 : 5$

(B) $M_A : M_B : M_C = \frac{1}{4} : \frac{1}{3} : \frac{1}{5}$

(C) $M_C > M_A > M_B$

(D) $M_B > M_A > M_C$

4. How many mmoles of sucrose should be dissolved in 500 gms of water so as to get a solution which has a difference of 103.57°C between boiling point and freezing point.

(K_f = 1.86 K Kg mol^{-1}, K_b = 0.52 K Kg mol^{-1})

(A) 500 mmoles

(B) 900 mmoles

(C) 750 mmoles

(D) 650 mmoles

5. 20g of a binary electrolyte (molecular weight = 100) are dissolved in 500 g of water. The freezing point of the solution is – 0.74°C ; K_f = 1.86 K molality^{-1}. The degree of dissociation of electrolyte is

(A) 50%

(B) 75%

(C) 100%

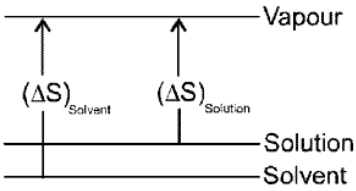
(D) Zero

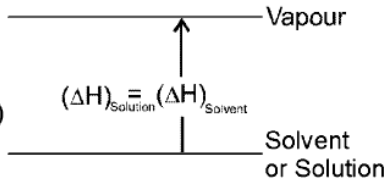
6. At 12°C the osmotic pressure of a urea solution is 500 mm. The solution is diluted and the temperature is raised to 27°C, when the osmotic pressure is found to be 100 mm. Determine the extent of dilution.

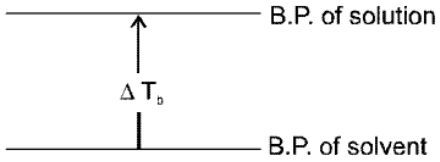
(A) 2.3 (B) 5.0

(C) 5.3 (D) cannot be calculated

7.* Which of the following diagrams represent the correct difference when non-volatile solute is present in an ideal solution ?

(A) 

(B) 

(C) 

(D) only (A) & (B)

8.* If cost per gram were not a concern, arrange the following arrangement(s) of the substances in the order in which they would be the most efficient per unit mass for melting snow from side walks and roads :

(P) glucose, (Q) LiCl, (R) NaCl, (S) $CaCl_2$

[C – 12, O – 16, Li – 7, Cl – 35.5, Na – 23, Ca – 40]

(A) R < S (B) P > S

(C) P > Q > S > R (D) Q < R

9. 1g of arsenic dissolved in 86 g of benzene brings down the freezing point to 5.31 °C from 5.50 °C. If K_f of benzene is 4.9 $\frac{°C}{m}$, the atomicity of the molecule is : (As – 75)

10.

	Column-I		**Column-II**
(A)	n-hexane + n-heptane.	(p)	Can be separated by fractional distillation.
(B)	Acetone + chloroform	(q)	Maximum boiling azeotrope.
(C)	Chloro-benzene and bromo-benzene	(r)	Cannot be separated by fractional distillation completely.
(D)	Ethanol + water.	(s)	Minimum boiling azeotrope.

PHYSICAL / INORGANIC CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 4

Total Marks : 38

Max. Time : 40 min.

Topic : Solution Colligative Properties

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.5	(3 marks, 3 min.)	[15, 15]
Subjective Questions ('–1' negative marking) Q.6 to Q.7	(4 marks, 5 min.)	[8, 10]
Comprehension ('–1' negative marking) Q.8 to Q.12	(3 marks, 3 min.)	[15, 15]

1. The osmotic pressure of equimolar solutions of $BaCl_2$, NaCl and glucose will be in the order

(A) glucose > NaCl > $BaCl_2$ (B) $BaCl_2$ > NaCl > glucose

(C) NaCl > $BaCl_2$ > glucose (D) NaCl > glucose > $BaCl_2$

2. A 0.004 M solution of Na_2SO_4 is isotonic with 0.010 M solution of glucose at same temperature. The apparent percentage dissociation of Na_2SO_4 is :

(A) 25% (B) 50% (C) 75% (D) 85%

3. An electrolyte A gives 3 ions and B is a non-electrolyte. If 0.1 M solution of B produces an osmotic pressure P, then 0.05 M solution of A will produce an osmotic pressure, assuming that the electrolyte is completely ionised:

(A) 1.5 P (B) P (C) 0.5 P (D) 0.75 P

4. 2.56g of sulfur in 100g of CS_2 has depression in freezing point of 0.01^0C.$K_f = 0.1^0 molal^{-1}$. Hence, the atomicity of sulfur in CS_2 is :

(A) 2 (B) 4 (C) 6 (D) 8

5. **Statement-1 :** The freezing point of water is depressed by the addition of glucose.

Statement-2 : Entropy of solution is less than entropy of pure solvent.

(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.

(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1

(C) Statement-1 is True, Statement-2 is False

(D) Statement-1 is False, Statement-2 is True

6. A 0.01 m solution of NH_4Cl (M – 53.5) solidifies at – 0.0358°C. Determine the degree of dissociation in this solution and the apparent molar mass of the salt if $K_f = 1.86 \frac{K}{kg-mol}$ for water ?

7. Calculate the molecular weight of cellulose acetate if its 0.2% (wt./vol.) solution in acetone (sp. gr. 0.8) shows an osmotic rise of 2.58 cm against pure acetone at 27°C.

Comprehension # (Q.8 to Q.12)

Read the following comprehension carefully and answer the questions (8 to 12).

A system of greater disorder of molecules is more probable. The disorder of molecules is reflected by the entropy of the system. A liquid vaporises to form a more disordered gas. When a solute is present, there is additional contribution to the entropy of the liquid due to increased randomness. As the entropy of solution is higher than that of pure liquid, there is weaker tendency to form the gas. Thus, a solute (non volatile) lowers the vapour pressure of a liquid, and hence a higher boiling point of the solution.

Similarly, the greater randomness of the solution opposes the tendency to freeze. In consequence, a lower the temperature must be reached for achieving the equilibrium between the solid (frozen solvent) and the solution. Elevation of B.Pt. (ΔT_b) and depression of F.Pt. (ΔT_f) of a solution are the colligative properties which depend only on the concentration of particles of the solute, not their identity. For dilute solutions, ΔT_b

and ΔT_f are proportional to the molality of the solute in the solution.

$\Delta T_b = K_b m$ $\quad K_b$ = Ebullioscopic constant = $\dfrac{RT_b^{\circ 2} M}{1000\ \Delta H_{vap}}$

And $\Delta T_f = K_f m$ $\quad K_f$ = Cryoscopic constant = $\dfrac{RT_f^{\circ 2} M}{1000\ \Delta H_{fus}}$ (M = molecular mass of the solvent)

The values of K_b and K_f do depend on the properties of the solvent. For liquids, $\dfrac{\Delta H_{vap}}{T_b^{\circ}}$ is almost constant.[**Troutan's Rule**, this constant for most of the **unassociated liquids**(not having any strong bonding like Hydrogen bonding in the liquid state) is equal to 90 J/mol.]

For solutes undergoing change of molecular state is solution (ionization or association), the observed ΔT values differ from the calculated ones using the above relations. In such situations, the relationships are modified as $\Delta T_b = i K_b m$; $\Delta T_f = i K_f m$

where i = Van't-Hoff factor, greater than unity for ionization and smaller than unity for association of the solute molecules.

8. Depression of freezing point of which of the following solutions does represent the cryoscopic constant of water?

(A) 6% by mass of urea is aqueous solution

(B) 100g of aqueous solution containing 18 g of glucose

(C) 59 g of aqueous solution containing 9 g of glucose

(D) 1 M KCl solution in water.

9. Dissolution of a non-volatile solute into a liquid leads to the :

(A) decrease of entropy (B) increase in tendency of the liquid to freeze

(C) increases in tendency to pass into the vapour phase. (D) decrease in tendency of the liquid to freeze

10. To aqueous solution of NaI, increasing amounts of solid HgI_2 is added. The vapor pressure of the solution

(A) decreases to a constant value

(B) increases to a constant value

(C) increases first and then decreases

(D) remains constant because HgI_2 is sparingly soluble in water.

11. A liquid possessing which of the following characteristics will be most suitable for determining the molecular mass of a compound by cryoscopic measurements?

(A) That having low freezing point and small enthalpy of freezing

(B) That having high freezing point and small enthalpy of freezing

(C) That having high freezing point and small enthalpy of vaporisation

(D) That having large surface tension

12. A mixture of two immiscible liquids at a constant pressure of 1 atm boils at a temperature

(A) equal to the normal boiling point of more volatile liquid

(B) equal to the mean of the normal boiling points of the two liquids

(C) greater than the normal boiling point of either of the liquid

(D) smaller than the normal boiling point of either of the liquid.

PHYSICAL / INORGANIC CHEMISTRY

DPP
DAILY PRACTICE PROBLEMS

DPP No. 5

Total Marks : 28

Max. Time : 32 min.

Topic : Coordination Compounds

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.4	(3 marks, 3 min.)	[12, 12]
Subjective Questions ('–1' negative marking) Q.5 to Q.6	(4 marks, 5 min.)	[8, 10]
Match the Following (no negative marking) Q.7	(8 marks, 10 min.)	[8, 10]

1. The IUPAC name for the complex compound $Li[AlH_4]$ is :
(A) lithium aluminium hydride
(B) hydrido - aluminiumlithium (III)
(C) lithium tetrahydridoaluminate (III)
(D) lithium tetrahydridoaluminate (I)

2. The IUPAC name for $K_2[Cr^{VI}NH_3(CN)_2O_2(O_2)]$ is
(A) potassium amminedicyanido-C-dioxidoperoxidochromate(VI)
(B) potassium amminedicyanatotetraoxochromium(III)
(C) potassium amminedicyanochromate (IV)
(D) potassium amminocyanodiperoxochromate (VI)

3. The IUPAC name for $K_2[OsCl_5N]$ is
(A) potassium pentachloroazidoosmate (VIII)
(B) potassium pentachloroazoosmate (VI)
(C) potassium pentachloridonitridoosmate (VI)
(D) potassium nitroosmate (III)

4. The formula of the complex sodium hydridotrimethoxoborate (III) is
(A) $Na_4[B_4H_2(OCH_3)_3]$ (B) $Na_2[BH(OCH_3)_3]$ (C) $Na[BH_2(OCH_3)_3]$ (D) $Na[BH(OCH_3)_3]$

5. Write IUPAC names of the following

(a)	$Na_2[Fe(CN)_5NO]$	(b)	$[Ni(DMG)_2]$
(c)	$NH_4[Cr(SCN)_4(NO)_2]$ (NO is nitrosyl)	(d)	$[Pd(H_2O)_2I_2(ONO)_2]$
(e)	$[Co(NH_3)_4Cl(NCS)]^+$	(f)	$K_4[FeO_4]$
(g)	$K_2[Co(N_3)_4]$	(h)	$[Ni(PPh_3)_2Cl_2]$
(i)	$[Cr(acac)_3]$	(j)	$[Pt(C_5H_5N)_4][PtCl_4]$

6. Write the structural formula corresponding to each of the following IUPAC names :
(a) hexaaquairon (II) chloride
(b) potassium tetrafluoridoargentate (III)
(c) pentachloridotitanate (II) ion
(d) tetraamminedichloridocobalt (III) chloride
(e) dicyanido-C-argentate (I) ion
(f) diamminetetrachloridonickelate (II) ion
(g) tris(ethylenediamine)copper(II) sulphate
(h) sodium diaquatetrahydroxidoaluminate (III)
(i) amminechloridobis(ethylene diamine)chromium(III) sulphate
(j) potassium tetracyanido-C-zincate (II)

7. Match the ligands listed in column – I with the characteristic(s)/type of ligands listed in column – II.

Column – I	Column – II
(A) Acetyl acetonato	(p) Resonance stabilization
(B) Oxalato	(q) Monoanion
(C) Dimethyl glyoximato	(r) Chelating ligand
(D) Nitrito	(s) Ambidentate ligand (t) Monodentate

NOTE : For resonance stabilization consider the ligands as only free ions.

PHYSICAL / INORGANIC CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 6

Total Marks : 18

Max. Time : 21 min.

Topic : Coordination Compounds

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.2	(3 marks, 3 min.)	[6, 6]
Subjective Questions ('–1' negative marking) Q.3 to Q.5	(4 marks, 5 min.)	[12, 15]

1. The coordination number of a central metal atom of a complex is :

(A) The number of only anionic ligands bonded to the metal ion.

(B) The number of ligands around a metal ion bonded by π bonds.

(C) The number of ligands around a metal ion bonded by σ and π bonds both.

(D) The number of σ bonds between ligands & central metal atom.

2. Which of the following statement(s) is/are true

(A) Chelation effect is maximum for five and six membered rings.

(B) Chelating ligands are at least bidentate ligand.

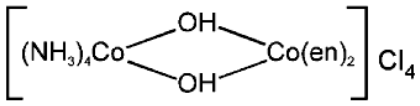
(C) As the number of rings in a complex increase stability of complex (Chelate) also increases.

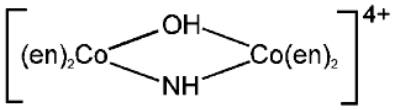
(D) Azide ion (N_3^-) has two N as donor atoms and behaves as a chelating ligand.

3. Write IUPAC names of the following

(a) $[Co(NH_3)_6][CuCl_5]$ (b) $[V(H_2O)_6]Cl_3$

(c) $(NH_4)_3[Co(C_2O_4)_3]$

(d) 

(e) 

(f) $Na_2[SiF_6]$ (g) $K_2[CrO_4]$

(h) $[(NH_3)_5Cr - OH - Cr(NH_3)_5]Cl_5$ (i) $[Fe(en)_3][Fe(CO)_4]$

(j) $[TiCl_4(Et_2O)_2]$ (k) $Mn_2(CO)_{10}$

(l) $[VO(acac)_2]$ (m) $Fe_4[Fe(CN)_6]_3$

4. Write the structural formula corresponding to each of the following IUPAC names :

(a) hexaamminechromium (III) tetrachloridocuprate (II)

(b) diamminedichloridoplatinum (II)

(c) tetracarbonyl nickel(0)

(d) tetraammineplatinum(II) amminetrichloridoplatinate (II)

(e) sodium dithiosulphatoargentate(I)

(f) potassium tetracyanido-C-nickelate(0)

(g) bis(η^5 – cyclopentadienyl)iron (II)

(h) tetrathiocyanato-N-zincate (II) ion

(i) potassium tetraoxidomanganate(VII)

(j) potassium trioxalatoaluminate (III)

(k) tetrapyridineplatinum (II) tetrachloridoplatinate (II)

5. A coordination compound has the formula $CoCl_3.4NH_3$. It does not liberate NH_3 but precipitates Cl^- ions as AgCl. Give the IUPAC name of the compound and write its structural formula.

PHYSICAL / INORGANIC CHEMISTRY

DPP
DAILY PRACTICE PROBLEMS

DPP No. 7

Total Marks : 37

Max. Time : 41 min.

Topic : Coordination Compounds

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.5	(3 marks, 3 min.)	[15, 15]
Comprehension ('–1' negative marking) Q.6 to Q.7	(3 marks, 3 min.)	[6, 6]
Subjective Questions ('–1' negative marking) Q.8 to Q.11	(4 marks, 5 min.)	[16, 20]

1. A coordination compound of cobalt has the molecular formula containing five ammonia molecules, one nitro group and two chlorine atoms for one cobalt atom. One mole of this compound produces three moles of ions in an aqueous solution. The aqeuous solution on treatment with an excess of $AgNO_3$ gives two moles of AgCl as a precipitate. The formula of this complex would be :

(A) $Co[NH_3)_4NO_2Cl][NH_3Cl]$ (B) $[Co(NH_3)Cl]\ [ClNO_2]$

(C) $[Co(NH_3)_5NO_2]Cl_2$ (D) $[Co(NH_3)_5]\ [(NO_2)_2Cl_2]$

2. A complex with the molecular formula $CrCl_3.6H_2O$ is such that 1/3 of the total chloride is precipitated by adding $AgNO_3$ to its aqueous solution. Then, which of the following is its best representation :

(A) $CrCl_3.6H_2O$ (B) $[Cr(H_2O)_3\ Cl_3].3H_2O$

(C) $[CrCl_2(H_2O)_4]Cl.2H_2O$ (D) $[CrCl(H_2O)_5]Cl_2.H_2O$

3. Match list I with list II and select the correct answer :

List (I) (Equiv. conductance at infinite dilution)	**List (II)** (Formula)
(1) 229	(a) $[Pt(NH_3)_5Cl]Cl_3$
(2) 97	(b) $[Pt(NH_3)_3Cl_3]Cl$
(3) 404	(c) $[Pt(NH_3)_4Cl_2]Cl_2$
(4) 523	(d) $[Pt(NH_3)_6]Cl_4$

The code :

	1	2	3	4
(A)	e	a	b	d
(B)	a	c	d	b
(C)	a	d	c	b
(D)	c	b	a	d

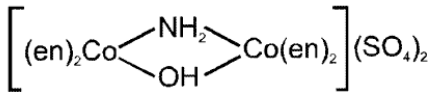
4. Which of the following complex ions obeys Sidgwick's effective atomic number (EAN) rule ?

(A) $[Fe(CN)_6]^{3-}$ (B) $[Fe(CN)_6]^{4-}$ (C) $[Cr(NH_3)_6]^{3+}$ (D) $[Ni(en)_3]^{2+}$

5. In which of the following complexes the effective atomic number is not equal to the atomic number of a inert gas

(A) $Ni(CO)_4$ (B) $[Co(NH_3)_6]^{3+}$ (C) $[Fe(CN)_6]^{4-}$ (D) $[CuCl_2]^-$

Comprehension # (Q.6 to Q.7)

The compound 

6. Correct IUPAC name of the above compound is :

(A) μ-amido-μ–hydroxidobis(bis(ethylenediammine)cobalt(III)) sulphate

(B) bis(ethylenediamine)cobalt(III)–μ–amido–μ–hydroxidobis(ethylenediamine)cobalt(III) sulphate

(C) Both A & B

(D) Neither (A) nor (B)

7. In the above compound bridging ligand(s) is/are :

(A) NH_2^- only (B) OH^- only (C) Both NH_2^- and OH^- (D) en and NH_2^-

8. Two compounds have the molecular formula, $Co(H_2O)_4(NO_2)_3$. In aqueous solution, one of these compounds does not conduct electricity while the other does. Write the possible structures of these two compounds.

9. Explain the following, giving appropriate reasons.

(i) Out of $K_4[Fe(CN)_6]$ and $K_3[Fe(NH_3)_6]$ solutions, the former has higher value of molar conductivity.

(ii) $[Pt(NH_3)_2Cl_2]$ and $[Pt(NH_3)_6]Cl_4$ differ in their electrolytic conductance

(iii) The value of molar conductivity of the aqueous solution of $[CoCl_3(NH_3)_3]$ is zero.

10. Arrange the following complexes in the increasing order of their electrical conductivity :

$[Co(NH_3)_3Cl_3]$, $[Co(NH_3)_6]Cl_3$ and $[Co(NH_3)_5Cl]Cl$.

11. The compound $CoCl_3.4NH_3$ contains only one Cl^- ion that is precipitated immediately on the addition of Ag^+ ions. Draw the structure of the compound on the basis of Werner's coordination theory.

PHYSICAL / INORGANIC CHEMISTRY

DPP
DAILY PRACTICE PROBLEMS

DPP No. 8

Total Marks : 36

Max. Time : 36 min.

Topic : Coordination Compounds

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.9	(3 marks, 3 min.)	[27, 27]
Comprehension ('–1' negative marking) Q.10 to Q.12	(3 marks, 3 min.)	[9, 9]

1. It is experimentally found that the compound $K_3[Ni(CN)_5]$ shows an decrease in its weight when placed in a magnetic balance and four metal–ligand bond lengths are equal but the rest is different. Then, which of the following set of informations is correct :

(i) The transition metal is sp^3d hybridised

(ii) The net dipole moment of complex is $\neq$ zero

(iii) The transition metal is dsp^3 hybridised

(iv) The net dipole moment of the complex is zero

(v) The complex ion is trigonal bipyramidal

(vi) The complex ion is square pyramidal

(A) (i),(ii),(v) (B) (ii),(iii),(vi) (C) (iii),(iv),(v) (D) none of these

2. It is an experiment fact that : DMG + Ni(II)salt + NH_4OH $\longrightarrow$ Red ppt.

Which of the following is wrong about this red ppt :

(A) It is a non–ionic complex (B) It involves intra molecular H–bonding

(C) Ni(II) is sp^3 hybridised (D) It is a diamagnetic complex

3. All the following complex ions are found to be paramagnetic :

P : $[FeF_6]^{3-}$; Q : $[CoF_6]^{3-}$

R : $[V(H_2O)_6]^{3+}$; S : $[Ti(H_2O)_6]^{3+}$

The correct order of their paramagnetic moment (spin only) is :

(A) P > Q > R > S (B) P < Q < R < S (C) P = Q = R = S (D) P > R > Q > S

4. When the complex K_6 $[(CN)_5$ Co–O–O–Co$(CN)_5]$ is oxidised by bromine into $K_5[(CN)_5$ Co–O–O–Co$(CN)_5]$. Then which of the following statements will be true about this change:

(In both complex Co have t_{2g}^6, $e_g^{0,0}$ configuration) :

(A) Co(II) is oxidised in Co(III) (B) The O–O bond length will increase

(C) The O–O bond length will decrease (D) 'A' & 'B' both are correct

5. The molecules having the same hybridization, shape and number of lone pairs of electrons :

(A) SeF_4, XeO_2F_2 (B) SF_4, XeF_2 (C) $XeOF_4$, TeF_4 (D) $SeCl_4$, XeF_4

6. **(a)** The crystal field-splitting for Cr^{3+} ion in octahedral field increases for ligands I^-, H_2O, NH_3 , CN^- and the order is:

(A) $I^- < H_2O < NH_3 < CN^-$ (B) $CN^- < I^- < H_2O < NH_3$

(C) $CN^- < NH_3 < H_2O < I^-$ (D) $NH_3 < H_2O < I^- < CN^-$

(b) In which of the following configurations will there be the possibility of both para and diamagnestism, depending on the nature of the ligands?

(A) d^7 (B) d^3 (C) d^6 (D) d^5

7. **(a)** The complex for which the calculation of crystal field splitting can be most easily done, by knowing its absorption spectrum, will be :

(A) $[TiCl_6]^{2-}$ (B) $[Fe(H_2O)_6]^{2+}$ (C) $[Ti(CN)_6]^{3-}$ (D)$[CoF_6]^{3-}$

(b) In which of the following complex ion, the metal ion will have t_{2g}^6, e_g^0 configuration according to CFT:

(A) $[FeF_6]^{3-}$ (B) $[Fe(CN)_6]^{3-}$ (C) $[Fe(CN)_6]^{4-}$ (D) None of these

8. The correct order for the CFSE (numerical value) for the following complexes is

Complex	P	Q	R	S
Formula	$[CoF_6]^{3-}$	$[Co(CN)_6]^{3-}$	$[Co(NH_3)_6]^{3+}$	$[Co(H_2O)_6]^{3+}$

(A) P > Q > R > S (B) Q > R > S > P (C) S > R > P > Q (D) R > Q > P > S

9. In the reaction : $[Ag(CN)_2]^- + Zn \longrightarrow$ the complex formed will be :

(A) Tetrahedral (B) square planar (C) octahedral (D) triangal bipyramidal

Comprehension # (Q.10 to Q.12)

Werner performed two experiments :

Expt-1 : He prepared a compound X by reacting KCl with $PtCl_4$. The compound X didn't give any ppt. with $AgNO_3$ but gave electrical conductance corresponding to 3 ions.

Expt-2 : He took 0.319 g of $CrCl_3.6H_2O$ and passed through a cation exchange resin & the acid coming out required 28.5 ml of 0.125 M NaOH.

Hence,

10. The formula of the compound X is :

(A) $[KPtCl]Cl_2$ (B) $K_2[PtCl_4]$ (C) $K_2[PtCl_6]$ (D) $K[PtCl_4]$

11. The hybridization in $K_2[PtCl_6]$ is :

(A) sp^3 (B) d^2sp^3 (C) sp^3d^2 (D) dsp^3

12. The complex $CrCl_3.6H_2O$ can be rightly represented as :

(A) $[Cr(H_2O)_4Cl_2]Cl$ (B) $[Cr(H_2O)_6]Cl_3$

(C) $[Cr(H_2O)_3Cl_3]3H_2O$ (D) $[Cr(H_2O)_5Cl]Cl_2$

PHYSICAL / INORGANIC CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 9

Total Marks : 46

Max. Time : 50 min.

Topic : Coordination Compounds

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.8	(3 marks, 3 min.)	[24, 24]
Subjective Questions ('–1' negative marking) Q.9 to Q.10	(4 marks, 5 min.)	[8, 10]
Comprehension ('–1' negative marking) Q.11 to Q.12	(3 marks, 3 min.)	[6, 6]
Match the Following (no negative marking) Q. 13	(8 marks, 10 min.)	[8, 10]

1. In the crystal field of the complex $[Fe(Cl)(CN)_4(O_2)]^{4-}$ the electronic configuration of metal is found to be t_{2g}^6, e_g^0 then, which of the following is true about this complex ion:

(A) It is a paramagnetic complex
(B) O–O bond length will be more than found in O_2 molecule
(C) Its IUPAC name will be chlorotetracyanosuperoxidoferrate (II) ion
(D) All the above are true

2. Which one of the following compounds has the electron-pair geometry as the trigonal bipyramidal with three equatorial positions occupied by lone pairs of electrons ?

(A) $[AlCl_3]$ (B) XeF_2 (C) $[Pt(NH_3)_2Cl_2]$ (D) CH_3 — Mg — Br.

3. **(a)** Spin only magnetic moment of a complex having CFSE = – 0.6 Δ_0 and surrounded by weak field ligands can be:

(A) 1.73 BM (B) 4.9 BM (C) both (A) & (B) (D) None of these

(b) Which of the following statements is not correct?
(a) $[Ni(H_2O)_6]^{2+}$ and $[Ni(NH_3)_6]^{2+}$ have same value of CFSE
(b) $[Ni(H_2O)_6]^{2+}$ and $[Ni(NH_3)_6]^{2+}$ have same value of magnetic moment

(A) Only a (B) Only b (C) Both a and b (D) None of these

4. Nitroprusside ion is :
A : $[Fe^{II}(CN)_5NO^+]^{2-}$ and not ;
B : $[Fe^{II}(CO)_5NO]^{2+}$. A and B can be differentiated by.

(A) estimating the concentration of iron (B) measuring the concentration of CN^-
(C) measuring the magnetic moment (D) thermally decomposing the compound.

5. All the following complexes shows a decrease in their weights when placed in a magnetic balance. Then, which of the these has square planar geometry :

(A) $Ni(CO)_4$ (B) $K[AgF_4]$ (C) $Na_2[Zn(CN)_4]$ (D) None of these

6. It is given that a complex formed by one Ni^{2+} ion and some Cl^- ions and some PPh_3 molecules does not show geometrical isomerism and its solution does not show electrical conductance. Then, which is correct about the complex :

(A) It is square planar (B) It is tetrahedral (C) It is diamagnetic (D) none of the above is correct

7. The green coloured complex $K_2[Cr(CN)_4(NH_3)(NO)]$ is paramagnetic and its paramagnetic moment (spin only) is 1.73 B.M. Which of the following is correct about it :
(i) Its IUPAC name is Potassium amminetetracyanonitrosylchromate (II)
(ii) Its IUPAC name is Potassium amminetetracyanonitrosoniumchromate (I)
(iii) Hybridisation state of chromium is sp^3d^2 (iv) It cannot show geometrical isomerism
(v) Hybridisation state of chromium is d^2sp^3 (vi) It can show linkage isomerism

(A) (ii), (iii),(iv) (B) (i),(iii), (vi) (C) (i), (v) (D) (ii), (v), (vi)

8. Which are correct statements ?
(A) $[Ag(NH_3)_2]^+$ is linear with sp hybridised Ag^+ ion.
(B) $NiCl_4^{2-}$, VO_4^{3-} and MnO_4^- have tetrahedral geometry
(C) $[Cu(NH_3)_4]^{2+}$, $[Pt(NH_3)_4]^{2+}$ and $[Ni(CN)_4]^{2-}$ have dsp^2 hybridisation of the metal ion
(D) $Fe(CO)_5$ have bipyramidal structure with dsp^3 hybridised iron.

9. In each of the following pair of complexes, choose the one that absorbs light at a longer wave length.
(a) $[Co(NH_3)_6]^{2+}$, $[Co(H_2O)_6]^{2+}$ (b) $[FeF_6]^{3-}$, $[Fe(CN)_6]^{3-}$ (c) $[Cu(NH_3)_4]^{2+}$, $[CuCl_4]^{2-}$

10. Observed (expermiental) lattice energies (in KJ/mol) of octahedrally coordinated crystals of VO and FeO are – 3917 and – 3923 respectively. The lattice energies of these crystals in the absence of CFSE are – 3691 and – 3856 kJ/mol respectively. Assuming that oxide ion (O^{2-}) is a weak field ligand, calculate CFSE value of V^{2+} and Fe^{2+} ion.

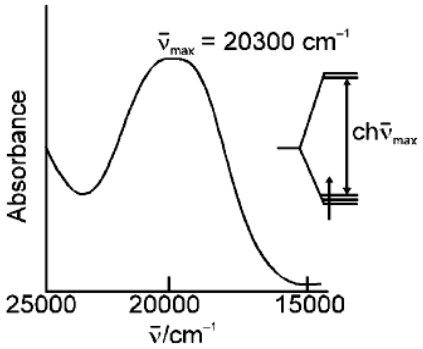
Comprehension # (Q.11 to Q.12)

Read the following passage based on Applications of crystal field theory to explains magnetic and spectral properties of complexes carefully and answer the questions (11- 12).

With the help of CFT number of unpaired electron in a compound can be calculated and we can calculate its paramagnetic moment(due to spin only), by the formula :

$\mu = \sqrt{n(n+2)}$ Bohr magneton (BM). where n is the number of unpaired electron in the complex.

For spectral analysis the separation between t_{2g} and e_g orbitals, called ligand field splitting. Parameter Δ_0 (for octahedral complexes) should be known to us, which can be easily calculated by observing the absorption spectrum of one electron complex. Figure shows the optical absorption spectrum of the d^1 hexaaquatitanium(III) ion $[Ti(H_2O)_6]^{3+}$. The CFT assigns the first absorption maximum at 20,300 cm^{-1} to the transition $e_g \leftarrow t_{2g}$. For multielectronic(d^2 to d^{10}) system, the calculation of Δ_0 by absorption spectrum is not that easy as the absorption spectrum will also be affected by electron-electron repulsions.



11. The crystal field stabilization energy (CFSE) for complex given in the passage, $[Ti(H_2O)]^{3+}$ will be (in kJ/mol) :
(A) 243 kJ/mole (B) 97 kJ/mole (C) 194 kJ/mole (D) 143 kJ/mole

12. The magnetic moments of following, arranged in increasing order will be (atomic number of Co = 27)
(1) Co^{3+} (octahedral complex with a strong field ligand)
(2) Co^{3+} (octahedral complex with a weak field ligand)
(3) Co^{2+} (tetrahedral complex)
(4) Co^{2+} (square planar complex)
(A) 1 > 2 > 3 > 4 (B) 2 > 3 > 4 > 1 (C) 3 > 2 > 4 > 1 (D) 2 > 4 > 3 > 1

13. **Match the pairs of complexes listed in column-I with the method(s) used for their differentiation listed in column-II.**

Column – I	**Column–II**
(A) $[Cr(H_2O)_6]Cl_3$ and $Cr(H_2O)_5Cl]Cl_2.H_2O$	(p) Can be differentiated by amount, nature or colour of precipitate formed.
(B) $[Co(NH_3)_5Br]SO_4$ and $[Co(NH_3)_5SO_4]Br$	(q) Can be differentiated by electrical conduction measurement method (appreciable difference)
(C) $[Co(NH_3)_5Cl]Cl_2$ and $[Co(NH_3)_6]Cl_3$	(r) Can be differentiated using cryoscopic measurement method.
(D) $[Cu(H_2O)_4]SO_4.H_2O$ and $[Cu(H_2O)_6](NO_3)_2$	(s) Can be differentiated by heating with concentrated H_2SO_4

PHYSICAL / INORGANIC CHEMISTRY

DPP
DAILY PRACTICE PROBLEMS

DPP No. 10

Total Marks : 51

Max. Time : 54 min.

Topic : Coordination Compounds

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.4	(3 marks, 3 min.)	[12, 12]
Multiple choice objective ('–1' negative marking) Q.5 to Q.7	(4 marks, 4 min.)	[12, 12]
Subjective Questions ('–1' negative marking) Q.8	(4 marks, 5 min.)	[4, 5]
Comprehension ('–1' negative marking) Q.9 to Q.11	(3 marks, 3 min.)	[9, 9]
Match the Following (no negative marking) Q. 12	(8 marks, 10 min.)	[8, 10]
Assertion and Reason (no negative marking) Q. 13 to Q. 14	(3 marks, 3 min.)	[6, 6]

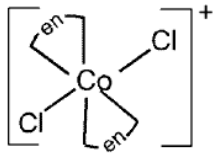
1. Which of the following is true :
(A) $[Zn(Cl)_2 (NH_3)_2]$ will exist in cis and trans forms
(B) [Pt(Br) (Cl) (NH_3) (Py)] is an optically active compound
(C) The brown ring complex $[Fe(H_2O)_5NO^+]^{2+}$ is paramagnetic
(D) All the above are true

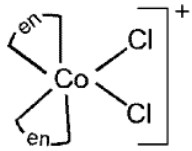
2. Which of the following is true about the complex $[PtCl_2(NH_3)(OH_2)]$; [Atomic no. of Pt = 78]
(i) It will have two geometrical isomeric forms, cis and trans
(ii) The hybridisation state of Pt(II) is sp^3
(iii) It is a square planar complex
(iv) It is a diamagnetic complex
(v) It can show hydrate isomerism
(vi) It is a tetrahedral complex
(A) (i), (iii),(iv) (B) (ii),(iv),(v) (C) (ii),(v),(vi) (D) (i),(v),(vi)

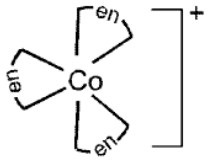
3. The octahedral complex $[Rh(NO_2) (SCN) (en)_2]^+$ can exist in a total number of isomeric forms including stereoisomers :
(A) 2 (B) 4 (C) 8 (D) 12

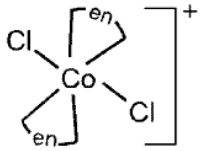
4. Total number of geometrical isomers of Ma_3b_3 type of octahedral complex are
(A) Two (B) four (C) Six (D) Zero

5. Which of the following ions are optically active ?

I 

II 

III 

IV 

(A) I (B) II (C) III (D) IV

6. Which is/are correct statement (s) ?
(A) $[Co(en)_3] [Cr(CN)_6]$ will display coordination isomerism.
(B) $[Mn(CO)_5(SCN)]$ will display linkage isomerism.
(C) $[Co(NH_3)_5(NO_3)]SO_4$ will display ionisation isomerism
(D) None is correct.

7. The compound Na_2IrCl_6 reacts with triphenylphosphine in diethyleneglycol in an atmosphere of CO to give $[IrCl(CO)(PPh_3)_2]$, known as 'Vaska's compound'. (Atomic number of Ir = 77)
Which of the following statements is /are correct?
(A) The IUPAC name of the complex is carbonylchloridobis(triphenylphosphine)iridium(I).
(B) The hybridisation of the metal ion is sp^3 .
(C) The magnetic moment (spin only) of the complex is zero.
(D) The complex shows geometrical as well as ionization isomerism.

8. Write a series of equations to show the stepwise displacement of H_2O ligands in $[Fe(H_2O)_6]^{3+}$ by ethylene-diamine (en) for which log K_1 = 4.44 ; log K_2 = 3.41 and log K_3 = 2.15. What is overall formation constant for the complex $[Fe(en)_3]^{3+}$?

Comprehension # (Q. 9 to Q.11)

A research-guide instructed his two students to synthesize complex

$$[Co(NH_3)_5(NO_2)]Cl_2$$

They synthesised the complexes with identical molecular formula, molar mass, geometry, conductance and spin, but they differed in colour. Based on the above facts answer the following questions.

9. The difference in colour is due to :

(A) optical isomerism (B) geometrical isomerism

(C) linkage isomerism (D) nuclear isomerism

10. Which of the ligands can show ambident property ?

(A) NO_2^- (B) NH_3 (C) H_2O (D) CO_3^{2-}

11. Complexes synthesized can be :

(A) $[Co(NH_3)_5(NO_2)]Cl_2$ (B) $[Co(NH_3)_5(ONO)]Cl_2$

(C) $[Co(NH_3)_5Cl_2]NO_2$ (D) (A) & (B) both.

12.

	Column – I		**Column – II**
(A)	$[Cr(NH_3)_6]^{3+}$	(p)	d^2sp^3
(B)	$[Co(en)_3]^{3+}$	(q)	CFSE = $-1.2\ \Delta_0$
(C)	$[Co(NO_2)_6]^{4-}$	(r)	Paramagnetic
(D)	$[Co(H_2O)_6]^{2+}$	(s)	sp^3d^2

13. **Statement-1 :** Tetrahedral complexes do not show geometrical isomerism

Statement-2 : All the bond angles in tetrahedral geometry are 109°.28'.

(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.

(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1

(C) Statement-1 is True, Statement-2 is False

(D) Statement-1 is False, Statement-2 is True

(E) Statement-1 is False, Statement-2 is False

14. **Statement-1 :** Out of $[NiF_6]^{4-}$ and $[NiF_6]^{2-}$ one can be high spin complex and other a low spin complex.

Statement-2 : F^- is a weak field ligand.

(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.

(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.

(C) Statement-1 is True, Statement-2 is False.

(D) Statement-1 is False, Statement-2 is True.

PHYSICAL / INORGANIC CHEMISTRY

DPP
DAILY PRACTICE PROBLEMS

DPP No. 11

Total Marks : 53

Max. Time : 53 min.

Topic : Coordination Compounds

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.3	(3 marks, 3 min.)	[9, 9]
Multiple choice objective ('–1' negative marking) Q.4 to Q.5	(4 marks, 4 min.)	[8, 8]
True False ('–1' negative marking) Q.6	(3 marks, 3 min.)	[3, 3]
Subjective Questions ('–1' negative marking) Q.7 to Q.10	(4 marks, 4 min.)	[16,16]
Match the column ('–1' negative marking) Q.11	(4 marks, 4 min.)	[4, 4]

1. Among the following which one of the following IUPAC name is not correctly mentioned ?

(A) Linkage isomer of $[Pt(NH_3)_2Cl(NO_2)]$; Diamminechloridonitrito-O-platinum(II)

(B) Ionization isomer of $[Pt(NH_3)_2Cl\ (NH_2CH_3)]Br$; Diamminebromido(methylamine)platinum(II) chloride.

(C) One of the hydrate isomer of $[Cr(H_2O)_5Cl]Cl_2.H_2O$; Hexaaquachromium(III) chloride.

(D) One of the coordination isomer of $[Co(NH_3)_6][Cr(CN)_6]$; Hexacyanidocobaltate(III) hexaamminechromium(III).

2. Match the complex ions listed in column-I with the characteristics listed in column-II using the codes given below.

Column-I	**Column-II**
(a) $[Ni\ (NH_3)_6]^{2+}$	(p) d^2sp^3 and diamagnetic
(b) $[Cr\ (NH_3)_6]^{3+}$	(q) sp^3d^2 and diamagnetic
(c) $[Co\ (NH_3)_6]^{3+}$	(r) sp^3d^2 and two unpaired electrons
(d) $[Zn\ (NH_3)_6]^{2+}$	(s) d^2sp^3 and three unpaired electrons.

	a	b	c	d		a	b	c	d
(A)	r	s	p	q	(B)	s	r	q	p
(C)	r	s	q	p	(D)	p	q	r	s

3. Consider the following complex :

$[Cr(NH_3)_4(NO_2)_2]$: inner orbital complex.

The oxidation number, number of d-electrons, number of unpaired d-electrons on the metal ion and number of isomers are respectively :

(A) 3, 3, 3, 2 (B) 2, 4, 0, 6 (C) 2, 4, 2, 6 (D) 2, 4, 4, 4

4. In which of the following complexes more than one type of structural isomerism are possible ?

(A) $[Co(NH_3)_5\ (NO_2)]Cl$ (B) $[Co(NH_3)_5(H_2O)](NO_2)_3$

(C) $[Pt(NH_3)_4][Pt(SCN)_4]$ (D) $[Cr(NH_3)_4\ (NO_2)_2]\ (NO_3)_2$

5. Consider the following statements.

(i) Blue salt $K_4[Mn(CN)_6]$. $3H_2O$ is isostructural with the hexacyanoferrate (II) and the former complex is paramagnetic but later one is diamagnetic.

(ii) In the series of isoelectronic species $[V(CO)_6]^-$, $[Cr(CO)_6]$ and $[Mn(CO)_6]^+$, from vanadium to manganese complexes there is a reduction in the strength of the bonding between metal and carbon and an increase in that in the carbonyl group (i.e. CO).

(iii) Chlorotristriphenylphosphinerhodium (I) is a square planar diamagnetic complex which is used as a homogeneous catalyst in hydrogenation of alkenes.

(iv) Like $[Co(NH_3)_4Cl_2]^+$ ion, $[Co(en)_2Cl_2]^+$ ion can exist in cis and trans forms and neither can display optical activity.

(v) $Ni(CO)_4$ and $NiCl_2(PPh_3)_2$ have same hybridisation but different, magnetic moment and effective atomic number

Which of the above statements are correct ?

(A) (i), (iii) and (v) (B) (ii), (iii) and (iv) (C) (ii), (iii) and (v) (D) (iii), (iv) and (v)

6. **S_1 :** CO forms strong complexes with transition elements because the drift of π electron density from metal to carbon tends to make the ligand more negative and so enhances its σ donor power.

S_2 : Amongst $[V(CO)_5]^{3-}$, $[V(CO)_6]^-$ and $[V(CO)_6]$, the C–O bond length is smallest in $[V(CO)_5]^{3-}$.

S_3 : The crystal field theory attributes the colour of the coordination compound to d–d transition of the electron.

S_4 : The number of electrons in t_{2g} orbitals in $[Cr(NH_3)_4(NO_2)_2](ClO_4)$ is 3.

(A) T F T T (B) F F T T (C) T F T F (D) T T T F

7. What is the $[Cd^{2+}]$ in 1.0L of solution prepared by dissolving 0.0010mol $Cd(NO_3)_2$ & 2 mol NH_3 ? K_d for the dissociation of $Cd(NH_3)_4^{2+}$ into Cd^{2+} & 4 NH_3 is 2×10^{-7}. Neglect the amount of cadmium in complexes containing fewer than 4 ammonia molecules.

8. How many of total isomers are possible for the complex $[Co(NH_3)_4(NO_2)_2]NO_3$?

9. Among the following complexes, how many have 'spin only' magnetic moment of 2.83 B.M. ?

$[Ni(CO)_4]$, $[Ni(CN)_4]^{2-}$, $[NiCl_2(PPh_3)_2]$, $[NiCl_4]^{2-}$, $[NiF_6]^{2-}$, $[NiF_6]^{4-}$, $[Ni(NH_3)_6]^{2+}$, $[Ni(en)_3]^{2+}$, $[Ni(H_2O)_6]^{2+}$

10. Total no. of isomers (including stereoisomers) for the complex $[Pd(NH_3)(H_2O)(NO_2)_2]$ are :

11.

	Column-I		**Column-II**
(A)	$[Cr(en)_3]^{3+}$	(p)	Paramagnetic
(B)	$[Mn(CN)_6]^{3-}$	(q)	$\mu_{spin} = \sqrt{15}$ B.M.
(C)	$[Co(H_2O)_6]^{2+}$	(r)	Two unpaired electrons
(D)	$[Fe(CN)_6]^{3-}$	(s)	Inner orbital complex.

PHYSICAL / INORGANIC CHEMISTRY

DPP
DAILY PRACTICE PROBLEMS

DPP No. 12

Total Marks : 36

Max. Time : 36 min.

Topic : Coordination Compounds

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.4	(3 marks, 3 min.)	[12, 12]
Multiple choice objective ('–1' negative marking) Q.5 to Q.6	(4 marks, 4 min.)	[8, 8]
Integer Answer Type		
Subjective Questions ('–1' negative marking) Q.7 to Q.10	(4 marks, 4 min.)	[16 ,16]

1. The IUPAC name of $[Fe(NH_2)(CO)_2I(PPh_3)_2]$ is :
(A) Amidodicarbonyliodidoditriphenylphosphineiron(II)
(B) Amidodicarbonyliodidobis(triphenylphosphine)iron(II)
(C) Aminedicarbonyliodidobis(triphenylphosphine)iron(II)
(D) Amidodicarbonyliodidobis(triphenylphosphine)ferrate(II)

2. EAN rule is followed by the complexes.
(i) $[Fe(\pi\text{-}C_5H_5)_2]$ (ii) $[Mn_2(CO)_{10}]$ (iii) $[V(CO_6)]^-$
(A) only (i) (B) only (ii) (C) only (iii) (D) all

3. Which of the following compound is expected to be coloured :
(A) $Ca_2[Fe(CN)_6]$ (B) $[Cu(CH_3CN)_4]BF_4$ (C) $K_3[Cu(CN)_4]$ (D) $K_4[VO_4]$

4. **S_1 :** The species $[CuCl_4]^{2-}$ exists but $[CuI_4]^{2-}$ does not.
S_2 : $[RhCl(Ph_3P)_3]$ and $[Ni(CO)_4]$ both are tetrahedral and diamagnetic.
S_3 : $N(Me)_3$ and $N(SiMe_3)_3$ are isostructural
(A) T T F (B) T F F (C) F T F (D) F T T

5. For Mn^{+3} pairing energy is 28000 cm^{-1}, Δ_0 for $[Mn(CN)_6]^{3-}$ is 38500 cm^{-1} then which of the following is / are correct.
(A) Complex will be coloured (B) Complex will be low spin complex
(C) Net CFSE = – 33600 cm^{-1} (D) Complex will be colourless

6. Which of the following statement(s) is/are correct?
(A) $[Cr(NH_3)_6]^{3+} > [Mn(CN)_6]^{3-} > [V(CO)_6]$, With respect to magnetic moment (spin values in B.M.)
(B) $[Co(CN)_6]^{3-} > [Co(NH_3)_6]^{3+} > [Co(H_2O)_6]^{3+}$, With respect to Δ_o values.
(C) $[Ni(CO)_4] > [Co(CO)_4]^- > [Fe(CO)_4]^{2-}$, With respect to strength of M – C, π-bond. (M = Ni, Co or Fe)
(D) $[NiCl_4]^{2-} < [CuCl_4]^{2-} < [ZnCl_4]^{2-}$, with respect to stability.

Integer Answer Type

7. Number of complexes that are paramagnetic in nature with number of unpaired electrons ($n \geq 2$) are :
1. $[MnCl_4]^{2-}$ 2. $[Mn_2(CO)_{10}]$ 3. $[V(CO)_6]^-$ 4. $[Ni(H_2O)_6]Cl_2$
5. $[Pt(NH_3)_4Cl_2]$ 6. $[Co(NH_3)_2(H_2O)_4]Cl_2$ 7. $[Ni(CN)_4]^{2-}$ 8. $[Cu(H_2O)_4]^{2+}$
9. $K_3[Cr(CN)_6]$

8. The brown ring complex is formulated as $[Fe(H_2O)_5NO^+]SO_4$. The oxidation number of iron is :

9. How many isomers are possible for the complex $[Ir(CO)Cl(PPh_3)_2]$?

10. In how many of the following complex ions, the central metal ions use (n – 1)d, ns and np orbitals for hybridisation ?
$[Mn(CN)_6]^{4-}$, $[Ni(NH_3)_6]^{2+}$, $[Co(ox)_3]^{3-}$, $[Cu(NO_2)_6]^{4-}$, $[AgF_4]^-$, $[Ni(CN)_4]^{2-}$, $[PdCl_4]^{2-}$, $[Pd(CN)_4]^{2-}$, $[Co(SCN)_4]^{2}$.

PHYSICAL / INORGANIC CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 13

Total Marks : 45

Max. Time : 48 min.

Topic : Ionic Equilibrium

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.4	(3 marks, 3 min.)	[12, 12]
Comprehension ('–1' negative marking) Q.5 (i to vii)	(3 marks, 3 min.)	[21, 21]
Subjective Questions ('–1' negative marking) Q.6 to Q.8	(4 marks, 5 min.)	[12, 15]

1. **(a)** Which of the following acids is monoprotic ?

(A) H_2SO_4 (B) $HClO_4$ (C) H_3PO_3 (D) H_3PO_4

(b) The weakest base is :

(A) ClO_4^- (B) HS^- (C) Cl^- (D) NH_3

(c) Which of the following can act both as a Bronsted acid & a Bronsted base ?

(A) HCl (B) H_3PO_4 (C) HCO_3^- (D) O^{2-}

2. **(a)** The ionic product of water at 45 ºC is 4×10^{-14}. What is pH of pure water at this temperature.

[Take : log 2 = 0.3]

(A) 6.7 (B) 7 (C) 7.3 (D) 13.4

(b) For which temperature the pOH of pure water can be greater than 7.

(A) 20 ºC (B) 30 ºC (C) 40 ºC (D) 50 ºC

3. **(a)** For pure water at 10 ºC and 60 ºC , the correct statement is

(A) $pOH_{10ºC} = pOH_{60ºC}$ (B) $pOH_{10ºC} > pOH_{60ºC}$ (C) $pOH_{60ºC} > pOH_{10ºC}$ (D) Can't say

(b) For pure water at 25 ºC and 50 ºC the correct statement is

(A) $pH_{25ºC} = pH_{50ºC}$ (B) $pH_{25ºC} > pH_{50ºC}$ (C) $pH_{50ºC} > pH_{25ºC}$ (D) Can't say

4. **(a)** At – 50ºC autoprotolysis of NH_3 gives $[NH_4^+] = 1 \times 10^{-15}$ M hence, autoprotolysis constant of NH_3 is:

(A) $\sqrt{1 \times 10^{-15}}$ (B) 1×10^{-30} (C) 1×10^{-15} (D) 2×10^{-15}

(b) The self ionization constant for pure formic acid, $K = [HCOOH_2^+][HCOO^-]$ has been estimated as 10^{-6} at room temperature .The density of formic acid is 1.15 g/cm^3. The percentage of formic acid converted to formate ion are :

(A) 0.002 % (B) 0.004 % (C) 0.006 % (D) 0.008 %

5. Comprehension #

Relative strengths of conjugate acid base pairs :

Stronger acid	$HClO_4$, HCl, H_2SO_4, HNO_3	Strong acids 100% dissociated in aqueous solution	ClO_4^-, Cl^-, HSO_4^-, NO_3^-	very weak bases Negligible tendency to be protonated in aqueous solution	Weaker base
	H_3O^+		H_2O		
↑	HSO_4^-, H_3PO_4, HNO_2, HF, CH_3COOH, H_2CO_3, H_2S, NH_4^+, HCN, HCO_3^-, H_2O	Weak acids Exist in solution as a mixture of HA A^-, and H_3O^+	SO_4^{2-}, $H_2PO_4^-$, NO_2^-, F^-, $CH_3CO_2^-$, HCO_3^-, HS^-, NH_3, CN^-, CO_3^{2-}, OH^-	Weak bases Moderate tendency to be protonated in aqueous solution	↓
Weaker acid	NH_3, OH^-, H_2	Very Weak acids Negligible tendency to dissociate.	NH_2^-, O^{2-}, H^-	Strong bases 100% protonated in aqueous solution	Strong base

(i). Account for the acidic properties of nitrous acid in terms of
(i) Arrhenius theory and (ii) Bronsted Lowry theory

(ii). Write a balanced equation for the dissociation of each of the following Bronsted Lowry acids in water.
(a) H_2SO_4 (b) H_3O^+ (c) HSO_4^-
Also write conjugate base of the acid

(iii). Which of the following reactions proceeds to the right and which proceeds to the left if you mix equal concentrations of reactants and products ?
(A) $HF(aq) + NO_3^-(aq) \rightleftharpoons HNO_3(aq) + F^-(aq)$ (B) $NH_4^+(aq) + CO_3^{2-}(aq) \rightleftharpoons HCO_3^-(aq) + NH_3(aq)$

(iv). What are conjugate base of each of the following Bronsted Lowry acid ?
(a) HOCl (b) HPO_4^{2-} (c) H_2O (d) $CH_3NH_3^+$
(e) H_2CO_3 (f) H_2 (g) H_2O_2 (h) HO_2^-

(v). Which of the following species behave as a strong acids or as strong base in aqueous solutions ?
(a) HNO_2 (b) HNO_3 (c) NH_4^+ (d) Cl^-
(e) H^- (f) O^{2-} (g) H_2SO_4

(vi). Consider following reactions :
(a) $H_2CO_3(aq) + HSO_4^-(aq) \rightleftharpoons H_2SO_4(aq) + HCO_3^-(aq)$
(b) $HF(aq) + Cl^-(aq) \rightleftharpoons HCl(aq) + F^-(aq)$
(c) $HF(aq) + NH_3(aq) \rightleftharpoons NH_4^+ + F^-(aq)$
(d) $HSO_4^-(aq) + CN^-(aq) \rightleftharpoons HCN(aq) + SO_4^{2-}(aq)$

Reactions proceeding to the right are :

(A) a, b (B) c, d (C) a, c (D) b, d

(vii) If following proceed in forward side :

$HNO_2 + HF \rightleftharpoons H_2F^+ + NO_2^-$; $CH_3COOH + HF \rightleftharpoons F^- + CH_3COOH_2^+$;

$H_2O + CH_3\ COOH \rightleftharpoons H_3O^+ + CH_3COO^-$

then increasing order of acid strength is :

(A) $H_2O < CH_3COOH < HF < HNO_2$ (B) $HNO_2 < HF < CH_3COOH < H_2O$

(C) $HNO_2 < HF < H_2O < CH_3COOH$ (D) $HNO_2 < CH_3COOH < HF < H_2O$

6. Several acids are listed below with their respective equilibrium constants.

$HF(aq) + H_2O(\ell) \rightleftharpoons H_3O^+(aq) + F^-(aq)$ $K_a = 7.2 \times 10^{-4}$

$HS^-(aq) + H_2O(\ell) \rightleftharpoons H_3O+(aq) + S^{2-}(aq)$ $K_a = 1.3 \times 10^{-11}$

$CH_3COOH(aq) + H_2O(\ell) \rightleftharpoons H_3O^+(aq) + CH_3COO(aq)$ $K_a = 1.8 \times 10^{-5}$

(i) Which is the strongest acid ? Which is the weakest ?

(ii) What is the conjugate base of the acid HF ?

(iii) Which acid has the weakest conjugate base ?

(iv) Which acid has the strongest conjugate base ?

7. Several bases are listed below with their respective K_b values :

$NH_3(aq) + H_2O(\ell) \rightleftharpoons NH_4^+(aq) + OH(aq)$. $K_b = 1.8 \times 10^{-5}$

$C_5H_5N(aq) + H_2O(\ell) \rightleftharpoons C_5H_5NH^+(aq) + OH^-(aq)$. $K_b = 1.5 \times 10^{-9}$

$N_2H_4(aq) + H_2O(\ell) \rightleftharpoons N_2H_5^+(aq) + OH(aq)$. $K_b = 8.5 \times 10^{-7}$

(i) Which is the strongest base ? Which is the weakest base.

(ii) What is the conjugate acid of C_5H_5N ?

(iii) Which base has the strongest conjugate acid ? Which has the weakest ?

8. The dissociation constants of HCOOH & CH_3COOH are 2×10^{-4} & 1.6×10^{-5} respectively . Calculate the relative strengths of the acids.

PHYSICAL / INORGANIC CHEMISTRY

DPP
DAILY PRACTICE PROBLEMS

DPP No. 14

Total Marks : 45

Max. Time : 54 min.

Topic : Ionic Equilibrium

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.3	(3 marks, 3 min.)	[9, 9]
Subjective Questions ('–1' negative marking) Q.4 to Q.12	(4 marks, 5 min.)	[36, 45]

1. **(a)** Given , $HF + H_2O \xrightarrow{K_a} H_3O^+ + F^-$; $F^- + H_2O \xrightarrow{K_b} HF + OH^-$.
Which relation is correct ?

(A) $K_b = K_w$ (B) $K_b = \frac{1}{K_w}$ (C) $K_a \times K_b = K_w$ (D) $\frac{K_a}{K_b} = K_w$

(b) A 0.0200 M acid is 20% dissociated. The equilibrium constant K_a for the acid is :
(A) 1.6×10^{-3} (B) 10^{-3} (C) 3.6×10^{-3} (D) 1.5×10^{-3}

2. **(a)** What is the K_b of a weak base that can produce one OH^- per molecule if its 0.04 M solution is 2.5% ionized.
(A) 7×10^{-8} (B) 1.6×10^{-6} (C) 2.5×10^{-5} (D) 2×10^{-11}

(b) What is the percent ionization of a 0.01 M HCN solution [$K_a = 6.4 \times 10^{-9}$] .
(A) 0.0025 % (B) 0.08 % (C) 0.25 % (D) 0.8 %

3. **(a)** $HCOOH \rightleftharpoons H^+ + HCOO^-$, $K_a = 1.7 \times 10^{-4}$. Then $[H^+]$ concentration of a solution containing 0.1 M HCOOH & 0.05 M HCOONa is nearly equal to :
(A) 8.5×10^{-5} (B) 3.4×10^{-4} (C) 4.1×10^{-3} (D) 1.8×10^{-2}

(b) pH of 10^{-8} N NaOH is :
(A) 8.0 (B) 6.0 (C) 6.98 (D) 7.02

4. **(a)** K_a for HCN is 5×10^{-10}, calculate K_b for CN^-.

(b) If equilibrium constant of $CH_3COO^- + H_2O \rightleftharpoons CH_3COOH + OH^-$ is 5.55×10^{-10}, calculate equilibrium constant of $CH_3COOH + H_2O \rightleftharpoons CH_3COO^- + H_3O^+$.

5. **(a)** K_b for trimethylamine is 6.4×10^{-5}. Calculate K_a for trimethyl ammonium ion $(CH_3)_3NH^+$.

(b) For the following equilibrium : $NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$ equilibrium consatnt is 5.55×10^{-10}. Calculate equilibrium constant for the equilibrium, $NH_4^+ + H_2O \rightleftharpoons NH_4OH + H^+$

6. CO_2 in aqueous solution shows following ionic equilibrium : $2H_2O + CO_2 \rightleftharpoons HCO_3^- + H_3O^+$
If hydronium ion (H_3O^+) concentration, is 2×10^{-6} M, what is hydroxide ion (OH^-) concentration ?

7. The degree of dissociation of 0.04 M HA is 0.01 . What would be the degree of dissociation of 0.01 M solution of the acid at the same temperature.

8. Calculate the pH values, assuming complete ionization of :
(a) 5×10^{-4} M monoprotic acid (b) 0.0016 M monoacidic base.

9. The pH of 0.10 M hydrocyanic acid solution is 5. What is the value of K_a for hydrocyanic acid ?

10. K_a of CH_3COOH is 1.8×10^{-5}.Calculate for 0.02 M CH_3COOH :
(i) $[H_3O^+]$, (ii) % ionisation and (iii) pH

REVISION QUESTIONS

11. A mixture of 4 moles of $A_2(g)$ and 1 mole of $XY_2(g)$ initially at a pressure of 1.25 atm at 1400 K is allowed to reach equilibrium, the pressure of the system becomes equal to 1.05 atm. Calculate K_P for the reaction
$A_2(g) + XY_2(g) \rightleftharpoons A_2Y(g) + A_2X(g)$.

12. The equilibrium concentrations of A, B and C for the reaction $A \rightleftharpoons B + C$ are 4, 2 and 2 mole/litre respectively at 25°C. If 2 moles per litre of A are removed, calculate the equilibrium concentration of A,B and C at the same temperature.

PHYSICAL / INORGANIC CHEMISTRY

DPP
DAILY PRACTICE PROBLEMS

DPP No. 15

Total Marks : 45

Max. Time : 54 min.

Topic : Ionic Equilibrium

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.3	(3 marks, 3 min.)	[9, 9]
Subjective Questions ('–1' negative marking) Q.4 to Q.12	(4 marks, 5 min.)	[36, 45]

1. **(a)** [Cl^-] in a mixture of 200mL of 0.01 M HCl and 100 ml of 0.01 M $BaCl_2$ is :
(A) 0.01 M (B) 0.0133 M (C) 0.03 M (D) 0.02 M

(b) Which has maximum pH ?
(A) 0.01 M H_2SO_4 (B) 0.01 M HCl (C) 0.01 M $Ca(OH)_2$ (D) 0.01 M NaOH

2. **(a)** 10^{-2} mole of NaOH was added to 10 litre of water. The pH will change by
(A) 4 (B) 3 (C) 11 (D) 7

(b) 100 mL of 1 M HCl is mixed with 50 mL of 2 M HCl. Hence, [H_3O^+] is :
(A) 1.00 M (B) 1.50 M (C) 1.33 M (D) 3.00 M

3. Blue litmus turns red in the following muxture of acid and base :
(A) 100 mL of 1×10^{-2} M H_2SO_4 + 100 mL of 1×10^{-2} M $Ca(OH)_2$
(B) 100 mL of 1×10^{-2} M HCl + 100 mL of 1×10^{-2} M $Ba(OH)_2$
(C) 100 mL of 1×10^{-2} M H_2SO_4 + 10 mL of 1×10^{-2} M NaOH
(D) 100 mL of 1×10^{-2} M HCl + 100 mL of 1×10^{-2} M NaOH

4. Calculate pH of
(a) 10^{-2} N H_2SO_4 (b) 10^{-2} M H_2SO_4 (c) 10^{-2} N $Ca(OH)_2$ (d) 10^{-2} M $Ca(OH)_2$

5. (a) pH of a solution is 10 in NaOH solution. What is concentration of NaOH ?
(b) What is molar concentration of $Ca(OH)_2$ if its solution has pH of 12 ?

6. How many moles of calcium hydroxide must be dissolved to produce 250 ml of an aqueous solution of pH 10.48. Assume complete dissociation. [log 3 = 0.48].

7. **(a)** Calculate the pH of solution obtained by mixing 100 ml of 0.01 M HCl & 100 ml of 0.02 M H_2SO_4 . [log 2 = 0.3]

(b) What will be the pH of a solution obtained by mixing 800 ml of 0.05 N NaOH and 200 ml of 0.1 N HCl, assuming complete ionization of the acid and the base.

8. What is normality of the resulting solution (acidic/basic/neutral) when following solution are mixed?
(i) 0.1 M H_2SO_4 , (ii) 0.1 M HCl,
(iii) 0.1 M $Ca(OH)_2$ (iv) 0.1 M NaOH
(a) i and ii, in 1 : 1 volume (b) i and ii in 1 : 2 volume
(c) i and iv in 1 : 2 volume (d) i and iii in 1 : 1 volume
(e) ii and iii in 1 : 1 volume (f) ii and iii in 2 :1 volume
(g) ii and iv in 1 : 2 volume

9. The dissociation constants of HCOOH & CH_3COOH are 2×10^{-4} & 1.6×10^{-5} respectively . Calculate the relative strengths of the acids.

10. Calculate the dissociation constant (K_a) of monobasic acid which is 3% dissociated in N/20 solution at 20°C.

11. **(a)** Calculate the pH of a decinormal solution of acetic acid which is 1.2% ionized. Also find its K_a.

(b) The pH of 0.05 M aqueous solution of diethyl amine is 12 . Calculate its K_b ?

12. Calculate (a) K_a for a monobasic acid whose 0.10 M solution has pH of 4.50.
(b) K_b for a monoacidic base whose 0.10 M solution has a pH of 10.50.

PHYSICAL / INORGANIC CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 16

Total Marks : 45

Max. Time : 54 min.

Topic : Ionic Equilibrium

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.3	(3 marks, 3 min.)	[9, 9]
Subjective Questions ('–1' negative marking) Q.4 to Q.12	(4 marks, 5 min.)	[36, 45]

1. **(a)** pH of a strong acid is 3 , On dilution its pH changes to 4. How many times the dilution takes place ?
(A) 10 times (B) 100 times (C) 1000 times (D) 10000 times

(b) Calculate the change in pH when a 0.1 M solution of CH_3COOH in water at 25ºC is diluted to a final concentration of 0.01 M. [$K_a = 1.85 \times 10^{-5}$]
(A) +0.5 (B) +0.4 (C) +0.7 (D) +0.6

2. At 25ºC , the dissociation constants of CH_3COOH and NH_4OH in an aqueous solution are almost the same. The pH of a solution of 0.01 N CH_3COOH is 4 at 25ºC. The pH of 0.01 N NH_4OH solution at the same temperature would be :
(A) 4 (B) 3 (C) 10 (D) 11

3. Which of the following increases with dilution at a given temperature?
(A) pH of 10^{-3}M acetic acid solution (B) pH of 10^{-3} M aniline solution
(C) degree of dissociation of 10^{-3}M acetic acid (D) degree of dissociation of 10^{-3}M aniline

4. Does the pH of solution increases, decreases or remain same when you
(a) add NH_4Cl(s) to 100 ml of 0.1 M NH_3?
(b) add sodium acetate(s) to 50 ml of 0.015 M acetic acid?
(c) add NaCl(s) to 25 ml of 0.1 M NaOH?

5. When 0.100 mol of NH_3 is dissolved in sufficient water to make 1.00 L of solution, the solution is found to have a hydroxide ion concentration of 1.2×10^{-3} M.
(a) What is the pH of the solution ?
(b) What will be the pH of the solution after 0.100 mol of NaOH is added to it ?
(c) Calculate K_b for ammonia .
(d) How will NaOH added to the solution affect the extent of dissociation of ammonia ?

6. **(a)** How much water must be added to 300 mL of a 0.2 M solution of CH_3COOH for the degree of dissociation of the acid to double ? (Assume K_a of acetic acid is of order of 10^{-5} M)

(b) What is the pH of a 1M solution of acetic acid ? To what volume must one litre of this solution be diluted so that the pH of the resulting solution will be twice the original value? Given : $K_a = 2 \times 10^{-5}$.

7. Saccharin ($K_a = 2 \times 10^{-12}$) is a weak acid represented by formula HSac. A 4×10^{-4} mole amount of saccharin is dissolved in 200 cm^3 solution of pH 3 . Assuming no change in volume, calculate the concentration of Sac^- ions in the resulting solution at equilibrium.

8. What is the pH of 0.01 M H_2S solution ? $K_{a1} = 9 \times 10^{-8}$, $K_{a2} = 1.2 \times 10^{-13}$.

9. Find the concentration of (i) hydrogen oxalate ion [$HC_2O_4^-$] and (ii) oxalate ion [$C_2O_4^{2-}$] in a solution 1.00 M with respect to $H_2C_2O_4$.$K_1 = 3.6 \times 10^{-3}$, $K_2 = 6.4 \times 10^{-7}$.

10. Calculate (i) [H^+], (ii) [$H_2PO_4^-$], (iii) [HPO_4^{2-}], and (iv) [PO_4^{3-}] in a 0.15 M solution of phosphoric acid, H_3PO_4. $K_1 = 7.5 \times 10^{-3}$, $K_2 = 6.2 \times 10^{-8}$, $K_3 = 3.6 \times 10^{-13}$.

11. H_2SO_3, sulfurous acid, is a weak acid capable of providing two H^+ ions. $K_{a1} = 0.02$, $K_{a2} = 6 \times 10^{-6}$.
(i) What is pH of a 0.4 M solution of H_2SO_3 ?
(ii) What is the equilibrium concentration of the sulfite ion, SO_3^{2-}, in the 0.4 M solution of H_2SO_3 ?

12. Hydrazine, N_2H_4, can interact with water in two stages.
$N_2H_4(aq) + H_2O(l) \rightleftharpoons N_2H_5^+(aq) + OH^-(aq)$ $K_{b1} = 8.1 \times 10^{-7}$
$N_2H_5^+(aq) + H_2O(l) \rightleftharpoons N_2H_6^{2+}(aq) + OH^-(aq)$ $K_{b2} = 9 \times 10^{-16}$
(i) What are the concentrations of OH^-, $N_2H_5^+$ and $N_2H_6^{2+}$ in a 0.010 M aqueous solution of hydrazine ?
(ii) What is pOH of the 0.010 M solution of hydrazine?

PHYSICAL / INORGANIC CHEMISTRY

DPP
DAILY PRACTICE PROBLEMS

DPP No. 17

Total Marks : 34

Max. Time : 41 min.

Topic : Ionic Equilibrium

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.2	(3 marks, 3 min.)	[6, 6]
Subjective Questions ('–1' negative marking) Q.3 to Q.9	(4 marks, 5 min.)	[28, 35]

1. **(a)** When CO_2 dissolves in water, the following equilibrium is established

$CO_2 + 2H_2O \rightleftharpoons H_3O^+ + HCO_3^-$ for which the equilibrium constant is 3.8×10^{-7} and pH = 6. The ratio of HCO_3^- to CO_2 would be

(A) 3.8 (B) 0.38 (C) 6 (D) 13.4

(b) The pH of blood is 7.4 . What is the ratio of $\left[\frac{HPO_4^{2-}}{H_2PO_4^-}\right]$ in the blood . $pK_a\ (H_2PO_4^-) = 7.1$

(A) 2 : 1 (B) 1 : 2 (C) 3 : 1 (D) 1 : 3

2. **(a)** Which of the following salts undergoes anionic hydrolysis?

(A) $CuSO_4$ (B) NH_4Cl (C) $FeCl_3$ (D) Na_2CO_3

(b) The pH value will be highest for the aqueous solution of

(A) NaCl (B) Na_2CO_3 (C) NH_4Cl (D) $NaHCO_3$

(c) Which of the following salts does not undergo hydrolysis?

(A) NH_4NO_3 (B) $FeCl_3 . 6H_2O$ (C) KCl (D) KCN

3. Determine the $[S^{2-}]$ in a saturated (0.1M) H_2S solution to which enough HCl has been added to produce a $[H^+]$ of 2×10^{-4} . $K_1 = 10^{-7}$, $K_2 = 10^{-14}$.

4. (i) What concentration of H_3O^+ ions will reduce $[S^{2-}]$ ion to 4×10^{-18} M in a 0.10 M solution H_2S?

(ii) What concentration of H_3O^+ ions will reduce $[HS^-]$ ion to 2×10^{-6} M in a 0.10 M solution H_2S ?

$K_1(H_2S) = 1 \times 10^{-7}$, $K_2(H_2S) = 10^{-14}$.

5. Find the concentration of H^+ , HCO_3^- & CO_3^{2-} in a 0.01 M solution of H_2CO_3 if the pH of this is 4.18 .

$K_a\ (H_2CO_3) = 4 \times 10^{-7}$; $K_a\ (HCO_3^-) = 4.8 \times 10^{-11}$.

6. What is the concentration of acetic acid which can be added to 0.5 M formic acid so that the % dissociation of neither acid is changed by the addition. K_a for acetic acid is 2×10^{-5}, K_a for formic acid = 2.4×10^{-4}.

7. Calculate the hydrolysis constant of the salt containing NO_2^- ions , K_a for HNO_2 is 5×10^{-4} .

8. Nicotine, $C_{10}H_{14}N_2$, has two basic nitrogen atoms and both can react with water to give a basic solution.

$Nic(aq) + H_2O(l) \rightleftharpoons NicH^+(aq) + OH^-(aq)$

$NicH^+(aq) + H_2O(l) \rightleftharpoons NicH_2^{2+}(aq) + OH^-(aq)$

K_{b1} is 8.0×10^{-7} and K_{b2} is 1.1×10^{-10}. Calculate the approximate pH of a 0.20 M solution.

9. A solution contains 0.10 M H_2S and 0.25 M HCl . Calculate the concentration of $[S^{2-}]$ and $[HS^-]$ ions in the solution. For H_2S, $K_{a_1} = 1.0 \times 10^{-7}$, $K_{a_2} = 1.3 \times 10^{-13}$

PHYSICAL / INORGANIC CHEMISTRY

DPP
DAILY PRACTICE PROBLEMS

DPP No. 18

Total Marks : 30

Max. Time : 41 min.

Topic : Ionic Equilibrium

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.2	(3 marks, 3 min.)	[6, 6]
Subjective Questions ('–1' negative marking) Q.3 to Q.8	(4 marks, 5 min.)	[24, 35]

1. 18 ml of mixture of acetic acid and sodium acetate required 6ml of 0.1 M NaOH for neutalization of the acid and 12 ml of 0.1 MHCl for reaction with salt, separately. If pK_a of the acid is 4.75, what is the pH of the mixture? [log2 = 0.3]

(A) 5.05 (B) 4.75 (C) 4.5 (D) 4.6

2. Blood is buffered with CO_2 and HCO_3^-. What is the ratio of the base concentration to the acid (i.e. CO_2(aq.) plus H_2CO_3) concentration to maintain the pH of blood at 7.4 ? The first dissociation constant of H_2CO_3 ($H_2CO_3 \rightleftharpoons H^+ + HCO_3^-$) is 4.2×10^{-7} where the H_2CO_3 is assumed to include CO_2(aq.) i.e., dissolved CO_2. (log 2 = 0.3, log 3 = 0.48, log 7 = 0.85, antilog1.06 = 11.5)

(A) 10.7 (B) 1.8 (C) 10 (D) 12

3. Calculate hydrolysis constants for each of the following salt solutions. Compute also the pH of the solution and the percentage of hydrolysis.

(i) 0.05 M NaAc ; K_a(HAc) = 2×10^{-5}.

(ii) 0.008 M NH_4Cl ; K_b (NH_3) = 2×10^{-5}.

(iii) 0.5 M Na_2S ; $K_a(HS^-) = 1.0 \times 10^{-15}$ [log (0.475) = - 0.32].

(iv) 0.64 M KCN : K_a (HCN) = 4.0×10^{-10}.

(v) 0.40 M NH_4Ac

(vi) 0.003 M NH_4CN

4. Calculate pH of the buffer solution containing 0.15 moles of NH_4OH and 0.25 moles of NH_4Cl . K_b for NH_4OH is 2×10^{-5} .

5. Determine the concentration of H_3O^+ ion in a mixture of 0.06 M CH_3COOH & 0.04 M CH_3COONa at 25ºC, dissociation constant of $CH_3COOH = 1.84 \times 10^{-5}$.

6. Calculate the hydrogen ion concentration in a solution containing 0.04 mole of acetic acid and 0.05 moles of sodium acetate in 500 ml of the solution. Dissociation constant for acetic acid is 1.8×10^{-5} .

7. Calculate the pH of solution of given mixtures. [log (1.8) = 0.26]

(a) 2 gm CH_3COOH + 4.1 gm CH_3COONa in 100 ml of mixture , $K_a = 1.8 \times 10^{-5}$.

(b) 5 ml of 0.1 M NH_4OH + 250 ml of 0.1 M NH_4Cl , $K_b = 1.8 \times 10^{-5}$.

8. Calculate the moles of pyridinium chloride (C_6H_5NHCl) which should be added to 500 ml solution of 0.4 M pyridine (C_5H_5N) to obtain a buffer of pH = 5 , K_b for pyridine is 1.5×10^{-9} .

PHYSICAL / INORGANIC CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 19

Total Marks : 31

Max. Time : 35 min.

Topic : Ionic Equilibrium

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.3	(3 marks, 3 min.)	[9, 9]
Subjective Questions ('–1' negative marking) Q.4 to Q.7	(4 marks, 5 min.)	[16, 20]
Comprehension ('–1' negative marking) Q.8 to Q.9	(3 marks, 3 min.)	[6, 6]

1. A weak acid HA after treatment with 12 ml of 0.1 M strong base BOH has a pH of 5 . At the end point, the volume of same base required is 27 ml . K_a of acid is :

(A) 1.8×10^{-5} (B) 8×10^{-6} (C) 1.8×10^{-6} (D) 8.2×10^{-5}

2. **(a)** Which of the following indicators is best suited in the titration of a weak acid versus a strong base ?

(A) phenolpthalein (8.3 – 10.0) (B) methyl orange (3.1 – 4.4)

(C) methyl red (4.2 – 6.3) (D) litmus (4.5 – 8.3)

(b) Which of the following indicators is best suited in the titration of a weak base versus a strong acid ?

(A) phenolphthalein (8.3 – 10.0) (B) phenol red (6.8 – 8.4)

(C) methyl organe (3.1 – 4.4) (D) litmus (4.5 – 8.3)

3. **(a)** The best indicator for the detection of end point in titration of a weak acid & a strong base is:

(A) methyl orange (pH 3 to 4) (B) methyl red (pH 5 to 6)

(C) bromothymol blue (pH 6 to 7.5) (D) phenolphthalein (pH 8 to 9.6)

(b) For the acid H_2X, $pK_1 = 4$ and $pK_2 = 10$. Which of the following indicators(with their ranges provided) is most suitable for the titration $H_2X + OH^- \rightarrow HX^- + H_2O$?

(A) Methyl orange (3.1 to 4.4) (B) Bromocresol green (3.8 to 5.4)

(C) p-nitrophenol (5.6 to 7.6) (D) Phenolphthalein (8 to 9.6)

4. 0.1 M CH_3COOH solution is titrated against 0.05 N NaOH solution. Calculate pH at $1/4^{th}$ and $3/4^{th}$ neutralization of acid. The pH for 0.1 M CH_3COOH is 3 .

5. 25 ml of 0.1 mol/litre aqueous pyridine ($K_b = 1.6 \times 10^{-9}$ mol/litre) is titrated with 0.1 mol/litre hydrochloric acid. Calculate pH at equivalence point (neutralization point) and after 30 cm^3 hydrochloric acid have been added .

6. The equivalent point in a titration of 40 ml of a solution of a weak monoprotic acid occurs when 32 ml of a 0.1 M NaOH solution has been added . The pH of the solution is 5.75 after the addition of 20 ml of NaOH solution. What is K_a of the acid. [antilog(0.45) = 2.8]

7. A solution of weak acid HA was titrated with NaOH, the end point is obtained by the addition of 36 ml of 0.1 N NaOH. Now 18 ml of 0.1 N HCl was added to titrated solution. The pH was found to be 4.5. Calculate K_a for the acid HA .

8. Comprehension # (Q.(i) to Q.(iii))

Read the following paragraph carefully and answer the following questions based on it : (Q.(i) to Q.(iii))

A solution capable of maintaining its pH relatively constant, when either excess acid or excess base is added, is said to be buffered. While it is not usually considered a buffered solution, a concentrated solution (10^{-2} M and higher) of a strong acid or strong base is buffered against large changes in pH when acids or bases are added.

Buffered solutions are usually those containing a weak acid and a salt of that weak acid or a weak base and the salt of that weak base. For example a solution containing HAC and NaAC resists large changes in pH when acid or alkali is added.

For a buffer solution Buffer capacity is defined as the number of moles of a strong acid or a strong base that causes 1L of the buffer to undergo a 1 unit change in pH. Buffer capacity is maximum when the molar ratio of the two components is unity and the buffer solution is considered good.

(i). The least change in pH on adding 0.01 mol of HCl to 1 litre of conc. HCl solutions will be in case of:

(A) 0.1 M HCl solution (B) 0.2 M HCl solution

(C) 0.3 M HCl solution (D) 0.4 M HCl solution

(ii). Which solution is not a buffer solution ?

(A) NaCN (2 mole) + HCl (1 mole) in 5 L (B) NaCN (1 mole) + HCl (1 mole) in 5L

(C) NH_3 (2 mole) + HCl (1 mole) in 5 L (D) CH_3COOH (2 mole) + KOH (1 mole) in 5L

(iii). Which species has the lowest concentration in a solution prepared by mixing 0.1 mole each of HCN and NaCN in 1L solution ? K_a (HCN) = 10^{-10}.

(A) CN^- (B) HCN (C) H^+ (D) OH^-

9. Comprehension # (Q.(i) to Q.(iii))

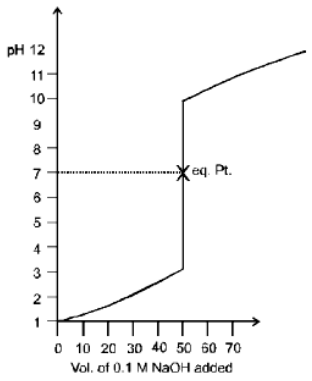
50 ml 0.1 M HCl is titrated against V ml 0.1 M NaOH solution. Titration curve is as follows.

This suitable indicator for this titration can be selected on the following basis.

The steep section of the titration curve at the equivalence point must encompass an internal of pH values at least as large as the pH transition range of an indicator.

The pH transition range of the indicator should most concide with the steep

portion of the titration curve.



Indicator	Colour change		pH transition range
	in acid form	in basic form	
Phenolphthalein	Colourless	Pink	8.3 to 10
Bromomethyl blue	Orange	Blue	6.0 to 8.0
Methyl orange	Red	Yellow	3.1 to 4.5

(i). Which of the following indicator can be used for this titration ?

(A) phenophthalein (B) Bromomethyl blue (C) Methyl orange (D) All of these

(ii). 50 ml of 0.1 M HCl is titrated with 0.1 M NaOH. At pH = 3, vol of NaOH used is (approximately) :

(A) 49 ml (B) 50 ml (C) 45 ml (D) 41 ml

(iii). 100 ml of 0.1 M NaOH is titrated with 100 ml of 0.05 M H_2SO_4. The pH of the solution is (For H_2SO_4, $Ka_1 = \infty$, $Ka_2 = 10^{-2}$, log 5 = 0.7, log 2 = 0.3).

(A) 7 (B) 7.2 (C) 7.4 (D) None

PHYSICAL / INORGANIC CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 20

Total Marks : 44

Max. Time : 52 min.

Topic : Ionic Equilibrium

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.4	(3 marks, 3 min.)	[12, 12]
Subjective Questions ('–1' negative marking) Q.5 to Q.12	(4 marks, 5 min.)	[32, 40]

1. **(a)** The solubility of A_2X is y mol dm^{-3}. Its solubility product is :

(A) $6\ y^4$ (B) $64\ y^4$ (C) $36\ y^5$ (D) $4\ y^3$

(b) The solubility of sparingly soluble electrolyte M_mA_a in water is given by the expression :

(A) $s = \left(\frac{K_{sp}}{m^m a^a}\right)^{m+a}$ (B) $s = \left(\frac{K_{sp}}{m^m a^a}\right)^{1/m+a}$ (C) $s = \left(\frac{K_{sp}}{m^a a^m}\right)^{m+a}$ (D) $s = \left(\frac{K_{sp}}{m^a a^m}\right)^{1/m+a}$

2. Three sparingly soluble salts M_2X, MX and MX_3 have the solubility product are in the ratio of 4: 1 : 27. Their solubilities will be in the order

(A) $MX_3 > MX > M_2X$ (B) $MX_3 > M_2X > MX$ (C) $MX > MX_3 > M_2X$ (D) $MX > M_2X > MX_3$

3. A student wants to prepare a saturated solution of Ag^+ ion . He has got three samples AgCl ($K_{sp} = 10^{-10}$) , AgBr ($K_{sp} = 1.6 \times 10^{-13}$) and Ag_2CrO_4 ($K_{sp} = 3.2 \times 10^{-11}$) . Which of the above compound will be used by him using minimum weight to prepare 1 lit. of saturated solution .

(A) AgCl (B) AgBr (C) Ag_2CrO_4 (D) all the above

4. The solubility product of AgCl is 4.0×10^{-10} at 298K. The solubility of AgCl in 0.04M $CaCl_2$ will be:

(A) 2.0×10^{-5} M (B) 1.0×10^{-10} M (C) 5.0×10^{-9} M (D) 2.2×10^{-4} M

5. Calculate the solubility of A_2X_3 in pure water, assuming neither kind of ion reacts with water. For A_2X_3, $K_{sp} = 1.08 \times 10^{-23}$.

6. A particular saturated solution of silver chromate, Ag_2CrO_4, has $[Ag^+] = 5 \times 10^{-5}$ and $[CrO_4^{2-}] = 4.4 \times 10^{-4}$ M. What is value of K_{sp} for Ag_2CrO_4?

7. If the solubility product of silver oxalate is 5×10^{-10}, what will be the weight of $Ag_2C_2O_4$ in 2.5 litres of a saturated solution ?

8. Calculate the solubility of AgCl (s) in pure water and in 0.1 M NaCl at 25° C .
K_{sp} (AgCl) = 2.56×10^{-10}. Comment on the influence of $[Cl^-]$ on the solubility of AgCl.

9. The solubility product of AgCl in water is 1.5×10^{-10} . Calculate its solubility in 0.01 M NaCl aqueous solution .

10. The solubility product of SrF_2 in water is 8×10^{-10}. Calculate its solubility in 0.1 M, NaF aqueous solution.

11. The solubility of CaF_2 in water at 1518°C is 2×10^{-4} mole/litre. Calculate K_{sp} of CaF_2 and its solubility in 0.1M NaF solution.

12. The solubility product of $BaSO_4$ is 1.6×10^{-9} . Find out its solubility in ,

(i) pure water

(ii) 0.1 M $BaCl_2$.

PHYSICAL / INORGANIC CHEMISTRY

DPP
DAILY PRACTICE PROBLEMS

DPP No. 21

Total Marks : 48

Max. Time : 57 min.

Topic : Ionic Equilibrium

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.4	(3 marks, 3 min.)	[12, 12]
Subjective Questions ('–1' negative marking) Q.5 to Q.13	(4 marks, 5 min.)	[36, 45]

1. The pK_a of iodic acid HIO_3 is log 6. Calculate the pH of a 1M HIO_3 solution
(A) log 6 (B) log 5 (C) log 4 (D) log 3

2. The pH of a solution containing 0.1 M CH_3COONa and 0.1 M $(C_2H_5COO)_2Ba$ will be $K_a(CH_3COOH) = 2 \times 10^{-5}$, $K_a(C_2H_5COOH) = 8 \times 10^{-6}$:
(A) 8.13 (B) 9.24 (C) 10.18 (D) 11.18

3. If the solubility of Ag_2SO_4 in 10^{-2} M Na_2SO_4 solution be 2×10^{-8} M then K_{sp} of Ag_2SO_4 will be:
(A) 32×10^{-24} (B) 16×10^{-18} (C) 32×10^{-18} (D) 16×10^{-24}

4. A solution is saturated with respect to $SrCO_3$ & SrF_2. The $[CO_3^{2-}]$ was found to be 1.2×10^{-3} M. The concentration of F^- in the solution would be : $K_{sp}(SrCO_3) = 10^{-9}$, $K_{sp}(SrF_2) = 3 \times 10^{-11}$.
(A) 3×10^{-3} M (B) 2×10^{-2} M (C) 6×10^{-2} M (D) 6×10^{-7} M

5. Find the solubility of CaF_2 in 0.5 M solution of $CaCl_2$ and water. How many times in solubility in the second case greater than in the first ? $K_{sp}(CaF_2) = 3.2 \times 10^{-11}$.

6. If you place the amounts given below in pure water, will all of the salt dissolve before equilibrium can be established, or will some salt remain undissolved ?
(a) 4.96 mg of MgF_2 in 125 ml of pure water, $K_{sp} = 3.2 \times 10^{-8}$
(b) 3.9 mg of CaF_2 in 100 ml of pure water, $K_{sp} = 4 \times 10^{-12}$
Also find the percentage saturation in each case.

7. The solubility product constant for silver iodate $AgIO_3$ is 1.0×10^{-8}. If 0.10 g of solid $AgIO_3$ is added to 100.0 ml of 0.02 M KIO_3, what are the concentrations of K^+, IO_3^- & Ag^+ at equilibrium?

8. Calculate the volume (mL) of 0.1 M Na_2SO_4 which must be added to 10 mL of HCl (pH = 1.0) so that pH of the resulting solution becomes two. (Given K_2 for $H_2SO_4 = 10^{-2}$]

9. Calculate the molar solubility of silver thiocyanate, AgSCN, in pure water & in water containing 0.01 M NaSCN. $K_{sp}(AgSCN) = 10^{-12}$.

10. Assume you place 1.234 g of solid $Ca(OH)_2$ in 1.00 litre of pure water at 25° C. The pH of the solution is found to be 12. Estimate the K_{sp} for $Ca(OH)_2$.

11. 25 ml clear saturated solution of PbI_2 (aq.) requires 12.5 ml of $AgNO_3$ (aq.) solution. What is molarity of $AgNO_3$ solution ? K_{sp} of PbI_2 is 5×10^{-10}, K_{sp} of AgI = 1.2×10^{-17} .

12. Calculate F^- in a solution saturated with respect of both MgF_2 and SrF_2.
$K_{sp}(MgF_2) = 9.5 \times 10^{-9}$, $K_{sp}(SrF_2) = 4 \times 10^{-9}$.

13. A solution is saturated with respect to $MgCO_3$ & Ag_2CO_3 . It is found to have $[Mg^{2+}] = 2.2 \times 10^{-5}$ M. Find $[Ag^+]$, given $K_{sp}(Ag_2CO_3) = 8.8 \times 10^{-12}$ M^3 and $K_{sp}(MgCO_3) = 1.6 \times 10^{-6}$ M^2.

PHYSICAL / INORGANIC CHEMISTRY

DPP
DAILY PRACTICE PROBLEMS

DPP No. 22

Total Marks : 43

Max. Time : 46 min.

Topic : Ionic Equilibrium

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.6	(3 marks, 3 min.)	[18, 18]
Multiple choice objective ('–1' negative marking) Q.7 to Q.8	(4 marks, 4 min.)	[8, 8]
Subjective Questions ('–1' negative marking) Q.9 to Q.11	(4 marks, 5 min.)	[12, 15]
True or False (no negative marking) Q.12	(2 marks, 2 min.)	[2, 2]
Comprehension ('–1' negative marking) Q.13	(3 marks, 3 min.)	[3, 3]

1. NH_4Cl (aq) is :

(A) acidic due to NH_4^+ (B) acidic due to Cl^-

(C) basic due to NH_4^+ (D) basic due to Cl^-

2. The number of H^+ in 1 cc of a solution of pH = 13 is

(A) 6.023×10^7 (B) 1×10^{-13} (C) 6.023×10^{13} (D) 1×10^{16}

3. The degree of dissociation of water in a 0.1 M aqueous solution of HCl at a certain temperature t°C is 3.6×10^{-15} . The temperature t must be : [density of water at t°C = 1 gm/ml.]

(A) < 25°C (B) = 25°C

(C) > 25°C (D) insufficient data to predict

4. Determine pH of a 0.01 M aqueous solution of $ClC_6H_4NH_3Cl$.

[$K_b(ClC_6H_4NH_2) = 4 \times 10^{-13}$, log 19 = 1.3, log 2 = 0.3, $\sqrt{16.25}$ = 4.02].

(A) 2.1 (B) 2.5 (C) 3.5 (D) 3.1

5. The indicator constant for an acidic indicator, HIn is 5×10^{-6} M. This indicator appears only in the colour of acidic form when $\frac{[In^-]}{[HIn]} \le \frac{1}{20}$ and it appears only in the colour of basic form when $\frac{[HIn]}{[In^-]} \le \frac{1}{40}$. The pH range of indicator is [Given : log 5 = 0.7]

(A) 4.3 – 6.3 (B) 4.0 – 6.6 (C) 4.0 – 6.9 (D) 3.7 – 6.6

(E) 12-14

6. At what minimum concentration OH^- will 10^{-3} mole of $Zn(OH)_2$ go into solution as $Zn(OH)_4^{2-}$ in 1 L solution.

$Zn(OH)_2$ (s) + $2OH^-$ (aq) $\rightleftharpoons$ $Zn(OH)_4^{2-}$ (aq) ($K_C = 10^{-2}$)

(A) 0.1 M (B) 0.632 M (C) 0.0316 M (D) 0.316 M

7.* Which of the following statements are correct at 25°C.

(A) pK_a for H_3O^+ is 15.74 (B) pK_b for OH^- is – 1.74

(C) $pK_a(CH_3COOH) + pK_b(NH_4OH) = pK_w(H_2O)$ (D) degree of dissociation of water is 1.8×10^{-7} %

8.* Choose the correct statement(s)

(A) pH + pOH = pk_W is applicable for dilute acid and dilute base aqueous solution as well as for pure water.

(B) In acidic/basic aqueous solution at 25°C degree of dissociation of water is less than 1.8×10^{-9}.

(C) No chemical reaction takes place when 0.1 mol of NaH_2PO_2 and 0.1 mol of NaOH is mixed in enough water to form 1 L solution.

(D) Relative acidic strength of HCl, $HClO_4$, HBr and HI can not be determined in water.

9. At what pH 0.1M Mg^{2+} solution begins to precipitate. Given K_{SP} $[Mg(OH)_2] = 10^{-11}$.

10. K_a for acetic acid in water is 10^{-5} at 25ºC. The pH of a mixture of 25 ml of 0.02 N acetic acid and 2.5 ml of 0.1 N NaOH (neglecting volume change) will be :

11. How many of the following solutions will turn blue litmus red ?

(i) $Al_2(SO_4)_3$ (ii) NaCl (iii) KCN (iv) H_3BO_3

(v) H_3PO_3 (vi) HIO_3 (vii) H_2PtCl_6 (viii) NH_4HSO_4

(ix) CH_3CH_2OH

12. Na_2HPO_3 is not an acid salt.

13. Comprehension #

For any polyprotic acid, we always consider successive dissociation. The value of equilibrium consant of successive dissociation decreases due to common ion effect.

For example :

H_2A is a dibasic acid.

$$H_2A \rightleftharpoons H^+ + HA^- \qquad K_1 = \frac{[H^+][HA^-]}{[H_2A]}$$

$$HA^- \rightleftharpoons H^+ + A^{--} \qquad K_2 = \frac{[H^+][A^{--}]}{[HA^-]}$$

K_1 is greater than K_2.

(i) Concentration of H^+ ions in 0.1 M H_2CO_3 is ($K_1 = 4 \times 10^{-7}$, $K_2 = 4 \times 10^{-11}$) :

(A) 2×10^{-4} M (B) 4×10^{-9} M (C) 2×10^{-3} M (D) None of these

(ii) Find the pH of 0.1 M $NaHCO_3$.

Use data ($K_1 = 4 \times 10^{-7}$, $K_2 = 4 \times 10^{-11}$ for H_2CO_3, log 4 = 0.6) :

(A) 3.7 (B) 8.4 (C) 9.6 (D) None of these

(iii) Find the concentration of H^+ ions in an aqueous solution which is saturated with H_2S (0.1 M) as well as H_2CO_3 (0.2 M).

Use data [$K_1 = 10^{-7}$, $K_2 = 10^{-14}$ for H_2S, $K_1 = 4 \times 10^{-7}$, $K_2 = 4 \times 10^{-11}$ for H_2CO_3] :

(A) 3×10^{-4} M (B) 3.83×10^{-4} M (C) 2.83×10^{-4} M (D) None of these

PHYSICAL / INORGANIC CHEMISTRY

DPP
DAILY PRACTICE PROBLEMS

DPP No. 23

Total Marks : 46

Max. Time : 51 min.

Topic : Ionic Equilibrium

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.6	(3 marks, 3 min.)	[18, 18]
Multiple choice objective ('–1' negative marking) Q.7 to Q.8	(4 marks, 4 min.)	[8, 8]
Subjective Questions ('–1' negative marking) Q.9 to Q.11	(4 marks, 5 min.)	[12, 15]
Match the Following (no negative marking) Q. 12	(8 marks, 10 min.)	[8, 10]

1. In which of the following cases the resulting solution is acidic.

I . $BeCl_2$ II. KCN III. Na_2CO_3 IV. C_5H_6NBr

(A) I & IV (B) I & III (C) I, III and IV (D) Only IV

2. We know that NH_3 is a stronger base than CH_4. Which of the following is correct ?

(A) NH_3 is a stronger acid than CH_4. (B) NH_3 is a weaker acid than CH_4.

(C) NH_4^+ is a weaker acid than CH_4. (D) All of these

3. In terms of K_1, K_2 and K_3 of a weak triprotic acid H_3B, the value of K_b for BH^{2-} will be :

(A) K_w/K_1 (B) K_w/K_2 (C) K_2/K_w (D) K_w/K_3

4. If a solution contains 10^{-6} M each of X^-, Y^{2-} and Z^{3-} ions, then upon addition of $AgNO_3(s)$ slowly to the above solution with stirring : (Given : K_{sp} (AgX) = 9×10^{-14}, $K_{sp}(Ag_2Y) = 4.9 \times 10^{-21}$, $K_{sp}(Ag_3Z) = 5.12 \times 10^{-28}$)

(A) Ag_3Z will be the first one to precipitate out. (B) Ag_2Y will be the first one to precipitate out.

(C) AgX will be the first one to precipitate out. (D) Nothing can be said with certainity.

5. The freezing point depression of a 0.1 M aq. solution of weak acid (HX) is –0.20°C.

What is the value of equilibrium constant for the reaction?

$$HX\,(aq) \rightleftharpoons H^+(aq) + X^-(aq)$$

[Given : K_f for water = 1.8 kg mol^{-1} K. & Molality = Molarity]

(A) 1.46×10^{-4} (B) 1.35×10^{-3} (C) 1.21×10^{-2} (D) 1.35×10^{-4}

6. Azhar wants to prepare a saturated solution of Ag^+ ion. He has got only three samples of AgCl (K_{sp}= 1.8×10^{-10}), AgBr (K_{sp} = 5×10^{-13}) and Ag_2CrO_4 (K_{sp} = 2.4×10^{-12}), which compound he should use to have maximum $[Ag^+]$?

(A) AgCl (B) AgBr (C) Ag_2CrO_4 (D) Either of them

7. In which of the following solutions, the solubility of AgCN will be greater than that in pure water :

Given $K_{sp}(AgCN) = 4 \times 10^{-16}$, K_a (HCN) $= 5 \times 10^{-10}$

(A) 0.01 M $AgNO_3$ solution

(B) A buffer solution of pH = 12

(C) 0.2 M NH_3 solution

(D) A buffer solution of pH = 5

8. Acetic acid and propionic acid have K_a values 1.75×10^{-5} and 1.3×10^{-5} respectively at a certain temperature. An equimolar solution of a mixture, of the two acids is partially neutralised by NaOH. How is the ratio of the contents of acetate and propionate ions related to the K_a values and the molarity:

(A) $\left(\frac{\alpha}{1-\alpha}\right) = \frac{1.75}{1.3} \times \left(\frac{\beta}{1-\beta}\right)$, where α and β are ionised fractions of their acids

(B) The ratio is unrelated to the K_a values.

(C) The ratio is unrelated to the molarity of acid.

(D) The ratio is unrelated to the pH of the solution.

9. A certain mixture of HCl and CH_3–COOH is 0.1 M in each of the acids. 20 ml of this solution is titrated against 0.1M NaOH. By how many units does the pH change from the start to the stage when the HCl is almost completely neutralised and acetic acid remains unreacted ? K_a for acetic acid = 2×10^{-5}.

10. CH_3COOH (60 ml, 0.1M) is titrated against 0.1M NaOH solution. Calculate the pH at the addition of 10 ml of NaOH. K_a of CH_3COOH is 2×10^{-5}. [log 2 = 0.3]

11. How many salts will turn blue litmus to red when dissolved in water ?

K_2SO_4, LiCN, $C_6H_5NH_3^+Cl^-$, $C_6H_5COO^-Na^+$, $FeCl_3$, $(NH_4)_2C_2O_4$, $Al(NO_3)_3$, CH_3COONa

12.

	Column-I	**Column-II**
(A)	$NaHCO_3$ (aq.)	(p) Significant cationic hydrolysis
(B)	CH_3COONH_4 (aq.)	(q) Significant anionic hydrolysis
(C)	$K_2SO_4 . Al_2(SO_4)_3$ (aq.)	(r) Acidic (pH < 7)
(D)	NaCN (aq)	(s) Basic (pH > 7)
		(t) pH is independent of concentration

Given : $K_1 = 5 \times 10^{-7}$, $K_2 = 5 \times 10^{-11}$ for H_2CO_3

K (CH_3COOH) $= 1.8 \times 10^{-5}$ K (NH_4OH) $= 1.8 \times 10^{-5}$

PHYSICAL / INORGANIC CHEMISTRY

DPP
DAILY PRACTICE PROBLEMS

DPP No. 24

Total Marks : 45

Max. Time : 49 min.

Topic : Thermodynamics (IInd Law)

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.7	(3 marks, 3 min.)	[21, 21]
Multiple choice objective ('–1' negative marking) Q.8 to Q.9	(4 marks, 4 min.)	[8, 8]
Subjective Questions ('–1' negative marking) Q.10 to Q.13	(4 marks, 5 min.)	[16, 20]

1. **(a)** Which of the following processes represent an increase in entropy of the system :

(A) Polymerisation of ethene gas forming polyethene.

(B) SO_3 gas on heating breaks up to form SO_2 gas and O_2 gas.

(C) Condensation of dew on leaves in winters.

(D) Crystallisation of $CuSO_4.5H_2O$ from solution.

(b) Which of the following reactions is associated with the most negative change in entropy ?

(A) $N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g)$ (B) $C_2H_2(g) + 2H_2(g) \longrightarrow C_2H_6(g)$

(C) $C(s) + O_2 \longrightarrow CO_2(g)$ (D) $2NO_2(g) \longrightarrow N_2O_4(s)$

(c) In which of the following cases entropy decreases :

(A) Solid changing to liquid (B) Expansion of a gas

(C) Crystal dissolves (D) Polymerisation

2. The spontaneous nature of a reaction is impossible if :

(A) ΔH is +ve : ΔS in also +ve (B) ΔH is –ve; ΔS is also –ve

(C) ΔH is –ve; ΔS in +ve (D) ΔH is +ve; ΔS in –ve

3. Two moles of an ideal diatomic gas at 27°C is made to expand reversibly and adiabatically to 4 times its initial volume. The change in entropy of the system during expansion is : (Given : R = 2 cal/K/mole, $\log_{10}2 = 0.3$, $\log_{10}3 = 0.48$)

(A) 5.6 Cal/k (B) 11.2 Cal/k (C) 2.8 Cal/k (D) None of these

4. The entropy change when two moles of ideal monoatomic gas is heated from 200 to 300°C reversibly and isochorically is :

(A) $3\,R\,\ln\left(\frac{300}{200}\right)$ (B) $\frac{5}{2}R\,\ln\left(\frac{573}{473}\right)$ (C) $3R\,\ln\left(\frac{573}{473}\right)$ (D) $\frac{3}{2}R\,\ln\left(\frac{573}{473}\right)$

5. What is the change in entropy when 2.5 g of water is heated from 27°C to 87°C ? Assume that the heat capacity is constant (specific heat of water = 4.2 J/g-K, ln (1.2) = 0.18)

(A) 16.6 J/K (B) 9 J/K (C) 34.02 J/K (D) 1.89 J/K

6. Calculate the total entropy change for the transition at 368 K of 1 mol of sulphur from the monoclinic to the rhombic solid state and $\Delta H = -436.8$ J mol^{-1} for the transition. Assume the surroundings to be an ice-water bath at 0°C :

(A) – 1.09 JK^{-1} (B) 1.47 JK^{-1} (C) – 0.22 JK^{-1} (D) 0.41 JK^{-1}

7. One mole of an ideal monoatomic gas at 27°C is subjected to a reversible isoentropic compression until final temperature reached to 327°C. If the initial pressure was 1.0 atm, then find the value of ln P_2: (Given : ln 2 = 0.7).

(A) 1.75 atm (B) 0.176 atm (C) 1.0395 atm (D) 2.0 atm

8.* **(a)** For an isothermal free expansion of an ideal gas against vacuum, which of the following parameters have zero value :

(A) q (B) ΔH (C) $\Delta S_{surr.}$ (D) $\Delta S_{sys.}$

(b) For Isothermal expansion against constant external pressure of an ideal gas :

(A) $\Delta S_{univ} > 0$ (B) $\Delta S_{sys} > 0$ (C) $\Delta S_{surr} < 0$ (D) $\Delta S_{surr} = 0$

(c) For reversible adiabatic compression of an ideal gas :

(A) $\Delta S_{univ} > 0$ (B) $\Delta S_{sys} < 0$ (C) $\Delta S_{surr} = 0$ (D) $\Delta S_{sys} = 0$

9.* For the process $H_2O(\ell)$ (1 bar, 373 K) $\rightleftharpoons$ $H_2O(g)$ (1 bar, 373 K), the correct set of thermodynamic parameters is :

(A) ΔG = –ve (B) $\Delta S > 0$ (C) $\Delta H > 0$ (D) $\Delta G = 0$

10. A sample of certain mass of an ideal polyatomic gas is expanded against constant pressure of 1 atm adiabatically from volume 2 L, pressure 6 atm and temperature 300 K to state where its final volume is 8L. Then calculate entropy change (in J / K) in the process. (Neglect vibrational degrees of freedom) [1L atm = 100 J, log 2 = 0.3, log 3 = 0.48, log e = 2.3]

11. **(a)** The enthalpy of vapourisation of liquid diethyl ether is 26 kJ/mol at its boiling point (35°C). Calculate ΔS for conversion of : (i) liquid to vapour, and (ii) vapour to liquid at 35°C.

(b) Calculate the value of ΔG at 700 K for the reaction : nx $\longrightarrow$ mB. Given that the value of ΔH = –113 KJ/mol and $\Delta S = -145\ JK^{-1}\ mol^{-1}$.

12. **(a)** For the reaction, $N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g)$; ΔH = –95.4 KJ and $\Delta S = -198.3\ JK^{-1}$.

Calculate the maximum temperature at which the reaction will proceed in forward direction.

(b) A certain reaction is non-spontaneous at 298 K. The entropy change during the reaction is 121 J/K. Is the reaction endothermic or exothermic ? What is the minimum value of ΔH for the reaction ?

13. For oxidation of iron,

$$4Fe(s) + 3O_2(g) \longrightarrow 2Fe_2O_3(s)$$

entropy change is $-549.4\ JK^{-1}\ mol^{-1}$ at 298 K. Inspite of negative entropy change of this reaction. The reaction is spontaneous, why ? Justify your answer (Given : $\Delta_r H° = -1648$ KJ/mol).

PHYSICAL / INORGANIC CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 25

Total Marks : 44

Max. Time : 46 min.

Topic : Thermodynamics (IInd Law)

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.8	(3 marks, 3 min.)	[24, 24]
Multiple choice objective ('–1' negative marking) Q.9 to Q.11	(4 marks, 4 min.)	[12, 12]
Subjective Questions ('–1' negative marking) Q.12 to Q.13	(4 marks, 5 min.)	[8, 10]

1. **(a)** The ΔG in the process of melting of ice at –15°C is :

(A) –ve (B) +ve (C) 0 (D) All of these

(b) The Gibbs energy change and standard Gibbs energy change for a reaction are same if the reaction quotient Q has value equal to :

(A) > 1 (B) < 1 (C) 0 (D) 1

2. A reaction has $\Delta H = -33$ kJ and $\Delta S = -58 \frac{J}{K}$. This reaction would be :

(A) spontaneous at all temperatures (B) non-spontaneous at all temperatures

(C) spontaneous above a certain temperature (D) spontaneous below a certain temperature

3. The enthalpy change for a given reaction at 298 K is $-x$ J mol^{-1} (x being positive). If the reaction occurs spontaneously at 298 K, the entropy change at that temperature :

(A) can be negative but numerically larger than x/298

(B) can be negative but numerically smaller than x/298

(C) cannot be negative

(D) cannot be positive

4. For prefectly crystalline solid $C_{p,m} = aT^3$, where a is constant. If $C_{p,m}$ is 0.42 J/K mol at 10 K, molar entropy at 20 K is :

(A) 0.42 J/K mol (B) 0.14 J/K mol (C) 1.12 J/K mol (D) zero

5. Given that :

ΔG_f° (CuO)= –30.4 kcal/mole

ΔG_f° (Cu_2O) = –34.98 kca/mole T = 298 K

Now on the basis of above data which of the following predictions will be most appropriate under the standard conditions and reversible reaction.

(A) Finely divided form of CuO kept in excess O_2 would be completely converted to Cu_2O

(B) Finely divided form of Cu_2O kept in excess O_2 would be completely converted to CuO

(C) Finely divided form of CuO kept in excess O_2 would be converted to a mixture of CuO and Cu_2O (having more of CuO)

(D) Finely divided form of CuO kept in excess O_2 would be converted to a mixture of CuO and Cu_2O (having more of Cu_2O)

6. The molar entropy content of 1 mole of oxygen (O_2) gas at 300 K and 1 atm is 250 J mole^{-1} K^{-1}. Calculate ΔG when 1 mole of oxgyen is expanded reversibily and isothermally from 300 K, 1 atm to double its volume (Take R = 8.314 J mole^{-1} K^{-1}, log e = 2.303)

(A) 1.728 KJ mole^{-1} K^{-1} (B) 0

(C) –1.728 KJ mole^{-1} K^{-1} (D) 0.75 KJ mole^{-1}K^{-1}

7. When a bottle of perfume is opened, odorous molecules mix with air and slowly diffuse throughout the entire room. The **incorrect** fact about the process is :

(A) ΔG = –ve (B) $\Delta H \simeq 0$ (C) ΔS = –ve (D) ΔS = +ve

8. For a perfectly crystalline solid $C_{p.m.} = aT^3$, where a is constant. If $C_{p.m.}$ is 0.42 J/K–mol at 10 K, molar entropy at 10 K is

(A) 0.42 J/K-mol (B) 0.14 J/K-mol (C) 4.2 J/K-mol (D) zero

9.* For free expansion of an ideal gas (expansion against vacuum) adiabatically, which of the following will have zero value :

(A) W (B) q (C) ΔU (D) ΔH

10.* The normal boiling point of a liquid `X` is 400 K. Which of the following statement is true about the process X (l) $\longrightarrow$ X(g)?

(A) at 400 K and 1 atm pressure $\Delta G = 0$ (B) at 400 K and 2 atm pressure ΔG = + ve

(C) at 400 K and 0.1 atm presure ΔG = – ve (D) at 410 K and 1 atm pressure ΔG = + ve

11.* One mole of an ideal diatomic gas (C_v = 5 cal) was transformed from initial 25°C and 1 L to the state when temperature is 100°C and volume 10 L. Then for this process(R = 2 calories/mol/K) (take calories as unit of energy and kelvin for temp)

(A) $\Delta H = 525$

(B) $\Delta S = 5 \ln \frac{373}{298} + 2 \ln 10$

(C) $\Delta E = 525$

(D) ΔG of the process can not be calculated using given information.

12. Calculate the pH { pH = –log[H$^+$] } at which the following reaction will be at equilibrium in basic medium

$$I_2(s) \rightleftharpoons I^-(aq) + IO_3^-(aq)$$

when the concentrations at 300 K are [I$^-$] = 0.10 M and [IO_3^-] = 0.10 M

Given that $\Delta G_f^0(I^-,aq)$ = – 50 kJ/mole, $\Delta G_f^0(IO_3^-,aq)$ = – 123.5 kJ/mole, $\Delta G_f^0(H_2O, \ell)$ = – 233 kJ/mole, $\Delta G_f^0(OH^-,aq)$ = – 150 kJ/mole, Ideal gas constant R = $\frac{25}{3}$ Jmole^{-1}K^{-1}, log e = 2.3

13. The equilibrium constant for the reaction given below is 2.0×10^{-7} at 300 K. Calculate the standard free energy change for the reaction;

$$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$$

Also calculate the standard entropy change if $\Delta H°$ = 28.40 KJ/mol.

PHYSICAL / INORGANIC CHEMISTRY

DPP
DAILY PRACTICE PROBLEMS

DPP No. 26

Total Marks : 46

Max. Time : 46 min.

Topic : Electro Chemistry

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.12	(3 marks, 3 min.)	[36, 36]
Multiple choice objective ('–1' negative marking) Q.13	(4 marks, 4 min.)	[4, 4]
Comprehension ('–1' negative marking) Q.14 to Q.15	(3 marks, 3 min.)	[6, 6]

1. In Galvanic cell :

(A) Chemical reaction produces electrical energy

(B) Electrical energy produces chemical reaction

(C) Reduction occurs at anode

(D) Oxidation occurs at cathode

2. The standard oxidation potentials, E°, for the half-reaction are as

$Zn = Zn^{2+} + 2e^-$; $E° = + 0.76$ V

$Fe = Fe^{2+} + 2e^-$; $E° = + 0.41$ V the $E°_{cell}$ is :

$Fe^{+2} + Zn \rightleftharpoons Zn^{2+} + Fe$ is :

(A) –0.35 V (B) + 0.35 V (C) +1.17 V (D) – 1.17 V

3. From the following E° values of half cells -

(i) $A + e^- \rightarrow A^-$; $E° = – 0.24$ V (ii) $B^- + e^- \rightarrow B^{2-}$; $E° = + 1.25$ V

(iii) $C^- + 2e^- \rightarrow C^{3-}$; $E° = –1.25$ V (iv) $D + 2e^- \rightarrow D^{2-}$; $E° = + 0.68$ V

What combination of two half cells would result in a cell with the largest potential

(A) (ii) and (iii) (B) (ii) and (iv) (C) (i) and (iii) (D) (i) and (iv)

4. The Ni/Ni^{2+} and F^-/F_2 electrode potentials are listed as +0.25 V and –2.87 V respectively (with respect to the standard hydrogen electrode). The cell potential when these are coupled under standard conditions is

(A) 2.62 V and dependent on the reference electrode chosen.

(B) 3.12 V and independent of the reference electrode chosen.

(C) 3.12 V and dependent on the reference electrode chosen.

(D) 2.62 V and independent of the reference electrode chosen.

5. E° for some half cell reactions are given below

$Sn^{+4} + 2e^- \longrightarrow Sn^{2+}$; $E° = 0.151$ V

$2Hg^{2+} + 2e \longrightarrow Hg_2^{+2}$; $E° = 0.92$ V

$PbO_2 + 4H^+ + 2e^- \longrightarrow Pb^{2+} + 2H_2O$; $E° = 1.45$ V

based on the given data which statement is correct.

(A) Sn^{4+} is a stronger oxidising agent than Pb^{+4}

(B) Sn^{2+} is a stronger reducing agent than Hg_2^{2+}

(C) Hg^{2+} is a stronger oxidising agent than Pb^{4+}

(D) Pb^{+2} is a stronger reducing agent than Sn^{2+}

6. For the cell prepared from electrode A and B, electrode A : $\frac{Cr_2O_7^{2-}}{Cr^{3+}}$, E^0_{red} = +1.33 V and electrode B : $\frac{Fe^{3+}}{Fe^{2+}}$, E^0_{red} = 0.77 V, which of the following statement is **not correct?**

(A) The electrons will flow from B to A (in the outer circuit) when connections are made.
(B) The standard emf of the cell will be 0.56 V.
(C) A will be positive electrode.
(D) None of the above.

7. The standard reduction potentials at 25°C for the following half reactions are given against each -

$Zn^{2+}(aq) + 2e^- \rightleftharpoons Zn(s)$, –0.762 V

$Cr^{3+}(aq) + 3e^- \rightleftharpoons Cr(s)$, –0.740 V

$2H^+ + 2e^- \rightleftharpoons H_2(g)$, 0.00 V

$Fe^{3+} + e^- \rightleftharpoons Fe^{2+}$, 0.77 V

Which is the strongest reducing agent -

(A) Zn (B) Cr (C) $H_2(g)$ (D) $Fe^{3+}(aq)$

8. Hydrogen gas will not reduce -

(A) heated cupric oxide (B) heated feric oxide
(C) heated stannic oxide (D) heated aluminium oxide

$[E^\circ_{Sn^{+4}/Sn^{+2}} = 0.15V \ ; \ E^\circ_{Cu^{+2}/Cu^+} = +0.167V \ ; \ E^\circ_{Fe^{+3}/Fe^{+2}} = +0.771V \ ; \ E^\circ_{Al^{+3}/Al} = -1.67V]$

9. Four colourless salt solutions are placed in separate test tubes and a strip of copper is dipped in each. Which solution finally turns blue ? (use data from electrochemical series)

(A) $Pb(NO_3)_2$ (B) $AgNO_3$ (C) $Zn(NO_3)_2$ (D) $Cd(NO_3)_2$

10. Red hot carbon will remove oxygen from the oxide XO and YO but not from ZO. Y will remove oxygen from XO. Use this evidence to deduce the order of activity of the three metals X, Y, and Z putting the most active first :

(A) XYZ (B) ZYX (C) YXZ (D) ZXY

11. Which statement about standard reduction potentials is correct

(A) $E^\circ_{H^+/H_2}$ = Zero at all temperature

(B) $E^\circ_{D^+/D_2}$ = zero at 298 K

(C) A redox reaction is feasible if sum of SRP of oxidant and that of reductant is a positive quantity
(D) $K_2Cr_2O_7$ (acid) is stronger oxidising agent than $KMnO_4$ (acid)

[Given : $E^\circ_{MnO_4^-/Mn^{2+}}$ = 1.51 V ; $E^\circ_{Cr_2O_7^{2-}/Cr^{3+}}$ = 1.33 V]

12. The temperature defining the standard electrode potential is

(A) 298 K (B) 273 K (C) 373 K
(D) any temperature can be selected but it must remain constant and species must be in their standard states.

13. The standard reduction potentials of some half cell reactions are given below :

$PbO_2 + 4H^+ + 2e^- \rightleftharpoons Pb^{2+} + 2H_2O$ $E^0 = 1.455$ V

$MnO_4^- + 8H^+ + 5e^- \rightleftharpoons Mn^{2+} + 4H_2O$ $E^0 = 1.51$ V

$Ce^{4+} + e^- \rightleftharpoons Ce^{3+}$ $E^0 = 1.61$ V

$H_2O_2 + 2H^+ + 2e^- \rightleftharpoons 2H_2O$ $E^0 = 1.71$ V

Pick out the correct statement :

(A) Ce^{+4} will oxidise Pb^{2+} to PbO_2 (B) MnO_4^- will oxidise Pb^{2+} to PbO_2

(C) H_2O_2 will oxidise Mn^{+2} to MnO_4^- (D) PbO_2 will oxidise Mn^{+2} to MnO_4^-

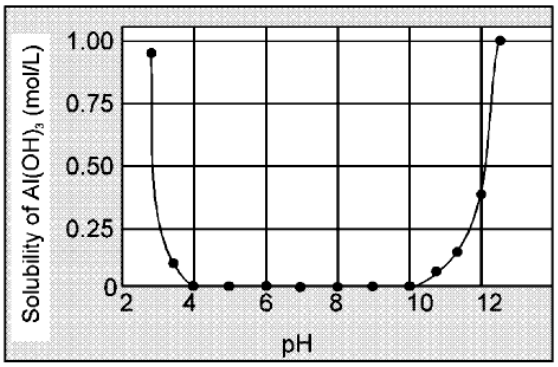
Comprehension # (Q.14 to Q.15)

Amphoteric oxides, such as aluminium oxide, are soluble both in strongly acidic and in strongly basic solutions :

In acid : $A\ell_2O_3(s) + 6H_3O^+(aq) \rightleftharpoons 2A\ell^{3+}(aq) + 9\,H_2O\,(\ell)$

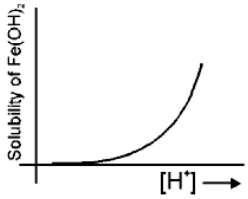
In base : $A\ell(OH)_3(s) + OH^-(aq) \rightleftharpoons A\ell(OH)_4^-(aq)$

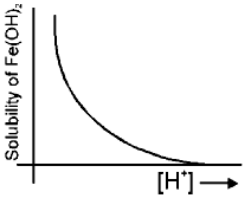
Dissolution of $Al(OH)_3$ in excess base is just a special case of the effect of complex-ion formation on solubility. $Al(OH)_3$ dissolves because excess OH^- ions convert it to the soluble complex ion $Al(OH)_4^-$ (aluminate ion). The effect of pH on the solubility of $A\ell(OH)_3$ is shown in figure.

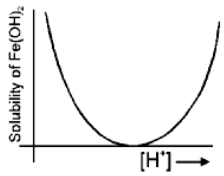


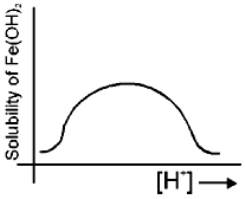
Other examples of amphoteric hydroxides include $Zn(OH)_2$, $Cr(OH)_3$, $Sn(OH)_2$ and $Pb(OH)_2$, which react with excess OH^- ions to form the soluble complex ions $Zn(OH)_4^{2-}$ (zincate ion), $Cr(OH)_4^-$ (chromite ion), $Sn(OH)_3^-$ (stannite ion), and $Pb(OH)_3^-$ (plumbite ion), respectively. By contrast, basic hydroxides, such as $Mn(OH)_2$, $Fe(OH)_2$,and $Fe(OH)_3$, dissolve in strong acid but not in strong base.

14. Which of the following curves best represents the variation of solubility of ferrous hydroxide $Fe(OH)_2$ with the concentration of $[H^+]$ ions in the solution :

(A) 

(B) 

(C) 

(D) 

15. At what maximum pH will 5.0×10^{-3} mol of $Al(OH)_3$ go into 1L solution as Al^{3+}?
Given $K_{sp}\,[Al(OH)_3] = 5.0 \times 10^{-33}$ and for $[Al(OH)_4^-] \rightleftharpoons Al^{3+} + 4OH^-$, $K_{eq} = 1.0 \times 10^{-34}$.

(A) 3.3 (B) 5 (C) 4 (D) 3

PHYSICAL / INORGANIC CHEMISTRY

DPP
DAILY PRACTICE PROBLEMS

DPP No. 26

Total Marks : 46

Max. Time : 46 min.

Topic : Electro Chemistry

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.12	(3 marks, 3 min.)	[36, 36]
Multiple choice objective ('–1' negative marking) Q.13	(4 marks, 4 min.)	[4, 4]
Comprehension ('–1' negative marking) Q.14 to Q.15	(3 marks, 3 min.)	[6, 6]

1. In Galvanic cell :
(A) Chemical reaction produces electrical energy
(B) Electrical energy produces chemical reaction
(C) Reduction occurs at anode
(D) Oxidation occurs at cathode

2. The standard oxidation potentials, E°, for the half-reaction are as
$Zn = Zn^{2+} + 2e^-$; $E° = + 0.76$ V
$Fe = Fe^{2+} + 2e^-$; $E° = + 0.41$ V the $E°_{cell}$ is :

$Fe^{+2} + Zn \rightleftharpoons Zn^{2+} + Fe$ is :

(A) –0.35 V (B) + 0.35 V (C) +1.17 V (D) – 1.17 V

3. From the following E° values of half cells -

(i) $A + e^- \rightarrow A^-$; $E° = – 0.24$ V (ii) $B^- + e^- \rightarrow B^{2-}$; $E° = + 1.25$ V

(iii) $C^- + 2e^- \rightarrow C^{3-}$; $E° = –1.25$ V (iv) $D + 2e^- \rightarrow D^{2-}$; $E° = + 0.68$ V

What combination of two half cells would result in a cell with the largest potential

(A) (ii) and (iii) (B) (ii) and (iv) (C) (i) and (iii) (D) (i) and (iv)

4. The Ni/Ni^{2+} and F^-/F_2 electrode potentials are listed as +0.25 V and –2.87 V respectively (with respect to the standard hydrogen electrode). The cell potential when these are coupled under standard conditions is
(A) 2.62 V and dependent on the reference electrode chosen.
(B) 3.12 V and independent of the reference electrode chosen.
(C) 3.12 V and dependent on the reference electrode chosen.
(D) 2.62 V and independent of the reference electrode chosen.

5. E° for some half cell reactions are given below
$Sn^{+4} + 2e^- \longrightarrow Sn^{2+}$; $E° = 0.151$ V
$2Hg^{2+} + 2e \longrightarrow Hg_2^{+2}$; $E° = 0.92$ V
$PbO_2 + 4H^+ + 2e^- \longrightarrow Pb^{2+} + 2H_2O$; $E° = 1.45$ V
based on the given data which statement is correct.
(A) Sn^{4+} is a stronger oxidising agent than Pb^{+4}
(B) Sn^{2+} is a stronger reducing agent than Hg_2^{2+}
(C) Hg^{2+} is a stronger oxidising agent than Pb^{4+}
(D) Pb^{+2} is a stronger reducing agent than Sn^{2+}

6. For the cell prepared from electrode A and B, electrode A : $\frac{Cr_2O_7^{2-}}{Cr^{3+}}$, E^0_{red} = +1.33 V and electrode B : $\frac{Fe^{3+}}{Fe^{2+}}$, E^0_{red} = 0.77 V, which of the following statement is **not correct?**

(A) The electrons will flow from B to A (in the outer circuit) when connections are made.
(B) The standard emf of the cell will be 0.56 V.
(C) A will be positive electrode.
(D) None of the above.

7. The standard reduction potentials at 25°C for the following half reactions are given against each -

$Zn^{2+}(aq) + 2e^- \rightleftharpoons Zn(s)$, –0.762 V
$Cr^{3+}(aq) + 3e^- \rightleftharpoons Cr(s)$, –0.740 V
$2H^+ + 2e^- \rightleftharpoons H_2(g)$, 0.00 V
$Fe^{3+} + e^- \rightleftharpoons Fe^{2+}$, 0.77 V

Which is the strongest reducing agent -
(A) Zn (B) Cr (C) $H_2(g)$ (D) $Fe^{3+}(aq)$

8. Hydrogen gas will not reduce -
(A) heated cupric oxide (B) heated feric oxide
(C) heated stannic oxide (D) heated aluminium oxide

[$E^\circ_{Sn^{+4}/Sn^{+2}} = 0.15V$; $E^\circ_{Cu^{+2}/Cu^+} = +0.167V$; $E^\circ_{Fe^{+3}/Fe^{+2}} = +0.771V$; $E^\circ_{Al^{+3}/Al} = -1.67V$]

9. Four colourless salt solutions are placed in separate test tubes and a strip of copper is dipped in each. Which solution finally turns blue ? (use data from electrochemical series)
(A) $Pb(NO_3)_2$ (B) $AgNO_3$ (C) $Zn(NO_3)_2$ (D) $Cd(NO_3)_2$

10. Red hot carbon will remove oxygen from the oxide XO and YO but not from ZO. Y will remove oxygen from XO. Use this evidence to deduce the order of activity of the three metals X, Y, and Z putting the most active first :
(A) XYZ (B) ZYX (C) YXZ (D) ZXY

11. Which statement about standard reduction potentials is correct

(A) $E^\circ_{H^+/H_2}$ = Zero at all temperature

(B) $E^\circ_{D^+/D_2}$ = zero at 298 K

(C) A redox reaction is feasible if sum of SRP of oxidant and that of reductant is a positive quantity
(D) $K_2Cr_2O_7$ (acid) is stronger oxidising agent than $KMnO_4$ (acid)

[Given : $E^\circ_{MnO_4^-/Mn^{2+}}$ = 1.51 V ; $E^\circ_{Cr_2O_7^{2-}/Cr^{3+}}$ = 1.33 V]

12. The temperature defining the standard electrode potential is
(A) 298 K (B) 273 K (C) 373 K
(D) any temperature can be selected but it must remain constant and species must be in their standard states.

13. The standard reduction potentials of some half cell reactions are given below :

$PbO_2 + 4H^+ + 2e^- \rightleftharpoons Pb^{2+} + 2H_2O$ $E^0 = 1.455$ V
$MnO_4^- + 8H^+ + 5e^- \rightleftharpoons Mn^{2+} + 4H_2O$ $E^0 = 1.51$ V
$Ce^{4+} + e^- \rightleftharpoons Ce^{3+}$ $E^0 = 1.61$ V
$H_2O_2 + 2H^+ + 2e^- \rightleftharpoons 2H_2O$ $E^0 = 1.71$ V

Pick out the correct statement :

(A) Ce^{+4} will oxidise Pb^{2+} to PbO_2 (B) MnO_4^- will oxidise Pb^{2+} to PbO_2
(C) H_2O_2 will oxidise Mn^{+2} to MnO_4^- (D) PbO_2 will oxidise Mn^{+2} to MnO_4^-

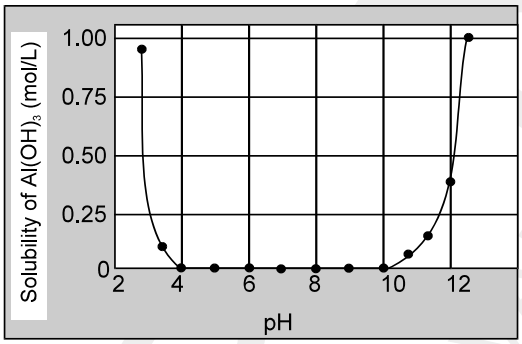
Comprehension # (Q.14 to Q.15)

Amphoteric oxides, such as aluminium oxide, are soluble both in strongly acidic and in strongly basic solutions :

In acid : $A\ell_2O_3(s) + 6H_3O^+(aq) \rightleftharpoons 2A\ell^{3+}(aq) + 9\,H_2O\,(\ell)$

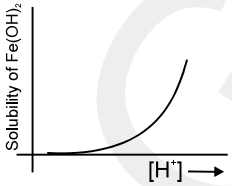
In base : $A\ell(OH)_3(s) + OH^-(aq) \rightleftharpoons A\ell(OH)_4^-(aq)$

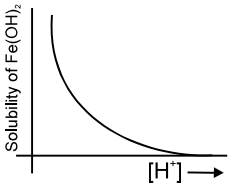
Dissolution of $Al(OH)_3$ in excess base is just a special case of the effect of complex-ion formation on solubility. $Al(OH)_3$ dissolves because excess OH^- ions convert it to the soluble complex ion $Al(OH)_4^-$ (aluminate ion). The effect of pH on the solubility of $A\ell(OH)_3$ is shown in figure.

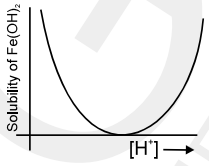


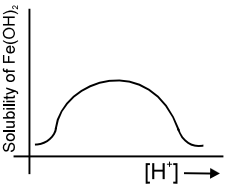
Other examples of amphoteric hydroxides include $Zn(OH)_2$, $Cr(OH)_3$, $Sn(OH)_2$ and $Pb(OH)_2$, which react with excess OH^- ions to form the soluble complex ions $Zn(OH)_4^{2-}$ (zincate ion), $Cr(OH)_4^-$ (chromite ion), $Sn(OH)_3^-$ (stannite ion), and $Pb(OH)_3^-$ (plumbite ion), respectively. By contrast, basic hydroxides, such as $Mn(OH)_2$, $Fe(OH)_2$,and $Fe(OH)_3$, dissolve in strong acid but not in strong base.

14. Which of the following curves best represents the variation of solubility of ferrous hydroxide $Fe(OH)_2$ with the concentration of $[H^+]$ ions in the solution :

(A) 

(B) 

(C) 

(D) 

15. At what maximum pH will 5.0×10^{-3} mol of $Al(OH)_3$ go into 1L solution as Al^{3+}?
Given K_{sp} $[Al(OH)_3] = 5.0 \times 10^{-33}$ and for $[Al(OH)_4^-] \rightleftharpoons Al^{3+} + 4OH^-$, $K_{eq} = 1.0 \times 10^{-34}$.
(A) 3.3 (B) 5 (C) 4 (D) 3

PHYSICAL / INORGANIC CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 27

Total Marks : 42

Max. Time : 44 min.

Topic : Electro Chemistry

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.10	(3 marks, 3 min.)	[30, 30]
Multiple choice objective ('–1' negative marking) Q.11	(4 marks, 4 min.)	[4, 4]
Subjective Questions ('–1' negative marking) Q.12 to Q.13	(4 marks, 5 min.)	[8, 10]

1. $E°$ for $F_2 + 2e^- \rightleftharpoons 2F^-$ is 2.8 V, $E°$ for $\frac{1}{2} F_2 + e^- = F^-$ is -

(A) 2.8 V (B) 1.4 V (C) –2.8 V (D) –1.4 V

2. The standard reduction potential of Cu^{2+}/Cu and Cu^{2+}/Cu^+ are 0.337 and 0.153 respectively. The standard electrode potential of Cu^+/Cu half-cell is -

(A) 0.184 V (B) 0.827 V (C) 0.521 V (D) 0.490 V

3. $E^0_{Fe^{3+}/Fe^{+2}} = +0.77$ V ; $E^0_{Fe^{+3}/Fe} = -0.036$ V. What is $E^0_{Fe/Fe^{+2}}$ and is Fe^{+2} stable to disproportionation in aqueous solution under standard conditions

(A) +0.44 V, yes (B) – 0.44 V, No (C) + 0.44 V, No (D) – 0.44 V, yes

4. Given that $E°_{Fe^{2+}/Fe} = -0.44$ V ; $E°_{Fe^{3+}/Fe^{2+}} = 0.77$ V if Fe^{2+}, Fe^{3+} and Fe solid are kept together then

(A) Fe^{3+} increases (B) Fe^{3+} decreases

(C) Fe^{2+}/Fe^{3+} remains unchanged (D) Fe^{2+} decreases

5. The spontaneous redox reaction/s among the following is/are

(a) $2Fe^{3+} + Fe \longrightarrow 3Fe^{++}$

(b) $Hg_2^{++} \longrightarrow Hg^{++} + Hg$

(c) $3\,AgCl + NO + 2H_2O \longrightarrow 3\,Ag + 3\,Cl^- + NO_3^- + 4H^+$

Given that

$E°_{Fe^{+++}/Fe^{++}} = 0.77$ V $E°_{Fe^{++}/Fe} = -0.44$ V

$E°_{Hg_2^{++}/Hg} = 0.85$ V $E°_{Hg^{++}/Hg_2^{++}} = 0.92$ V

$E°_{AgCl/Ag} = 0.22$ V $E°_{NO_3^-/NO} = 0.96$ V

(A) a (B) a, b, c (C) a, b (D) a, c

6. $\Delta G°$ of the cell reaction $AgCl(s) + \frac{1}{2} H_2(g) \rightleftharpoons Ag(s) + H^+ + Cl^-$ is –21.52 kJ.

$\Delta G°$ of $2AgCl(s) + H_2(g) = 2Ag(s) + 2H^+ + 2Cl^-$ is -

(A) –21.52 kJ (B) –10.76 kJ (C) –43.04 kJ (D) 43.04 kJ

7. In a concentration cell, $Zn \mid Zn^{2+}$ (1.0M) $\mid\mid Zn^{2+}$ (0.15 M) $\mid$ Zn as the cell discharges,

(A) reaction proceeds to the right

(B) the two solutions approach each other in concentration

(C) no reaction takes place

(D) water gets decomposed

8. In a half-cell contaning $[Tl^{3+}]$ = 0.1 M and $[Tl^{+}]$ = 0.01M, the cell potential is –1.2496 V for the reaction $Tl^{+} \longrightarrow Tl^{3+} + 2e^{-}$. The standard reduction potential of the $T\ell^{+3}/T\ell^{+1}$ couple at 25°C is

(A) 144 V (B) 0.61 V (C) 2.44 V (D) 1.22 V

9. A galvanic cell is composed of two hydrogen electrodes, one of which is a standard one. In which of the following solutions should the other electrode be immersed to get maximum e.m.f. ($K_a = 10^{-5}$ for acetic acid and $K_a = 10^{-3}$ for phosphoric acid)

(A) 0.1 M HCl (B) 0.1 M CH_3COOH (C) 0.1 M H_3PO_4 (D) 0.1 M H_2SO_4

10. The standard electrode potential for the reactions,

$Ag^{+}(aq) + e^{-} \longrightarrow Ag(s)$

$Sn^{2+}(aq) + 2e^{-} \longrightarrow Sn(s)$

at 25°C are 0.80 volt and –0.14 volt, respectively. The emf of the cell $Sn|Sn^{2+}$ (1 M) $||Ag^{+}$ (1M)|Ag is-

(A) 0.66 volt (B) 0.80 volt (C) 1.08 volt (D) 0.94 volt

11. For the cell Tl | Tl^{+} (0.001 M) | | Cu^{2+} (0.1 M) | Cu. E_{cell} at 25°C is 0.83 V, which can be increased-

(A) by increasing $[Cu^{2+}]$ (B) by increasing $[Tl^{+}]$

(C) by decreasing $[Cu^{2+}]$ (D) by decreasing $[Tl^{+}]$

12. Given the standard reduction potentials $T\ell^{+} + e^{-} \longrightarrow T\ell$, E° = – 0.34V and $T\ell^{3+} + 2e^{-} \longrightarrow T\ell^{+}$, E° = 1.25V. Examine the spontaneity of the reaction, $3T\ell^{+} \longrightarrow 2T\ell + T\ell^{3+}$. Also find E° for this disproportionation.

13. What is the electrode potential of Mg^{2+} | Mg electrode at 25°C, in which the concentration of Mg^{2+} is 0.01M. E° (Mg^{2+} | Mg) = – 2.36V.

PHYSICAL / INORGANIC CHEMISTRY

DPP
DAILY PRACTICE PROBLEMS

DPP No. 28

Total Marks : 43

Max. Time : 45 min.

Topic : Electro Chemistry

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.7	(3 marks, 3 min.)	[21, 21]
Multiple choice objective ('–1' negative marking) Q.8	(4 marks, 4 min.)	[4, 4]
Subjective Questions ('–1' negative marking) Q.9 to Q.10	(4 marks, 5 min.)	[8, 10]

1. Which of the following concentration cells will produce maximum E_{cell} at 298 K.

[Take p_{H_2} = 1.0 atm in each case.]

(A) Pt | H_2 (g) | H^+ (0.01 M) || H^+ (0.1 M) | H_2 (g) | Pt
(B) Pt | H_2 (g) | NH_4Cl (0.01 M) || HCl (0.1 M) | H_2 (g) | Pt
(C) Pt | H_2 (g) | H^+ (0.1 M) || H^+ (0.2 M) | H_2 (g) | Pt
(D) Pt | H_2 (g) | H^+ (pH = 0.0) || H^+ (pH = 0.0) | H_2 (g) | Pt.

2. Given that (at T = 298 K)

$Cu(s) \mid Cu^{2+}(1.0\ M) \parallel Ag^+(1.0\ M) \mid Ag(s)$ $\quad E^o_{cell} = 0.46$ V
$Zn(s) \mid Zn^{2+}(1.0\ M) \parallel Cu^{2+}(1.0\ M) \mid Cu(s)$ $\quad E^o_{cell} = 1.10$ V

Then E_{cell} for

$Zn \mid Zn^{2+}(0.1\ M) \parallel Ag^+(1.0\ M) \mid Ag$ at 298 K will be

(A) 1.59 V (B) 1.53 V
(C) 2.53 V (D) cannot be calculated due to insufficient data

3. What is the value of the reaction quotient, Q, for the cell -

$Ni(s) \mid Ni(NO_3)_2$ (0.190M) | | KCl(0.40M)| Cl_2(g, 0.10 atm) |Pt(s)

(A) 3×10^{-1} (B) 1.3×10^{-1} (C) 8.0×10^{-2} (D) 3.0×10^{-2}

4. A hydrogen electrode placed in a buffer solution of CH_3COONa and CH_3COOH in the molar ratios x : y and y : x has oxidation potentials E_1 and E_2 volts respectively at 298 K. $(p_{H_2} = 1atm)$.The pK_a value of acetic acid will be given by .

(A) $\frac{E_1 - E_2}{0.118}$ (B) $\frac{E_2 - E_1}{0.118}$ (C) $\frac{E_1 + E_2}{0.118}$ (D) None of these

5. For the cell Pt | H_2(g) | solution X || KCl (saturated) | Hg_2Cl_2 | Hg | Pt
the observed EMF at 25°C was 600 mV. When solution X was replaced by a standard phosphate buffer with pH = 7.00, the EMF was 718 mV. Find the pH of solution X.

(A) 3 (B) 4 (C) 5 (D) 6

6. The dissociation constant for $[Ag(NH_3)_2]^+$ into Ag^+ and NH_3 is 10^{-13} at 298 K. If $E^0_{Ag^+/Ag}$ = 0.8 V, then E^0 for the half cell $[Ag(NH_3)_2]^+ + e^- \longrightarrow Ag + 2NH_3$ will be

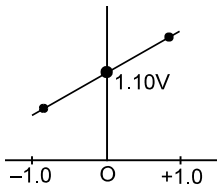
(A) 0.33 V (B) – 0.33 V (C) – 0.033 V (D) 0.033 V

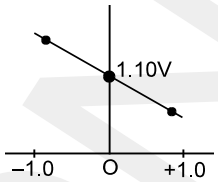
7. You are given the following cell at 298 K with E°_{cell} = 1.10 V

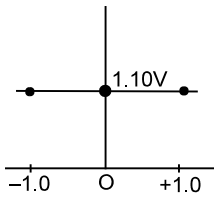
$Zn(s) \mid Zn^{2+}(C_1) \parallel Cu^{++}(C_2) \mid Cu(s)$

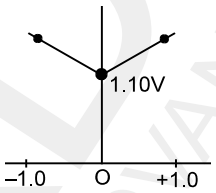
where C_1 and C_2 are the concentration in mol/lit then which of the following figures correctly correlates E_{cell} as a function of concentrations..

x-axis : $\log \frac{C_1}{C_2}$ and y-axis : E_{cell}

(A) 

(B) 

(C) 

(D) 

8. Make out the right combination of cell and condition for the spontaneity :

(A) $Pt(H_2) \mid HCl \mid Pt(H_2)$; $P_1 > P_2$ (B) $Zn \mid Zn^{2+}(C_1) \parallel Zn^{2+}(C_2) \mid Zn$; $C_2 > C_1$

P_1 1M P_2

(C) $Pt(Cl_2) \mid Cl^-(C_1) \parallel Cl^-(C_2) \mid Pt(Cl_2)$; $C_2 > C_1$ (D) $Pt(H_2) \mid HCl(C_1) \parallel HCl(C_2) \mid Pt(H_2)$; $C_2 > C_1$

1 atm 1 atm 1 atm 1 atm

Single Integer

9. Depression of freezing point of 0.01 molal aqueous CH_3COOH solution is 0.02046°. 1 molal aqueous urea solution freezes at – 1.86°C. Assuming molality to be equal to molarity, calculate pH of CH_3COOH solution.

10. The active ingredient in aspirin is acetyl salicylic acid,

$HC_9H_7O_4 + H_2O \rightleftharpoons H_3O^+ + C_9H_7O_4^-$, $K_a = 6.25 \times 10^{-9}$

What is the pH of the solution obtained by dissolving two aspirin tablets in 250mL of water ? Assume that each tablet contains 0.36 g of acetyl salicylic acid.

PHYSICAL / INORGANIC CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 29

Total Marks : 34

Max. Time : 38 min.

Topic : Electro Chemistry

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1	(3 marks, 3 min.)	[3, 3]
Subjective Questions ('–1' negative marking) Q.2 to Q.5	(4 marks, 5 min.)	[16, 20]
Comprehension ('–1' negative marking) Q.6 to Q.8	(3 marks, 3 min.)	[9, 9]
Short Subjective Questions ('–1' negative marking) Q.9 to Q.10	(3 marks, 3 min.)	[6, 6]

1. When 0.1 mole HCl gas is added in 1lt of 0.1 M CH_3COOH(aq) then which statement is wrong? ($K_a = 2 \times 10^{-5}$, log 2 = 0.3)

(A) degree of dissociation of CH_3COOH decreases sharply.

(B) change in pH would be 1.85

(C) conc of $[Cl^-]$ = 0.1 M, $[CH_3COOH]$ = 0.1 M, $[H^+]$ = 0.2 M in final solution

(D) on addition of HCl, K_a of CH_3COOH does not change.

2. Calculate E° and E for the cell Sn | Sn^{2+} (1M) || Pb^{2+} (10^{-3} M) | Pb , E° (Sn^{2+} / Sn) = – 0.14V. Eº (Pb^{2+} / Pb) – 0.13V. What do you infer from cell EMF?

3. Calculate the equilibrium constant for the reaction Fe + $CuSO_4 \rightleftharpoons FeSO_4$ + Cu at 25°C.Given Eº (Fe/Fe^{2+}) = 0.44V, Eº (Cu/Cu^{2+}) = – 0.337 V.

4. For a cell Mg(s) |Mg^{2+} (aq) || Ag^+ (aq)| Ag, Calculate the equilibrium constant at 25°C. Also find the maximum work that can be obtained by operating the cell. E°(Mg^{2+} / Mg) = – 2.37V, E° (Ag^+/Ag) = 0.8 V.

5. At 25°C the value of K for the equilibrium Fe^{3+} +Ag $\rightleftharpoons$ Fe^{2+} + Ag^+ is 0.531 mol/litre. The standard electrode potential for Ag^+ + e $\rightleftharpoons$ Ag is 0.799V. What is the standard potential for Fe^{3+} + e $\Leftrightarrow$ Fe^{2+} ?

Comprehension # (Q.6 to Q.8)

(Read the following passage and answer the questions numbered 5 to 7. They have only one correct option)

Standard reduction potentials (SRP) for different systems can be used to decide the spontaneity of a reaction e.g. $E^\circ_{Zn^{2+}/Zn}$ = – 0.76V, hence for the reaction Zn + $2H^+ \longrightarrow Zn^{2+} + H_2$, ΔG° is negative. It has been found experimentally that if (SRP of an oxidant – SRP of a reductant) is more than 1.7V, then their combination may lead to explosion (though it may be prevented by kinetic factors).

Now go through the following data and answer the questions.

Data : $E^\circ_{Ag^+/Ag}$ = 0.80 V ; $E^\circ_{N_2/N_3^-}$ = – 3.09 V

$E^\circ_{ClO_4^-/ClO_3^-}$ = 1.23 V ; $E^\circ_{Na^+/Na}$ = – 2.71 V

$E^\circ_{Fe^{3+}/Fe^{2+}}$ = 0.77 V ; $E^\circ_{O_2/H_2O_2}$ = – 1.03 V

$E^\circ_{H_2O_2/H_2O}$ = 1.76 V ; $E^\circ_{O_3/O_2}$ = 2.07 V

$E^\circ_{MnO_4^-/Mn^{2+}}$ = 1.54 V ; $E^\circ_{Cr_2O_7^{2-}/Cr^{3+}}$ = 1.33 V

6. Which of the following ionic combinations may lead to the formation of explosive substance.

(A) Sodium ion and azide ion (B) Silver ion and perchlorate ion

(C) Silver ion and azide ion (D) All the above

7. Which of the following ions will be capable of causing catalytic decomposition of H_2O_2.

(A) Fe^{3+} (B) Fe^{2+} (C) both (D) None of these

8. Which is correct about the reaction between H_2O_2 and O_3

(A) It is a case of mutual reduction

(B) O_3 will oxidise H_2O_2 into O_2

(C) It is not a redox reaction

(D) H_2O_2 being a stronger oxidising agent will decompose ozone into oxygen

SINGLE INTEGER

9. The ionization constant of nitrous acid is 4×10^{-4}. Calculate the pH of 0.04 M sodium nitrite solution.

10. For aqueous solution of how many of the following compounds / mixtures, does the pH remains constant even upon dilution :

(1) NH_4Cl (2) Na_2CO_3 (3) A 1 : 2 molar ratio mixture of Na_2S and HCl.

(4) A 5 : 2 molar ratio mixture of NaOH and H_3PO_4. (5) A 5 : 4 molar ratio mixture of CH_3COONa and HCl.

(6) NaH_2PO_4 (7) A 2 : 1 molar ratio mixture of HCl and $NaHCO_3$.

(8) CH_3COONH_4 (9) A 4 : 3 molar ratio mixture of NH_4OH and HCl.

PHYSICAL / INORGANIC CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 30

Total Marks : 39

Max. Time : 44 min.

Topic : Electro Chemistry

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.5	(3 marks, 3 min.)	[15, 15]
Subjective Questions ('–1' negative marking) Q.6 to Q.8	(4 marks, 5 min.)	[12, 15]
Match the Following (no negative marking) Q. 9	(8 marks, 10 min.)	[8, 10]
True or False (no negative marking) Q.10 & Q.11	(2 marks, 2 min.)	[4, 4]

1. $E^{\circ}_{Al^{3+}/Al}$ = – 1.66 V and K_{SP} of $Al(OH)_3$ = 1.0×10^{-33}. Reduction potential of the above couple at pH = 14 is :

(A) – 2.31 V (B) + 2.31 (C) – 1.01 V (D) + 1.01 V.

2. At 298K the standard free energy of formation of $H_2O(\ell)$ is –257.20 kJ/mole while that of its ionisation into H^+ ion and hydroxyl ions is 80.35 kJ/mole, then the emf of the following cell at 298 K will be : (take F = 96500 C] : $H_2(g,1\ bar) \mid H^+(1M) \parallel OH^-(1M) \mid O_2(g,\ 1bar)$

(A) 0.40 V (B) 0.50 V (C) 1.23 V (D) – 0.40 V

3. pH of the solution in the anode compartment of the following cell at 25ºC is x when $E_{cell} - E^{\circ}_{cell}$ = 0.0591 V, $Pt(H_2)$ (1 atm) | pH = x | | Ni^{2+} (1 M) | Ni x is :

(A) 4 (B) 3 (C) 2 (D) 1

4. The emf of the cell, Ag | Ag^+ (1 M) || I^- (1 M) | AgI | Ag is E

The solubility product of AgI can be expressed as :

(A) $K_s = \frac{nF}{2.303\ RT} \log E$ (B) $\ln K = nF\left[\frac{\partial E}{\partial T} - E\right]$ (C) $\ln K_s = \frac{nF}{E}$ (D) $\log K_s = \frac{nFE}{2.303\ RT}$

5. The emf of the cell Zn | $ZnCl_2$ (0.05 M) | AgCl(s) | Ag is 1.015 V at 298 K and the temperature coefficient of its emf is -4.92×10^{-4} V/K. How many of the reaction thermodynamic parameters ΔG, ΔS and ΔH are negative at 298 K?

(A) None of them (B) One of them (C) Two of them (D) All of them

6. If $E^{\circ}_{Ag^+/Ag}$ = 0.80 V at 298 K and K_{SP} (AgCl) is 1.56×10^{-10} , calculate Eº for Cl^- | AgCl | Ag half-cell.

7. Calculate solubility of AgBr in 0.1 M $AgNO_3$ solution.

Given $Ag^+ + e^- \longrightarrow Ag\ (s)$, Eº = 0.80 V.

$AgBr\ (s) + e^- \longrightarrow Ag\ (s) + Br^-$, Eº = 0.073 V.

8. At 25ºC, $\left(\frac{dE^{\circ}}{dT}\right)_P$ = -1.25×10^{-3} V K^{-1} and Eº = 1.36 V for the cell, Pt |H_2 (g)| HCl (aq) | Cl_2 (g) | Pt.

Calculate the enthalpy and entropy change for cell reaction.

9.

	Column – I		Column – II
(A)	H^+ (aq)	(p)	$\Delta H_f^0 = 0$
(B)	H (gas)	(q)	$\Delta H_f^0 \neq 0$
(C)	H_2 (gas)	(r)	$\Delta G_f^0 = 0$
(D)	C (s, diamond)	(s)	$\Delta H_f^0 > 0$

10. **S_1 :** 1 mole O_2 gas at STP has more entropy than 1 mole O_2 gas at 273 K in a volume of 11.2 litre.
S_2 : Expansion of a sample of ideal gas always represents an increase in entropy of the system.
S_3 : On keeping a heated metal block into open atmosphere, there occurs an increase in entropy of universe.
S_4 : 1 mole O_2 gas at STP has more entropy than 1 mole O_2 gas at 273 K and 0.25 atm.

(A) T T T F (B) T F T F (C) F F F T (D) F T F T

11. **S_1 :** For an irreversible adiabatic compression process, entropy change of surrounding will be equal to zero.
S_2 : Molar entropy of a substance follows the order $(S_m)_{Solid} < (S_m)_{liquid} < (S_m)_{gas}$
S_3 : Entropy change for the reaction $H_2(g) \longrightarrow 2H(g)$ is +ve.
S_4 : Molar entropy of a non-crystalline solid will be zero at absolute zero temperature.

(A) F T T F (B) T T T F (C) T T F T (D) F F T T

PHYSICAL / INORGANIC CHEMISTRY

DPP
DAILY PRACTICE PROBLEMS

DPP No. 31

Total Marks : 33

Max. Time : 33 min.

Topic : Electro Chemistry

Type of Questions **M.M., Min.**

Single choice Objective ('–1' negative marking) Q.1 to Q.11 **(3 marks, 3 min.)** **[33, 33]**

1. **(a)** Which process occurs in the electrolysis of an aqueous tin(II) chloride solution at a tin anode?

(A) $Sn = Sn^{2+} + 2e^-$ (B) $2Cl^- = Cl_2 + 2e^-$

(C) $2H_2O = O_2 + 4H^+ + 4e^-$ (D) none of these

(b) In the electrolysis of an aqueous nickel(II) sulphate solution, the process $2H_2O = O_2 + 4H^+ + 4e^-$ occurs at the anode. The material of construction of the anode is

(A) nickel (B) gold (C) copper (D) none of these

2. **(a)** In the electrolysis of an aqueous potassium sulphate solution, the pH of the solution in the space near an electrode increased. Which pole of the current source is the electrode connected to?

(A) The positive pole (B) Could be either pole

(C) The negative pole (D) Cannot be determined

(b) In the electrolysis of an aqueous solution of a salt, the pH in the space near one of the electrodes increased. A solution of which salt is being electrolyzed?

(A) none of the following (B) $CuCl_2$

(C) $Cu(NO_3)_2$ (D) KCl

3. Number of electrons lost during electrolysis of 0.355 g of Cl^- is -

(A) 0.01 (B) 0.01 N_0 (C) 0.02 N_0 (D) $\frac{0.01}{2N_0}$

4. In the electrolysis of a copper(II) chloride solution, the mass of the cathode increased by 3.2 g. What occurred at the copper anode?

(A) 0.05 mol of Cu^{2+} passed into the solution (B) 0.56 L of O_2 was liberated

(C) 0.1 mol of Cu^{2+} passed into the solution (D) 0.112 L of Cl_2 was liberated

5. The passage of a constant current through a solution of dilute H_2SO_4 with 'Pt' electrodes liberated 336 cm^3 of a mixture of H_2 and O_2 at S.T.P. The quantity of electricity that was passed is

(A) 96500 C (B) 965 C (C) 1930 C (D) $\frac{1}{100}$ faraday

6. A very thin copper plate is electro-plated with gold using gold chloride in HCl. The current was passed for 20 min. and the increase in the weight of the plate was found to be 2g. [Au = 197]. The current passed was -

(A) 0.816 amp (B) 1.632 amp (C) 2.448 amp (D) 3.264 amp

7. In the electrolysis of an aqueous $SnCl_2$ solution, 4.48 L of chlorine at STP were liberated at the anode. The mass of tin deposited at the cathode was (M of Sn = 118.5)

(A) 119 g (B) 79.3 g (C) 47.4 g (D) 23.7 g

8. What must be the concentration of Ag^+ in an aqueous solution containing Cu^{2+} = 1.0 M so that both the metals can be deposited on the cathode simultaneously. Given that $E^0_{Cu/Cu^{2+}} = -0.34$ V and $E^0_{Ag^+/Ag}$ = 0.812 V, T = 298 K

(A) nearly 10^{-19} M (B) 10^{-12} M (C) 10^{-8} M (D) nearly 10^{-16} M

9. Electrolytic reduction of 6.15 g of nitrobenzene using a current effeciency of 40% will require which of the following quantity of electricity. [C = 12, H = 1, N = 14, O = 16]

(A) 0.75 F (B) 0.15 F (C) 0.75 C (D) 0.125 C

10. Electrolysis of a solution of HSO_4^- ions produces $S_2O_8^{--}$. Assuming 75% current efficiency, what current should be employed to achieve a production rate of 1 mole of $S_2O_8^{--}$ per hour ?

(A) +71.5 amp (B) 35.7 amp (C) 142.96 amp (D) 285.93 amp

11. A current is passed through 2 voltameters connected in series. The first voltameter contains XSO_4 (aq.) and second has Y_2SO_4 the relative atomic masses of X and Y are in the ratio of 2 : 1. The ratio of the mass of X liberated to the mass of Y liberated is

(A) 1 : 1 (B) 1 : 2 (C) 2 : 1 (D) None of the above

PHYSICAL / INORGANIC CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 32

Total Marks : 33

Max. Time : 36 min.

Topic : Electro Chemistry

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.3	(3 marks, 3 min.)	[9, 9]
Subjective Questions ('–1' negative marking) Q.4 to Q.6	(4 marks, 5 min.)	[12, 15]
Comprehension ('–1' negative marking) Q.7 to Q.10	(3 marks, 3 min.)	[12, 12]

1. Aqueous solution of Na_2SO_4 containing a small amount of HPh (Phenolphthalein) is electrolysed using Pt-electrodes. The colour of the solution after some time will :
(A) remain colourless (B) change from pink to colourless
(C) change from colourless to pink (D) remain pink

2. For the electrolytic production of $NaClO_4$ from $NaClO_3$ as per the equation, $NaClO_3 + H_2O \longrightarrow NaClO_4 + H_2$, how many faradays of electricity will be required to produce 0.5 mole of $NaClO_4$, assuming 60% efficiency?
(A) 0.835 F (B) 1.67 F (C) 3.34 F (D) 1.6 F

3. Identify the true and false statement and answer in given options
1. During electrolysis of 1M NaCl solution Cl_2 does not form at the anode.
2. For a concentration cell with its reaction at equilibrium both E_{cell} and E°_{cell} are zero.
3. The hybridisation of $[Cr(H_2O)_6]^{+++}$ is sp^3d^2.

(A) F T F (B) T T T (C) F F F (D) F T T

4. A current of 0.2 A is passed for 10 minutes through 0.05 dm^3 of 0.1 M NaCl. If only chlorine is produced at anode and water is reduced to H_2 at cathode, what is the OH^- concentration in the solution after electrolysis?

5. Find the thickness of the electro deposited silver if the surface area over which deposition occurred was 100 cm^2 and a current of 0.2 A flowed for 1hr with the cathodic efficiency of 80%. Density of Ag = 10 g/cc (Ag = 108).

6. A 300 mL solution of NaCl was electrolysed for 6.00 min. If the pH of the final solution was 12.24, calculate the average current used.

Comprehension # (Q.7 to Q.10)

If an electrolytic solution consists of more than two ions and electrolysis is done, it is observed that all the ions are not discharge at the electrodes simultaneously but certain ions are liberate at the electrodes in perferential discharge theory. It states that if more than one type of ions are attracted towards a particular electrode, then the one discharged is the ion which required least energy. The potential at which the ion is discharge or deposited on the apropriate electrode is termed as discharge or depositon potential (E). If current of 1 ampere is passed through an aqueous (1 litre) electrolytic solution having $[Zn^{2+}] = [Cu^{2+}] = [Mn^{2+}] = 0.03$ M. The standard electrode potential, $E^0_{Cu^{2+}/Cu} = 0.34$ V, $E^0_{Zn/Zn^{2+}} = 0.762$ V and $E^0_{Mn/Mn^{2+}} = 1.8$ V are observed and 1 Faraday = 96500 coulomb.

7. Which of the following metal is almost first deposited at cathode ?
(A) Cu (B) Zn (C) Mn (D) All of these.

8. What would be the approximate concentration of metal ions Cu^{2+}, Zn^{2+} and Mn^{2+} after 96.5 min respectively?
(A) 0.01 M , 0.03 M, 0.001 M (B) 0.01 M, 0.03 M, 0.03 M
(C) 0 M, 0.03 M, 0.03 M (D) 0.003 M, 0.03 M, 0 M.

9. After 106.5 minute the metal deposited is approximately ?
(A) 0.012 mole of Cu (B) 0.03 mole of Zn (C) 0.03 mole of Mn (D) 0.003 mole of Zn

10. If current efficiency is 50%, what volume of O_2 gas evolved at NTP after 96.5 minutes ?
(A) 332 mL (B) 168 mL (C) 84 mL (D) 42 mL

PHYSICAL / INORGANIC CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 33

Total Marks : 33

Max. Time : 36 min.

Topic : Electro Chemistry

Type of Questions		**M.M., Min.**
Single choice Objective ('–1' negative marking) Q.1 to Q.7	**(3 marks, 3 min.)**	**[21, 21]**
Subjective Questions ('–1' negative marking) Q.8 to Q.10	**(4 marks, 5 min.)**	**[12, 15]**

1. To observe the effect of concentration on the conductivity, electrolytes of different nature are taken in two vessel 'A' and 'B'. 'A' contains weak electrolyte e.g., NH_4OH and 'B' contains strong electrolyte e.g., NaCl. In both container concentration of respective electrolyte is increased and conductivity observed :
(A) in 'A' conductivity increases, in 'B' conductivity decreases
(B) in 'A' conductivity decreases while in 'B' conductivity increases
(C) in both 'A' and 'B' conductivity increases
(D) in both 'A' and 'B' conductivity decreases

2. The conductivity of 0.1 N NaOH solution is 0.022 S cm^{-1}. To this solution equal volume of 0.1 N HCl solution is added which results into decrease of conductivity of solution to 0.0055 S cm^{-1}. The equivalent conductivity of NaCl solution in S cm^2 $equiv^{-1}$ is :
(A) 0.011 (B) 110 (C) 0.0055 (D) 55.0

3. 100 mL of solutions of A and B (containing the same strong electrolyte) fill a conductivity cell with the electrodes being exactly half dipped into the solution and the conductances of 0.01 S and 0.005 S were registered. What would be the conductance if both solution are mixed together and tested upon in the same conductivity cell ?
(A) 0.0075 S (B) 0.015 S (C) 0.03 S (D) none of these

4. The specific conductivity is 0.0382 Ω^{-1} cm^{-1} for a solution which is 0.1 M in KCl and 0.2 M in NaCl (a strong electrolyte). Calculate $\lambda(Na^+)$ if the $\lambda(k^+) = 74$ and $\lambda(Cl^-) = 76$ resp.
(A) 10 (B) 20 (C) 30 (D) 40

5. The solubility of $[Co(NH_3)_4Cl_2]ClO_4$ if the $\lambda_{CO(NH_3)_4Cl_2^+} = 50$, $\lambda_{ClO_4^-} = 70$ and the measured resistance was 33.5 Ω in a cell with cell constant of 0.20 is _____
(A) 59.7 mmol/L (B) 49.7 mmol/L (C) 39.7 mmol/L (D) 29.7 mmol/L

6. For a saturated solution of AgCl at 25°C, $\kappa = 3.4\times10^{-6}$ S cm^{-1} and that of H_2O (ℓ) used is 2.02×10^{-6} S cm^{-1}. Λ°_m for AgCl is 138 S cm^2 mol^{-1} then the solubility of AgCl in moles per liter will be -
(A) 10^{-5} (B) 10^{-10} (C) 10^{-14} (D) 10^{-16}

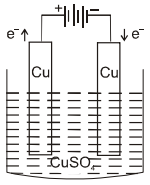
7. Given that (in S cm^2 eq^{-1}) at T = 298 K :
Λ°_{eq} for $Ba(OH_2)$, $BaCl_2$ & NH_4Cl are 228.8, 120.3 & 129.8 respectively.
Specific conductance for 0.2 N NH_4OH solution is 4.766×10^{-4} S cm^{-1}, then value of pH of the given solution of NH_4OH will be nearly.
(A) 9.2 (B) 11.3 (C) 12.1 (D) 7.9

8. The resistance of a $\frac{N}{10}$ KCl solution is 250 Ω. Calculate the specific conductance and the equivalent conductance of the solution if the electrodes in the cell are 7 cm apart and each has an area of 7 sq. cm.

Integer Answer Type

This section contains 2 questions. The answer to each of the questions is a single digit integer, ranging from 0 to 9.

9. In the adjacent diagram the electrolytic cell contains 1 L of an aqueous 1 M Copper (II) sulphate solution. If 0.4 mole of electrons are passed through the cell, the molar concentration of copper ion after passage of the charge will be :



10. The charge required for discharging 115 gram of Na from molten NaCl is ..... Faradays.

PHYSICAL / INORGANIC CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 34

Total Marks : 40

Max. Time : 47 min.

Topic : Electro Chemistry

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.4	(3 marks, 3 min.)	[12, 12]
Match the Following (no negative marking) Q. 5	(8 marks, 10 min.)	[8, 10]
Subjective Questions ('–1' negative marking) Q.6 to Q.10	(4 marks, 5 min.)	[20, 25]

1. Two aqueous solutions A and B containing solute $CuSO_4$ and NaBr respectively were electrolysed using platinum electrodes. The pH of the resulting solutions will show a/an :

(A) Increase in both the solutions (B) Decrease in both the solutions

(C) Increase in A and decrease in B (D) Decrease in A and increase in B

2. 'Spin only' magnetic moment of Ni in $[Ni(dmg)_2]$ is same as that found in :

(A) Ni in $[NiCl_2(PPh_3)_2]$ (B) Mn in $[MnO_4]^{2-}$

(C) Co in $[CoBr_4]^{2-}$ (D) Pt in $[Pt(H_2O)_2Br_2]$

3. **S_1 :** pH of the solution increases when 1M aqueous solution $CuSO_4$ is electrolysed using platinum electrodes.

S_2 : At equilibrium, E°_{cell} of a Daniel cell will be equal to zero.

S_3 : Equivalent conductance of a weak electrolyte solution increases with decreases in concentration of solution.

(A) FTT (B) FFT (C) TFT (D) TTF

4. **Statement-1 :** On increasing dilution, the conductivity of solution gets increased.

Statement-2 : On increasing dilution, degree of ionization of weak electrolyte increases and mobility of ions also increases.

(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.

(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.

(C) Statement-1 is True, Statement-2 is False.

(D) Statement-1 is False, Statement-2 is True.

5.

Column – I (Quantities)	**Column – II (Factors on which dependency exist)**
(A) Molar conductance	(p) Temperature
(B) emf of a cell in operation	(q) Concentration of species involved
(C) Gibbs energy change (ΔG) for a cell	(r) Nature of substance involved
(D) Conductivity	(s) Stoichometric coefficient of the cell reaction.
	(t) Presence of complex forming ligand in sufficient concentration.

Integer Answer Type

This section contains 3 questions. The answer to each of the questions is a single digit integer, ranging from 0 to 9.

6. Equivalent conductance of 0.2 M aqueous solution of a weak monobasic acid (HA) is 10 S cm^2 $equiv^{-1}$ and that at infinite dilution is 200 S cm^2 $equiv^{-1}$. Hence pH of this solution is.

7. Conductivity of a saturated solution of $Cu_2[Fe(CN)_6]$ after subtracting the conductivity of water is $1.28 \times 10^{-5}\ \Omega^{-1}\ cm^{-1}$. Calculate value of solubility of $Cu_2[Fe(CN)_6]$.
[$\Lambda_m^\infty(CuSO_4)$ = 260 S cm^2 mol^{-1}, $\Lambda_m^\infty(K_2SO_4)$ = 300 S cm^2 mol^{-1}, $\Lambda_m^\infty(K_4Fe(CN)_6)$ = 720 S cm^2 mol^{-1}]
Report your answer as (solubility) × (10^5)

8. A dilute solution of KCl was placed between two Pt electrodes 10 cm apart across which a potential difference of 6.0 volts was applied. Calcualte how far (in cm) would K^+ ion move in 2 hours 46 minutes and 60 seconds at 25ºC. Given that ionic conductivity of K^+ at infinite dilution is 96.50 S cm^2 eq^{-1} at 25ºC. (Assume 1F = 96500 C).

9. Calculate K_{sp} for $BaSO_4$ with the help of following data at 298 K. Specific conductance of saturated solution of $BaSO_4$ = 4.44×10^{-6} $ohm^{-1}\times cm^{-1}$ and that of water used for making the solution = 1.34×10^{-6} $ohm^{-1}\times cm^{-1}$, molar ionic conductance at infinite dilution for Ba^{++} and SO_4^{--} are 127.28 and 159.60 respectively.

10. A conductivity cell has a resistance of 250 Ω when filled with 0.02 M KCl at 25^0C and one of 10^5 Ω when filled with 6×10^{-5} M NH_4OH solution, the specific conductivity of 0.02 M KCl is 0.00277 S cm^{-1} and the $\lambda_\varepsilon NH_4^+$ and $\lambda_\varepsilon OH^-$ are 73.4 and 198 respectively. Calculate the cell constant and the degree of dissociation of NH_4OH in the 6×10^{-5} M solution.

PHYSICAL / INORGANIC CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 35

Total Marks : 50

Max. Time : 55 min.

Topic : p-block elements (Nitrogen and Oxygen family)

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.7	(3 marks, 3 min.)	[21, 21]
Multiple choice objective ('–1' negative marking) Q.8	(4 marks, 4 min.)	[4, 4]
True or False (no negative marking) Q.9	(2 marks, 2 min.)	[2, 2]
Assertion and Reason (no negative marking) Q. 10	(3 marks, 3 min.)	[3, 3]
Subjective Questions ('–1' negative marking) Q.11 to Q. 15	(4 marks, 5 min.)	[20, 25]

1. Heating of ammonium dichromate produes :
(A) NH_3, Cr_2O_3 and H_2O. (B) N_2, Cr_2O_3 and H_2O.
(C) NO_2, CrO_3 and H_2O. (D) N_2O, CrO_3 and H_2O.

2. **(a)** Which of the following oxides is amphoteric in nature ?
(A) N_2O_3 (B) P_2O_3 (C) Sb_2O_3 (D) Bi_2O_3

(b) Which of the following compounds does not give nitrogen on heating ?
(A) NaN_3 (B) $(NH_4)_2SO_4$ (C) NH_4NO_2 (D) NH_4ClO_4

3. Which of the following oxides of nitrogen is solid ?
(A) NO_2 (B) NO (C) N_2O (D) N_2O_5

4. Which of the following statement is correct ?
(A) Black phosphorus is thermodynamically most stable allotrope of phosphorus:
(B) One mole of calcium phosphide on reaction with excess water gives two moles of phosphine
(C) PbO_2 on treatment with concentrated HNO_3 produces NO_2 gas.
(D) (A) and (B) both

5. **(a)** One mole of calcium phosphide on reaction with dilute hydrochloric acid gives :
(A) Two moles of phosphine (B) Two moles of phosphorus pentachloride
(C) One mole of phosphine (D) One mole of phosphorus trichloride

(b) Ammonia can be dried by :
(A) conc. H_2SO_4 (B) P_4O_{10} (C) anhydrous $CaCl_2$ (D) none

6. For H_3PO_3 and H_3PO_4, the correct choice is:
(A) H_3PO_3 is stronger acid than H_3PO_4 (B) H_3PO_3 is dibasic and reducing.
(C) H_3PO_4 is tribasic and reducing (D) (A) and (B) both

7. Which of the following statement (s) is/are incorrect ?
(A) Ammonia is oxidised to NO_2 by oxygen at 800^0C in presence of a catalyst platinum.
(B) Nitric acid on standing slowly turns yellow.
(C) Colloidal sulphur is formed when H_2S gas is passed through nitric acid solution.
(D) N_2O_3 gas dissolves in water giving a pale blue solution.

8. Which of the following statement (s) is/are true ?
(A) Ammonia burns in air with a pale yellow flame.
(B) Calcium carbide reacts with nitrogen gas at 1100^0C to form a fertilizer, nitrolim.
(C) All the elements of nitrogen family are polyatomic.
(D) The melting point of antimony is less than arsenic.

9. **True/False :**

(A) Dry ammonia gas can be obtained by passing it through a U-tube containing anhydrous calcium chloride.

(B) The brown ring test for nitrates depends on the ability of Fe^{2+} to reduce nitrates to nitric oxide which then reacts with Fe^{2+} to form a brown coloured complex.

(C) Metals like chromium, aluminimum dissolves in concentrated nitric acid (80%).

(A) F T F (B) T F T (C) F T T (D) T F F

10. **Statement-1 :** NO(s) is a neutral oxide, diamagnetic and is not an acid anhydride.

Statement-2 : NO as a ligand is a three electron donor and paramagnetic in gaseous state.

(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.

(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1

(C) Statement-1 is True, Statement-2 is False

(D) Statement-1 is False, Statement-2 is True

11. An orange solid (A) on heating gives a green residue (B), a colourless gas (C) and water vapour. The dry gas (C) on passing over heated magneisum gave a white solid (D). (D) on reaction with water gave a gas (E) which formed dense white fumes with HCl.

Identify (A) to (E) giving reactions.

12. **(a)** Why does the reactivity of nitrogen differ from phosphorus ?

(b) Nitrogen exists as diatomic molecule and phosphorus as P_4 . Why ?

(c) Explain why NH_3 is basic while BiH_3 is only feebly basic.

13. **(a)** What happens when ? CaO in water reacts with phosphorus (white).

(b) Give equations for the reactions of the following compound with water.

(a) AlN (b) P_4O_6

(c) What happens when carbon reacts with concentrated HNO_3.

14. **(a)** Why white phosphorus is kept in water ?

(b) Pure phosphine does not burn in air but impure sample of phosphine burns in air. Why ?

(c) What happens when solution of PH_3 in water is exposed to light ?

15. ***Integer Answer Type***

This question contains 3 questions. The answer to each of the questions is a single digit integer, ranging from 0 to 9.

(i) How many P-P single bonds are present in white phosphrus (P_4) molecule ?

(ii) In the disproportionation reaction of NaOH with one molecule of P_4, number of molecules of NaOH reacting are ..... .

(iii) The basicity of phosphorus acid (H_3PO_3) is

PHYSICAL / INORGANIC CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 36

Total Marks : 46

Max. Time : 50 min.

Topic : p-block elements (Nitrogen and Oxygen family)

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.8	(3 marks, 3 min.)	[24, 24]
Subjective Questions ('–1' negative marking) Q.9 to Q.11, Q.14	(4 marks, 5 min.)	[16, 20]
Comprehension ('–1' negative marking) Q.12 to Q.13	(3 marks, 3 min.)	[6, 6]

1. White phosphours has :

(A) six P – P single bonds (B) four lone pairs of electrons

(C) PPP angle of 60ºC (D) all of these

2. Consider the following statements.

(i) β–black phosphorus is a good conductor of electricity

(ii) Metalloids like Sb and As do form their corresponding metal oxy acid with concentrated HNO_3.

(iii) Lead nitrate on heating at a temperature of 673 K liberates only oxygen gas.

(A) (i) and (ii) are correct only (B) (iii) and (iv) are correct only

(C) (i), (iii) and (iv) ae correct only (D) all are correct.

3. **(a)** The decrease stability of higher oxidation state in p–block with increasing atomic number is due to:

(A) decrease in bond energy as going down the group.

(B) energy required to unpair ns^2 – electrons is not compensated by the energy released in forming the two additional bonds.

(C) both are correct.

(D) none is correct.

(b) In group 15, the melting points of the elements :

(A) increase regularly on moving down the group.

(B) decrease regularly on moving down the group.

(C) first decrease upto As and then increase to Bi.

(D) first increase form N to As and then decrease to Bi.

4. The thermal stability of the hydrides of group 15 follows the order :

(A) $NH_3 < PH_3 < AsH_3 < SbH_3 < BiH_3$ (B) $NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$

(C) $PH_3 > NH_3 > AsH_3 > SbH_3 < BiH_3$ (D) $AsH_3 < PH_3 > SbH_3 > BiH_3 > NH_3$

5 Which of the following order(s) is / are incorrect ?

(A) $H_3PO_4 > H_3PO_3 > H_3PO_2$ (reducing character)

(B) $N_2O < NO < N_2O_3 < N_2O_5$ (oxidation state on nitrogen atom.)

(C) $NH_3 > PH_3 > AsH_3 > SbH_3 \geq$ (basicity.)

(D) $SbH_3 > NH_3 > AsH_3 > PH_3$ (reducing character.)

6. Consider the following statements

S_1 : Ammonia on heating with concentrated solution of sodium hypochlorite gives N_2H_4.

S_2 : The phosphine gas dissolves in water in presence of sunlight and produces phosphonium hydroxide like ammonium hydroxide.

S_3 : Barium azide on heating gives pure nitrogen gas.

S_4 : The oxo-acids of phosphorus in which phosphorus has lower oxidation state less than +5 contain either P–P or P–H bonds but not both in addition to P=O and P–OH bonds.

and arrange in the order of true/false.

(A) T F T T (B) F F T T (C) T T T F (D) T F T F

7. **Statement-1 :** NO_2 and ClO_2 both being odd electron molecules dimerise.
Statement-2 : On dimerisation, NO_2 is converted to stable N_2O_4 molecule with even number of electrons.
(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1
(C) Statement-1 is True, Statement-2 is False
(D) Statement-1 is False, Statement-2 is True

8. **Statement-1 :** The order of densities of the various allotropes of phosphorus is as follows; black phosphorus > red phosphorus > white phosphorus because
Statement-2 : As tendency of polymerisation increases, the compactness of substance also increases.
(A) Statement 1 and statement 2 are correct and statement 2 is the correct explanation of statement 1.
(B) Statement 1 and statement 2 are correct but statement 2 is not the correct explanation of statement 1.
(C) Statement 1 is correct while statement 2 is false.
(D) Statement 1 is false while statement 2 is correct.

9. Explain the following.
(a) Single N–N bond is weaker than the single P–P bond.
(b) BiH_3 is the strongest reducing agent amongst all the hydrides.
(c) SbH_3 has higher boiling point than NH_3.

10. **(a)** Give the disproportionation reaction of HNO_2 and H_3PO_3 ?

(b) What happens when ?
(A) White phosphorus reacts with thionyl chloride.
(B) Sulphur dioxide is chlorinated using PCl_5

11. Match the following (one or more than one)

Column - I	**Column - II**
(A) $H_3PO_2 \xrightarrow[\text{(ii) } 435K]{\text{(i) } 415K}$	(p) One of the products acts as reducing agent.
(B) $PCl_3 + H_2O \xrightarrow{435\,K}$	(q) One of the products is tribasic and non reducing.
(C) $NO_2 + H_2O \longrightarrow$	(r) Dehydration
(D) $HNO_3 + P_4O_{10} \xrightarrow{\Delta}$	(s) In one of the products the central atom is in +5 oxidation state.

Comprehension # (Q.12 to Q.13)

Turning to indicators used in titrations by the oxidation-reduction reaction, we must first work that in some cases it is possible to do without them if the colour of the titration solution undergoes a sharp enough change as the result of the reaction.

Titration without indicator is possible, for example, various reducing agents are oxidised by MnO_4^- in acid solution. We know that the purple-violet colour of MnO_4^- ion disapperas owing to reduction to the almost colourless Mn^{2+} ion. When all the reducing agent has been titrated a single excess drop of MnO_4^- colours the whole solution a distinct pink.

Similarly, reducing agents can be titrated with iodine solution without the use of indicators, because the dark brown colour of iodine disappears as a result of reduction of I_2 to I^-.However, since the colour of I_2 solutions is not very deep, it is convenient in such cases to use an indicator starch solution, which gives an intense blue colour even with very small amount of free iodine. The use of starch is based on its ability to form a blue adsorption compound with iodine, and is unrelated to the oxidising properties of I_2.

Redox indicators are substances which can be reversibly oxidised or reduced with different colours in the oxidised and reduced forms.

The interconversion can be represented as.

$$Ind_{ox} + ne \rightleftharpoons Ind_{red}$$

Applying the nernst equation to it, we have

$$E = E^{o} + \frac{0.059}{n} \log \frac{[Ind_{ox}]}{[Ind_{red}]}$$

If we add 1-2 drops of a solution of some redox indicator to a solution of reducing (or oxidising) agent, the $[Ind_{ox}]$ and $[Ind_{red}]$ will be in the ratio of corresponding potential of the solution. The solution acquires colour corresponding to the ratio. However our eye only detect the colour of one form if the concentration of the given form minimum ten times to the concentration of other form.

12. Diphenylamine is an redox indicator having $E^{o} = 0.76$ V. For any given reaction n = 2. Within what potential difference diphenylamine changes it colour ?

(A) 0.66 V to 0.86 V (B) 0.7895 V to 0.7306 V

(C) 0.75 V to 0.77 V (D) None of these

13. What is the range of redox indicator ferroin ? The oxidised form of ferroin is $Fe(C_{12}H_8N_2)_3^{3+}$ (pale blue). The reduced form of ferroin is $Fe(C_{12}H_8N_2)_3^{2+}$ (red). For ferroin $E^{o} = 1.14$ V

(A) From 1.081 V to 1.199 V (B) From 1.1105 V to 1.199 V

(C) From 0.963 V to 1.317 V (D) From 1 V to 2 V

14. Find the volume of gases evolved by passing 0.965 A current for 1 hr through an aqueous solution of CH_3COONa at 25^0C and 1 atm.

PHYSICAL / INORGANIC CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 37

Total Marks : 39

Max. Time : 42 min.

Topic : p-block elements (Nitrogen and Oxygen family)

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.6	(3 marks, 3 min.)	[18, 18]
Multiple choice objective ('–1' negative marking) Q.7	(4 marks, 4 min.)	[4, 4]
True or False (no negative marking) Q.8	(2 marks, 2 min.)	[2, 2]
Assertion and Reason (no negative marking) Q.9	(3 marks, 3 min.)	[3, 3]
Subjective Questions ('–1' negative marking) Q.10	(4 marks, 5 min.)	[4, 5]
Match the Following (no negative marking) Q. 11	(8 marks, 10 min.)	[8, 10]

1. **(a)** Which one of the following reactions will give oxygen gas ?

(A) A reaction of PbO_2 with concentrated HNO_3. (B) A reaction of MnO_2 with concentrated H_2SO_4.

(C) A reaction of $KMnO_4$ with concentrated HCl. (D) (A) and (B) both

(b) Which of the following statement is correct ?

(A) Al_2O_3, ZnO, TeO_2 and Sb_2O_3 are amphoteric oxides.

(B) Super oxides dissolve in water forming hydrogen peroxide and liberating oxygen gas.

(C) CrO_3, Mn_2O_7 , P_4O_{10} and Cl_2O_7 are acidic oxides.

(D) All of these.

2. Which of the following is used as a bleaching agent ?

(A) Hydrogen peroxide (B) Ozone (C) calgon (D) (A) and (B) both

3. **(a)** The oxidation number of sulphur in S_2Cl_2, SF_4 and S_8 respectively are :

(A) +1, + 4 and 0 (B) + 2, + 4 and – 2 (C) 0, + 4 and – 1 (D) 0, + 4 and 0

(b) H_2S cannot be dried by :

(A) anhydrous $CaCl_2$ (B) P_2O_5 (C) Conc. H_2SO_4 (D) All of these

4. **(a)** Hot concentrated sulphuric acid dissolves sulphur forming

(A) SO_3 (B) SO_2 (C) H_2SO_3 (D) $H_2S_2O_3$

(b) $KClO_3 + H_2SO_4 \xrightarrow{\Delta} KHSO_4 + HClO_4 + (X) + H_2O$.

The product [X] is :

(A) O_2 (B) Cl_2 (C) ClO_2 (D) Cl_2O_3

5. Which of the following statement is false for sulphurdioxide ?

(A) It reacts with dry chlorine in presence of charcoal to form sulphuryl chloride.

(B) It reduces KIO_3 to iodine in acidic medium.

(C) It when passed through a solution of sodium sulphide, produces Na_2SO_3.

(D) It oxidises $SnCl_2$ to $SnCl_4$ in presence of HCl.

6. **(a)** Consider the following statements

(i) Sulphur dioxide exists as discrete SO_2 molecules in gaseous as well as solid state.

(ii) Sulphur trioxide exists in several modifications in solid state ; cyclic trimer, and polymeric chain.

(iii) Bleaching by sulphur dioxide is through reduction process and is temporary.

Select the correct one from the codes given.

(A) (i) and (ii) only (B) (i), and (iii) only (C) (i), (ii) and (iii) (D) (ii) and (iii) only.

(b) Which of the following is correct ?

(A) S_3O_9 – contains no S–S linkage. (B) $S_2O_6^{2-}$ – contains –O–O– linkage.

(C) $(HPO_3)_3$ – contains P – P linkage (D) $S_2O_8^{2-}$ contains S–S linkage

7. **(a)** Aqueous solution of hydrogen peroxide :
(A) turns blue litmus pink
(B) gives bright blue colour in ether with acidified $K_2Cr_2O_7$ solution.
(C) gives yellow or orange coloured solution with an acidified solution of titanium salt.
(D) bleaches blue litmus.

(b) Which of the following statement(s) is / are true for the hydrides of the elements of 16^{th} group?
(A) Their acidic character increases from H_2O to H_2Te
(B) Their thermal stability increases from H_2O to H_2Te
(C) Their reducing character increases from H_2S to H_2Te
(D) The order of their boiling points is $H_2S < H_2Se < H_2Te < H_2O$

8. **(a)** Consider the following statements
S_1 : $(HPO_3)_n$ can be prepared by heating phosphorus acid and bromine in a sealed tube.
S_2 : Dry iodine reacts with ozone and forms a yellow solid, I_4O_9.
S_3 : β-Sulphur is stable below 369 K.
and arrange in the order of true/false.
(A) F T F (B) T T F (C) T T T (D) T F F

(b) True / false.
S_1 : Sodium thiosulphate with $FeCl_3$ solution develops a pink or violet colour which soon vanishes.
S_2 : White precipitate of PbS_2O_3 gets soluble when boiled with water.

9. **Statement-1:** Aqueous solution of hydrogen peroxide is kept in glass or metal container containing some urea or phosphoric acid beacuse
Statement-2 : Urea or phosphoric acid acts as a negative catalyst for the decomposition of hydrogen peroxide.
(A) Statement 1 and statement 2 are correct and statement 2 is the correct explanation of statement 1.
(B) Statement 1 and statement 2 are correct but statement 2 is not correct explanation of statement 1.
(C) Statement 1 is correct but statement 2 is false.
(D) Statement 1 is false but statement 2 is correct.

10. **(a)** There is large difference in the melting and boiling points of oxygen and sulphur. Explain.
(b) Why solution of sodium thiosulphate turns milky on acidification ?
(c) Out of following forms of sulphur which one is paramagnetic and why ? S_8, S_6 and S_2.

11. Match the following (one or more then one)

Column - I	**Column - II**
(A) $H_2Te < H_2O$	(p) Boiling point
(B) $SO_2 < SO_3$	(q) Thermal stability
(C) $H_2O_2 < H_2SO_4$	(r) Acidic character
(D) $PH_3 < NH_3$	(s) Reducing character

PHYSICAL / INORGANIC CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 38

Total Marks : 33

Max. Time : 35 min.

Topic : p-block elements (Nitrogen and Oxygen family)

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.4	(3 marks, 3 min.)	[12, 12]
Multiple choice objective ('–1' negative marking) Q.5	(4 marks, 4 min.)	[4, 4]
Assertion and Reason (no negative marking) Q.6 to Q. 8	(3 marks, 3 min.)	[9, 9]
Subjective Questions ('–1' negative marking) Q.9 to Q.10	(4 marks, 5 min.)	[8, 10]

1. $NH_4ClO_4 + HNO_3$(dilute) $\longrightarrow HClO_4 + [X]$

$[X] \xrightarrow{\Delta} Y(g)$

[X] and [Y] are respectively.

(A) NH_4NO_3 and N_2O (B) NH_4NO_2 and N_2 (C) HNO_4 and O_2 (D) None

2. Match the following

(A) $H_2O > H_2Te > H_2Se > H_2S$	(p) Basic character
(B) $NH_3 > PH_3 > AsH_3 > SbH_3$	(q) Acidic character
(C) $H_2O < H_2S < H_2Se < H_2Te$	(r) Boiling point
(D) $KCl < CaCl_2 < AlCl_3 < SnCl_4$	(s) Ionic character
	(t) Covalent character

(A) (A) – r ; (B) – p ; (C) – q ; (D) – t (B) (A) – p ; (B) – r ; (C) – q ; (D) – t

(C) (A) – s ; (B) – p ; (C) – p ; (D) – t (D) (A) – r ; (B) – p ; (C) – q; (D) – s

3. In the following reaction, $2MnO_4^- + 5H_2O_2^{18} + 6H^+ \rightarrow 2Mn^{2+} + 8H_2O + 5O_2$

The radioactive oxygen will appear in :

(A) H_2O (B) O_2

(C) bothH_2O & O_2 (D) above reaction does not take place

4. **(a)** Which is correct regarding the cyclic trimer of SO_3

(A) It contains three S – S, σ bonds

(B) It contains three O – O, σ bonds

(C) It contains six O – O, π bonds

(D) The total number of σ and π bonds in it are 12 and 6 respectively

(b) In SO_2 molecule, there are two σ-bonds and two π-bonds. The two π-bonds are formed by :

(A) $p\pi - p\pi$ overlap between S and O atoms

(B) sp^2 – p overlap between S and O atoms

(C) one by $p\pi - p\pi$ overlap and other by $p\pi - d\pi$ overlap

(D) both by $p\pi - d\pi$ overlap

5. Identify the correct statement(s)

(A) P_4O_{10} is used as a drying agent

(B) P_4O_{10} contains $p\pi$–$p\pi$ back bonding

(C) In P_4O_{10} each P atom is bonded to three oxygen atoms

(D) P_4O_{10} hydrolyse in water forming phosphorus acid

6. **S_1 :** H_2O_2 solutions are stored in dark coloured plastic or wax coated glass vessels often with negative catalysts such as urea or sodium stannate added as stabilizers.

S_2 : With stronger oxidising agents H_2O_2 is oxidised and in such cases O_2 is always evolved.

S_3 : H_2O_2 is more hydrogen bonded than is water and so has a higher boiling point than water.

S_4 : In dilute aqueous solution H_2O_2 is more acidic than water.

(A) T T F T (B) T T T T (C) T T T F (D) T F T T

7. **Statement-1 :** Molecular oxygen is attracted by magnetic field.
Statement-2 : Molecular oxygen contains 2 unpaired electrons which occupy two different π – molecular orbitals
(A) Statement 1 and statement 2 are correct and statement 2 is the correct explanation of statement 1
(B) Statement 1 and statement 2 are correct but statement 2 is not correct explanation of statement 1
(C) Statement 1 is correct but statement 2 is false
(D) Statement 1 is false but statement 2 is correct

8. **Statement-1 :** Mercury in contact with ozone loses its mobility and starts sticking to the glass surface.
Statement-2 : This is known as tailing of mercury.
(A) Statement 1 and statement 2 are correct and statement 2 is the correct explanation of statement 1
(B) Statement 1 and statement 2 are correct but statement 2 is not correct explanation of statement 1
(C) Statement 1 is correct but statement 2 is false
(D) Statement 1 is false but statement 2 is correct

9. What happens when ?
(a) Hypophosphorus acid is heated.
(b) Phosphorus penta oxide reacts with PCl_5.

10. ***Integer Answer Type***

This section contains 3 questions. The answer to each of the questions is a single digit integer, ranging from 0 to 9.

(i) If Phosphorous acid, Tetrathionic acid and Pyrophosphoric acid have number of acidic hydrogen per molecule respectively as x, y and z, then find the value of x + y – z.

(ii) How many orders among following are correct with respect to the properties indicated :

(1) $NH_3 < H_2O < H_2S$	Boiling point
(2) $PH_3 < AsH_3 < NH_3 < SbH_3$	Boiling point
(3) $BF_3 < BCl_3 < BBr_3$	Extent of hydrolysis
(4) $CH_3Cl > CH_3F > CH_3Br > CH_3I$	Dipole moment
(5) $BF_3 < BCl_3 < BBr_3$	Lewis acidic strength
(6) $Na^+ > Mg^{+2} > Al^{+3}$	Extent of hydration

(iii) Depending upon the nature of oxides, they are classified as acidic, basic, amphoteric and neutral oxides.
Among the following, the total number of acidic oxides are :
NO_2, , CuO, NO, CO_2, P_4O_6, CO, PbO_2, SiO_2, SnO_2.

PHYSICAL / INORGANIC CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 39

Total Marks : 41

Max. Time : 43 min.

Topic : p-block elements (Halogens and Noble gas)

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.2	(3 marks, 3 min.)	[6, 6]
Multiple choice objective ('–1' negative marking) Q.3 to Q.4	(4 marks, 4 min.)	[8, 8]
True or False (no negative marking) Q.5 & Q.9	(2 marks, 2 min.)	[10, 10]
Comprehension ('–1' negative marking) Q.10 to Q.12	(3 marks, 3 min.)	[9, 9]
Subjective Questions ('–1' negative marking) Q.13 to Q.14	(4 marks, 5 min.)	[8, 10]

1. **(a)** Which of the following is a mixed anhydride ?

(A) Cl_2O_7 (B) Cl_2O_3 (C) ClO_2 (D) Cl_2O_5

(b) $KClO_3$ on heating disproportionates to :

(A) $KClO_2$, $KClO_4$ (B) KClO, $KClO_4$ (C) Cl_2, $KClO_4$ (D) $KClO_4$, KCl

2. **(a)** The correct order of the thermal stability of hydrogen halides (H – X) is

(A) HI > HBr > HCl > HF (B) HF > HCl > HBr > HI

(C) HCl < HF < HBr < HI (D) HI > HCl < HF < HBr

(b) $H_2SO_4 + NaCl\ (s) \longrightarrow NaHSO_4 + HCl$. Hydrochloric acid is liberated because

(A) H_2SO_4 is a reducing agent. (B) HCl is a smaller molecule than H_2SO_4

(C) HCl is more volatile than H_2SO_4 (D) (B) and (C) Both

(c) Concentrated HNO_3 reacts with I_2 to give :

(A) HI (B) HOI (C) HIO_3 (D) $HOIO_3$

3. Iodine (I_2) is soluble in :

(A) KI solution (B) Water

(C) Carbon tetrachloride (D) Alcohol

4. ClO^- formed in the following reaction

$$Cl_2 + 2OH^- \longrightarrow ClO^- + Cl^- + H_2O$$

In this reaction :

(A) Cl_2 has undergone disproportionation

(B) Cl_2 has been reduced to ClO^- and Cl^-

(C) equivalent mass of Cl_2 is equal to its molar mass

(D) equivalent mass of Cl_2 is half of its molar mass

5. Consider the following statements

Statement-1 : Hydrofluoric acid can not be kept in glass vessel.

Statement-2 : Hydrochloric acid can be dried by passing it through concentrated H_2SO_4.

Statement-3 : Chlorine monoxide is evolved when $KClO_3$ is treated with conc. H_2SO_4

Statement-4 : Chlorine reacts with hot and concentrated NaOH to form NaCl and $NaClO_3$.

and arrenge in the order of true/false.

(A) F T F T (B) F F F T (C) T T FT (D) F T T F

6. Consider the following statements

Statment-1 : Fluorine oxidises water to oxygen.

Statment-2 : Bromine reacts with water to form HBr and HOBr.

Statment-3 : Iodide (I^-) can be oxidised by oxygen in acidic medium.

Statment-4 : Thermally stable oxide of fluorine at room temperature is OF_2.

and arrange in the order of true/false.

(A) T T T T (B) F T F T (C) T F T F (D) T T F F

7. Consider the following statements
Statement-1 : HBr is a stronger acid then HI because of hydrogen bonding.
Statement-2 : F^- ion has higher hydration energy than Cl^-.
Statement-3 : O_3 is more powerful oxidising agent than F_2 because it contains three 'O'.
Statement-4 : fluorine does not form polyhalides.
and arrange in the order of true/false.
(A) T T T F (B) F T F T (C) T F T F (D) F F T T

8. **(a) Statement-1 :** The red liquid bromine reacts with sodium carbonate solution and forms sodium bromide and sodium bromate.
Statement-2 : Sodium bromide reacts with conc. H_2SO_4 to form HBr.
(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1
(C) Statement-1 is True, Statement-2 is False
(D) Statement-1 is False, Statement-2 is True

(b) Statement-1 : All halogens except fluorine exhibit +1, +3, +5 and +7 oxidation states in addition to –1 oxidation state.
Statement-2 : Except fluorine all other halogens have d-orbitals and, therefore, can expand their octets.
(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1
(C) Statement-1 is True, Statement-2 is False
(D) Statement-1 is False, Statement-2 is True

(c) Statement-1 : Most of the reactions of fluorine, are exothermic.
Statement-2 : It forms small and strong bond with other elements.
(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1
(C) Statement-1 is True, Statement-2 is False
(D) Statement-1 is False, Statement-2 is True

9. **(a) Statement-1 :** ClO_2 is anhydride of chloric acid.
Statement-2 : $2ClO_2 + H_2O \longrightarrow HClO_2 + HClO_3$.
(A) If both statement-1 and statement-2 are true and statement-2 is a correct explanation of statement-1.
(B) If both statement-1 and statement-2 are true and statement-3 is not a correct explanation of statement-1.
(C) If statement-1 is true but statement-2 is false.
(D) If statement-1 is false but statement-2 is true.

(b) Statement-1 : Bond energy of F_2 is greater than Cl_2.
Statement-2 : F-atom is smaller in size than Cl-atom.
(A) If both statement-1 and statement-2 are true and statement-2 is a correct explanation of statement-1.
(B) If both statement-1 and statement-2 are true and statement-3 is not a correct explanation of statement-1.
(C) If statement-1 is true but statement-2 is false.
(D) If statement-1 is false but statement-2 is true.

(c) Statement-1 : Chlorine and sulphur dioxide both are bleaching agents.
Statement-2 : The bleaching action of chlorine is performed through the process of oxidation.
(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1
(C) Statement-1 is True, Statement-2 is False
(D) Statement-1 is False, Statement-2 is True

(d) Statement-1 : Iodine stains are removed with the help of sodium thiosulphate solution.
Statement-2 : Sodium thiosulphate solution reacts with iodine to form colourless sodium iodide and sodium tetrathionate ($Na_2S_4O_6$).
(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1
(C) Statement-1 is True, Statement-2 is False
(D) Statement-1 is False, Statement-2 is True

Comprehension # (Q.10 to Q.12)

When sodium chloride is treated with concentrated sulphuric acid, a colourless gas, X, which fumes in moist air, is formed. When sodium iodide is treated in the same way a coloured vapour, Y, is produced.

If 90% phosphoric (v) acid is used instead of sulphuric acid a colourless gas is produced in each reaction.

A number of oxoanions of chlorine are known ; examples include ClO^-, ClO_3^- and ClO_4^-, ClO^- is formed when chlorine reacts with aqueous alkali.

10. Gases X and Y are respectively :

(A) Cl_2, I_2 (B) HCl, I_2 (C) HCl, HI (D) HClO, I_2

11. With 90% phosphoric acid (H_3PO_4), colourless gases formed are :

(A) HCl, HI (B) Cl_2, I_2 (C) HCl, I_2 (D) Cl_2, HI

12. Behaviour of H_2SO_4 and H_3PO_4 is different towards NaI because :

(A) H_2SO_4 is stronger acid than H_3PO_4

(B) H_2SO_4 is a strong oxidising agent and oxidises colourless gas to coloured vapour Y

(C) H_3PO_4 is tribasic acid

(D) H_2SO_4 is a dibasic acid

13. Give an example of oxidation of one halide by another halogen. Explain the feasibility of reaction.

14.

Integer Answer Type

This section contains 2 questions. The answer to each of the questions is a single digit integer, ranging from 0 to 9.

(i) How many Si–O–Si bridge are presnt in wollastonite molecule ?

(ii) In Cl_2O_7, the Cl—O bonds showing double bond character are.

PHYSICAL / INORGANIC CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 40

Total Marks : 47

Max. Time : 52 min.

Topic : p-block elements (Halogens and Noble gas)

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.5	(3 marks, 3 min.)	[15, 15]
Comprehension ('–1' negative marking) Q.6 to Q.8	(3 marks, 3 min.)	[9, 9]
Subjective Questions ('–1' negative marking) Q.9	(4 marks, 5 min.)	[4, 5]
Match the Following (no negative marking) Q.10 to Q.11	(8 marks, 10 min.)	[16, 20]
Short Subjective Questions ('–1' negative marking) Q.12	(3 marks, 3 min.)	[3, 3]

1. **(a)** F_2 is formed by reacting K_2MnF_6 with

(A) SbF_5 (B) MnF_3 (C) $KSbF_6$ (D) MnF_5

(b) Which of the following product is formed, when dilute alkali reacts with fluorine ?

(A) HOF (B) OF_2 (C) O_2F_2 (D) O_2

2. **(a)** Which one is the anhydride of $HClO_4$

(A) Cl_2O (B) ClO_2 (C) Cl_2O_6 (D) Cl_2O_7

(b) When dry chlorine is passed through silver chlorate heated to 90°C, then which of the oxide of chlorine is obtained ?

(A) ClO_2 (B) Cl_2O (C) Cl_2O_3 (D) Cl_2OS

3. Which one of the following statements regarding helium is incorrect :

(A) It is used to produce and sustain powerful superconducting magnets

(B) It is used as a cryogenic agent for carrying out experiments at low temperatures

(C) It is used to fill gas balloons instead of hydrogen becuase it is lighter and non-inflammable

(D) It is used in gas-cooled nuclear reactors

4. **(a)** **S_1 :** Argon is used in arc welding of metals or alloys to provide an inert atmosphere.

S_2 : XeF_2, XeF_4 and XeF_6 are colourless crystalline solids and sublime readily at 298K.

S_3 : XeF_2, XeF_4 and XeF_6 are readily hydrolysed.

S_4 : Xenon fluorides react with fluoride ion acceptor to form cationic species and fluoride ion donors to form fluoro anions.

(A) FFFF (B) TFTF (C) TTTT (D) FTFT

(b) **S_1 :** XeO_3 is a colourless explosive solid and has a pyramidal molecular structure.

S_2 : XeF_2 is not a better oxidising agent.

S_3 : Xe, Kr and Ne all form clatherate compounds.

S_4 : Fluorine in dilute solution of sodium hydroxide disproportionates in fluoride and hypofluorite.

(A) TFFF (B) TFTF (C) TTTT (D) FTFT

5. **(a)** **Statement-1 :** Finely divided iron does not form ferric chloride with hydrochloric acid.

Statement-2 : Hydrochloric acid produces hydrogen gas with iron.

(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.

(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1

(C) Statement-1 is True, Statement-2 is False

(D) Statement-1 is False, Statement-2 is True

(b) Statement-1 : XeF_6 reacts with small quantities of water to form $XeOF_4$.
Statement-2 : XeF_6 reacts with glass and form $XeOF_4$.
(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1
(C) Statement-1 is True, Statement-2 is False
(D) Statement-1 is False, Statement-2 is True

(c) Statement-1 : Noble gases have positive electron gain enthalpy.
Statement-2 : Noble gases have highest value of ionization enthalpy.
(A) If both statement-1 and statement-2 are true and statement-2 is a correct explanation of statement-1.
(B) If both statement-1 and statement-2 are true and statement-3 is not a correct explanation of statement-1.
(C) If statement-1 is true but statement-2 is false.
(D) If statement-1 is false but statement-2 is true.

Comprehension # 1 (Q.6 to Q.8)

The chemical reactivity of noble gases involves the loss of electrons and hence it can form compounds with highly electronegative elements like F and O. Although Xe forms several fluorides, Xenon tetrafluoride is the most important among fluorides. The various compounds of xenon involve xenon in first second or third excited states.

6. The type of hybridisation and number of lone pair(s) of electrons of Xe in $XeOF_4$ respectively are :
(A) sp^3d and 1 (B) sp^3d and 2 (C) sp^3d^2 and 1 (D) sp^3d^2 and 2.

7. The type of hybridisation and shape of XeF_2 respectively are
(A) $sp^3d$and angular (B) sp^3d and pyramidal (C) sp^3d and linear (D) sp and linear

8. XeF_4 and XeF_6 are excepted to be
(A) oxidising (B) reducing (C) unreactive (D) strongly basic.

9. Complete the following reactions
(A) SiO_2 (s) + F_2 (g) $\longrightarrow$ (B) $Na_2S_2O_3 + H_2O + Cl_2 \longrightarrow$
(C) $I_2 + H_2O + Cl_2$ (excess) $\longrightarrow$ (D) $IO_3^- + HSO_3^- \longrightarrow$
(E) $KMnO_4 + HCl \longrightarrow$

10. **Match the following :**

Column-I	**Column-II**
(A) $XeF_4 + H_2O \longrightarrow$	(p) disproportionation
(B) $[HXeO_4]^- + 2OH^- \longrightarrow$	(q) one of the products is a gas which is paramagnetic
(C) $H_2O + F_2$ (2:2 by mole) $\longrightarrow$	(r) one of the products is used in light bulbs
(D) $NOCl + O_2 \longrightarrow$	(s) one of the products is corrosive to glass and is stored in wax-lined bottles.

11.

Column I	**Column II**
(A) XeF_6	(p) sp^3d hybridisation
(B) $XeOF_2$	(q) one lone pair
(C) $XeOF_4$	(r) sp^3d^2 hybridisation
(D) XeO_2F_2	(s) sp^3d^3 hybridisation
	(t) See-saw shape

12. Find the sum of average oxidation number of S in H_2SO_5 (peroxy monosulphuric acid) and $Na_2S_2O_3$ (sodium thiosulphate).

PHYSICAL / INORGANIC CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 41

Total Marks : 38

Max. Time : 40 min.

Topic : Solid State

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.10	(3 marks, 3 min.)	[30, 30]
Match the Following (no negative marking) Q.11	(8 marks, 10 min.)	[8, 10]

1. Column A describe nature of bonding and Column B the solid having that type of bonding :

A (Nature of bonding)	B (solid)
I. Van der Waals	**P.** Al, Cd
II. Ionic	**Q.** CO_2,H_2
III. Metallic	**R.** Si, diamond
II. Covalent	**S.** MgO, NaCl

Correct matching of A and B is in alternate :

	I	II	III	IV		I	II	III	IV
(A)	P	Q	R	S	(B)	Q	S	P	R
(C)	Q	P	R	S	(D)	S	P	Q	R

2. **(a)** The most unsymmetrical crystal system is:

(A) Cubic (B) Hexagonal (C) Triclinic (D) Orthorhombic

(b) The number of crystal systems known are :

(A) 7 (B) 8 (C) 6 (D) 4

3. **(a)** Tetragonal crystal system has the following unit cell dimensions:

(A) $a = b = c$ and $\alpha = \beta = \gamma = 90°$ (B) $a = b \neq c$ and $\alpha = \beta = \gamma = 90°$

(C) $a \neq b \neq c$ and $\alpha = \beta = \gamma = 90°$ (D) $a = b \neq c$ and $\alpha = \beta = 90°$, $\gamma = 120°$

(b) The lattice parameters of a given crystal are a = 5.62 Å, b = 7.41 Å and c = 9.48 Å. The three coordinate axes are mutually perpendicular to each other. The crystal is :

(A) tetragonal (B) orthorhombic (C) monoclinic (D) trigonal.

4. **(a)** Which of the following is not a crystal system ?

(A) Triclinic (B) Rhombohedral (C) Tetragonal (D) Isomorphous.

(b) The most unsymmetrical and the most symmetrical crystal systems based on lattice parameters (i.e., unit cell lengths and angles), are respectively represented by the examples

(A) $CuSO_4 . 5H_2O$, NaCl (B) Monoclinic sulphur, diamond

(C) rhombic sulphur, NaCl (D) diamond, NaCl

5. **(a)** The crystal system in which $a \neq b \neq c$ and the angles $\alpha \neq \beta \neq \gamma$ is

(A) Triclinic (B) monoclinic (C) hexagonal (D) cubic

(b) The unit cell parameters of a rhombohedral crystal are

(A) $a \neq b \neq c$, $\alpha = \beta = \gamma = 90°$ (B) $a = b = c$, $\alpha = \beta = \gamma \neq 90°$

(C) $a \neq b \neq c$, $\alpha \neq \beta \neq \gamma \neq 90°$ (D) $a = b \neq c$, $\alpha = \beta = \gamma = 90°$

6. **(a)** Three elements P, Q and R crystallize in a cubic solid lattice. The P atoms occupy the corners, Q atoms the cube centres and R atoms the edges. The formula of the compound is:

(A) PQR (B) PQR_2 (C) PQR_3 (D) PQ_3R.

(b) A compound alloy of gold and copper crystallises in a cubic lattice in which the gold atoms occupy the lattice points at the corner of a cube and the copper atoms occupy the centres of each of the cube faces. Hence compound alloy has formula :

(A) AuCu (B) Au_3Cu (C) Au_2Cu (D) $AuCu_3$

7. In a face centred cubic arrangement of A and B atoms whose A atoms are at the corner of the unit cell and B atoms at the face centres. One of the A atom Is missing from one corner in unit cell. The simplest formula of the compound is

(A) A_7B_3 (B) AB_3 (C) A_7B_{24} (D) A_2B_3

8. The compound AB crystallizes in cubic lattice in which both the elements have co-ordination number of eight. The crystal class is :

(A) simple cubic (B) face-centered cubic

(C) body-centered cubic (D) None of these.

9. **(a)** TiO_2 is well known example of

(A) Triclinic system (B) Tetragonal system

(C) Monoclinic system (D) None

(b) In the primitive cubic unit cell, the atoms are present at the :

(A) comers of the unit cell (B) centre of the unit cell

(C) centre of each face of the unit cell (D) one set of faces of the unit cell

10. **(a)** Which has no axis of rotation of symmetry ?

(A) Hexagonal (B) Orthorhombic (C) Cubic (D) Triclinic

(b) A compound is formed by elements A and B. This crystallises in the cubic structure where the A atoms are at the corners of the cube and B atoms are at the body centres. The simplest formula of the compound is :

(A) A_8B_4 (B) AB_6 (C) AB (D) A_6B

11. **Column-I** and **Column-II** contains four entries each. Entries of **Column-I** are to be matched with some entries of **Column-II**. One or more than one entries of **Column-I** may have the matching with the same entries of **Column-II**.

	Column-I (Bravais Lattice(s))		**Column-II [Crystal system]**
(A)	Primitive, face centered, body centered, end centered	(p)	Cubic
(B)	Primitive, face centered, body centered	(q)	Orthorhombic
(C)	Primitive, body centered	(r)	Hexagonal
(D)	Primitive only	(s)	Tetragonal

PHYSICAL / INORGANIC CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 42

Total Marks : 46

Max. Time : 50 min.

Topic : Solid State

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.9	(3 marks, 3 min.)	[27, 27]
Fill in the Blanks ('–1' negative marking) Q.10	(3 marks, 3 min.)	[3, 3]
Subjective Questions ('–1' negative marking) Q.11 to Q.14	(4 marks, 5 min.)	[16, 20]

1. The contribution to the until cell by in atom present at the edge centre is :

(A) 1/8 (B) 1/2 (C) 1/4 (D) 1

2. **(a)** In a face centred cubic lattice the number of nearest neighbours for a given lattice point are

(A) 6 (B) 8 (C) 12 (D) 14

(b) How many 'nearest' and 'next nearest' neighbours respectively does potassium have in b.c.c. lattice

(A) 8, 8 (B) 8, 6 (C) 6, 8 (D) 8, 2

3. A metal crystallizes in two cubic phases i.e., FCC and BCC whose unit cell lengths are 3.5Å and 3.0 Å respectively. The ratio of their densities is :

(A) 3.12 (B) 2.04 (C) 1.26 (D) 0.72

4. If a metal has a bcc crystal structure, the coordination number is 8, because :

(A) each atom touches four atoms in the layer above it, four in the layer below it and none in its own layer.

(B) each atom touches four atoms in the layer above it, four in the layer below it and one in its own layer.

(C) two atoms touch four atoms in the layer above them, four in the layer below them, and none in their own layer.

(D) each atom touches eight atoms in the layer above it, eight in the layer below it and none in its own layer.

5. A metal has face centered cubic arrangement. If length of the edge of the cell is x cm and M is its atomic mass, then density will be equal to (N_0 is Avogadro number):

(A) $[(M)/(X^3 \times N_0)]$ g cm^{-3} (B) $[(M \times N_0)(X^3)]$ g cm^{-3}

(C) $[(4M)/(X^3 \times N_0)]$ g cm^{-3} (D) $[(M)/(4X^3 \times N_0)]$ gm cm^{-3}

6. **(a)** In a ccp structure, the :

(A) first and third layers are repeated

(B) first and fourth layers are repeated

(C) second and fourth layers are repeated

(D) first, third and sixth layers are repeated.

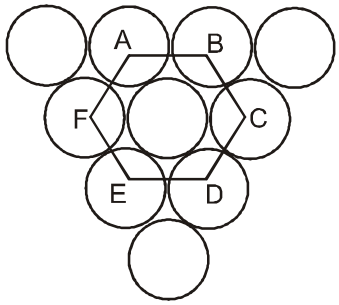
(b) The numbers of tetrahedral and octahedral holes in a ccp array of 100 atoms are respectively

(A) 200 and 100 (B) 100 and 200 (C) 200 and 200 (D) 100 and 100

7. In a face centred cubic arrangement of metallic atoms, what is the relative ratio of the sizes of tetrahedral and octahedral voids?

(A) 0.543 (B) 0.732 (C) 0.414 (D) 0.637

8. The percentage packing efficiency of the two dimensional arrangement of sphere for plane ABCDEF shown below is :



(A) 90.64% (B) 74.05% (C) 68.02% (D) 78.54%

9. A solid has a structure in which 'W' atoms are located at the corners of cubic lattice, 'O' atoms at the centre of edges and 'Na' atoms at the centre of the cube. The formula for the compound is :

(A) $NaWO_2$ (B) NaO_3W (C) Na_2WO_3 (D) $NaWO_4$

10. If the ratio of co-ordination no. P to that of Q be Y : Z, then the formula of the solid is _____.

11. A mineral having formula AB_2 crystallize in the cubic close packed lattice, with the A atoms occupying the lattice points. What is the co-ordination no. of A atoms? of the B atoms? what fraction of tetrahedral sites is occupied by B atoms.

12. Krypton crystallizes with four atoms per unit cell and unit cell is a cube. If the density of krypton is 3.19g/ml,what is the edge length of the unit cell? What is the minimum distance between the two nearest neighbours?

13. Potassium crystallizes in body centred cubic lattice with a unit cell length a = 5.2 Å

(A) What is the distance between nearest neighbours

(B) What is the distance between next nearest neighbours

(C) How many nearest neighbours does each K atom have

(D) How many next nearest neighbours does each K have

(E) What is calculated density of crystalline K.

14. Potassium crystallizes in a body centred cubic lattice. What is the approximate number of until cells in 4.0g of potassium? Atomic mass of potassium = 39.

PHYSICAL / INORGANIC CHEMISTRY

DPP
DAILY PRACTICE PROBLEMS

DPP No. 43

Total Marks : 42

Max. Time : 45 min.

Topic : Solid State

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.7	(3 marks, 3 min.)	[21, 21]
Subjective Questions ('–1' negative marking) Q.8 to Q.11	(4 marks, 5 min.)	[12, 15]
Comprehension ('–1' negative marking) Q.12 to Q.14	(3 marks, 3 min.)	[9, 9]

1. The density of KBr is 2.75 gm/cc length of the unit cell is 654 pm. K = 38, Br = 80, then what is true about the predicted nature of the solid.
(A) Solid has F.C.C. structure with co-ordination number = 6
(B) Solid has simple cubic structure with co-ordination number = 4
(C) Solid has F.C.C. structure with co-ordination numbers-1
(D) None of these

2. CsBr has b.c.c. structure with edge length 4.3 A. The shortest inter ionic distance in between Cs^+ and Br^- is:
(A) 3.72 (B) 1.86 (C) 7.44 (D) 4.3

3. The number of nearest neighbours and next near neighbours of a Na^+ ion in a crystal of NaCl are respectively
(A) $6Na^+$, $12Cl^-$ (B) $6Cl^-$, $6Na^+$ (C) $12Cl^-$, $6Na^+$ (D) $6Cl^-$, $12Na^+$

4. A solid has a b.c.c. structure. If the distance of closest approach between the two atoms is 1.73 Å. The edge belli length of the cell is ;
(A) $\sqrt{2}$ pm (B) $\sqrt{(3/2)}$ pm (C) 200 pm (D) 142.2 pm

5. The radius of metal atom can be expressed in terms of the length of a unit cell is :
(A) it is a/2 for simple cubic lattice (B) it is ($\sqrt{3}$a/4) for b.c.c. lattice
(C) it is (a/2$\sqrt{2}$) for F.C.C. lattice (D) All of the above.

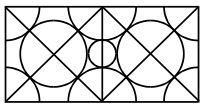
6. Fraction of the total volume occupied by atoms in a simple cube is
(A) $\pi/6$ (B) $\sqrt{3\pi}/8$ (C) $\sqrt{2\pi}/6$ (D) $\pi/3$

7. Lithium borohydride crystallizes in an orthorhombic system with 4 molecules per unit cell. The unit cell dimensions are a = 6.8 Å, b = 4.4 Å and c=7.2 Å. If the molar mass is 21.76, then the density of crystals is :
(A) 0.6708 g cm^{-2} (B) 1.6708 g cm^{-3} (C) 2.6708 g cm^{-3} (D) None of these.

8. Show by drawing a diagram that in the NaCl lattice each $Cl^{\ominus}$ ion occupies an octahedral void space provided by $Na^{\oplus}$ ions. How many $Cl^{\ominus}$ ions surround each $Cl^{\ominus}$ ion in the lattice?

9. A simple cubic lattice consists of eight identical spheres of radius R in contact, placed at the corners of a cube. What is the volume of the cubical box that will just enclose these eight spheres and what fraction of this volume is actually occupied by the spheres?

10. Copper has a face-centred cubic structure with a unit-cell edge length of 3.61Å. What is the size of the largest atom which could fit into the interstices of the copper lattice without distorting it?



(Hint.: Calculate the radius of the smallest circle in the figure)

BooSt YoUr PreViouS ConCept

Integer Answer Type

11. This section contains 2 questions. The answer to each of the questions is a single digit integer, ranging from 0 to 9.

(i) Potassium dichromate in alkaline solution, with 30% H_2O_2 produces K_3CrO_8. How many peroxide linkages are found in the structure of K_3CrO_8 ?

(ii) The sum of bond order and number of π-bond in C_2 molecule on the basis of molecular orbital theory is :

Comprehension # (Q.12 to Q.14)

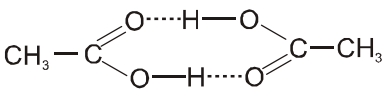
A hydrogen atom when bonded with highly electronegative atom such as fluorine, oxygen etc acquires a positive charge. In consequence of this, such a hydrogen atom exerts an electro static attraction on other highly electronegative atom like fluorine, nitrogen or oxygen. There is thus a dipole-dipole or dipole ion attraction, which has been given name, hydrogen bond. This may be represented as, $\overset{\delta-}{X}—\overset{\delta+}{H}\cdots\overset{\delta-}{Y}—A$

Where X and Y are strongly electronegative atoms of fluorine, oxygen and nitrogen.
The hydrogen bond, a sort of polar link, is formed as the attraction between H and Y outweighs the repulsion between X and Y. But Y must be a small electronegative atom such as fluorine, oxygen or nitrogen.
Such a bonding is significant only with hydrogen because of the minute size of the almost bare proton which enables Y to make a close approach to the positive charge.
Maximum energy of H bond = 45 KJ/mol.

12. Hydrogen bonding with chlorine is rarely observed because :
(A) Chlorine atom is not sufficiently electronegative to form hydrogen bond.
(B) The charge density of the chlorine atom is greater.
(C) The electron affinity of chlorine is highest among the halogen.
(D) The size of the chlorine is greater.

13. Which of the following statement is true regarding the existence of X – H – Y type bond -
(A) The given type of bond rarely occurs because a hydrogen atom can accomodate two electrons only in the 1s orbital. The use of 2s will involve much higher energy.
(B) The hydrogen atom has metal like properties. The valency of hydrogen is always limited to one. Thus X–H–Y type of bond never exists.
(C) X–H–Y type of bonding may occur in the electron deficient molecules. The formation of X–H–Y type of bond occur like the three centre two electron bond in the electron deficient molecules.
(D) Both (A) & (C) are correct.

14. Acetic acid CH_3COOH, can form dimer $(CH_3COOH)_2$ in gaseous state



At 25°C equilibrium constant for dimerisation is 10^3 atm and for dimerisation $\Delta S°$ is, –0.16 KJ/mole/K
The dimerisation reaction is $2CH_3COOH \rightleftharpoons (CH_3COOH)_2$
What is the H bond energy in dimer of acetic acid in gaseous state for per mole hydrogen bond.
(A) 64.769 KJ (B) 32.385 KJ (C) 22.562 KJ (D) 50.79 KJ

PHYSICAL / INORGANIC CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 44

Total Marks : 33

Max. Time : 34 min.

Topic : Solid State

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.3	(3 marks, 3 min.)	[9, 9]
Subjective Questions ('–1' negative marking) Q.4 to Q.8	(4 marks, 5 min.)	[20, 25]
Match the Following (no negative marking) Q.9	(8 marks, 10 min.)	[8, 10]

Integer Answer Type

Subjective Questions ('–1' negative marking) Q.10	(4 marks, 5 min.)	[4, 5]

BooSt YoUr PreViouS ConCept

Single choice Objective ('–1' negative marking) Q.11	(3 marks, 3 min.)	[3, 3]

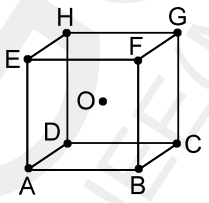
1. A metallic element has simple cubic arrangement. The number of unit cells in 100 g of this metal (edge length = 288 pm, density = 7.2 g cm^{-3}) are 5.8 x 10^{23}. The total number of atoms in 100 g of the metal is :

(A) 5.8 x 10^{24} (B) 5.8 x 10^{23} (C) 0.58 x 10^{23} (D) 58 x 10^{24}

2. An fcc lattice has lattice parameter a = 400 pm. Calculate the molar volume of the lattice including all the empty space:

(A) 10.8 mL (B) 96 mL (C) 8.6 mL (D) 9.6 mL

3. A body centred cubic arrangement is show :



O is the body centre ; A, B, C, D, ..., H are the corners. What is the magnitude of the angle AOB?

(A) 120° (B) 109° 28′ (C) 104° 31′ (D) 70° 32′

4. Radiis of A^+ and that of X^- and Y^- have been given as:

A^+ 1.00 pm

X^- 1.00 pm

Y^- 2.00 pm

Assign structure of AX and AY crystals and also determine volume of the unit cell of AZ and AY crystals.

5. A metallic element has cubic lattice. Each edge of the unit cell is 3.0Å. The density of the metal is 8.5 g/cc. How many unit cells will be present in 50 g of the metal?

6. A solid A^+B^- has NaCl type close packed structure. Compute the radius of the cation when the radius of anion is 250 pm.

Can a cation C^+ having a radius of 180 pm be accommodated into the tetrahedral site of the crystal A^+B^-? Give reason for your answer

7. At 1425ºC Fe crystallised in a body-centred cubic lattice whose edge length is 2.93 Å. Assuming the atoms to be packed spheres, calculate :
(a) the radius of the spheres,
(b) the distance between centres of neighbouring spheres,
(c) the number of atoms of Fe per unit lattice, and
(d) the total volume occupied by an atom of Fe.

8. Metallic gold crystallizes in the face, centered cubic lattice. The length of cubic unit cell is a = 4.07Å
(a) What is closest distance between gold atoms
(b) What is the distance between next nearest neighbours
(c) How many nearest neighbours does each gold atom have
(d) How many next nearest neighbours does each gold have
(e) What is calculated density of crystalline gold
(f) What is packing efficiency of gold ?

9.

Column - I	**Column - II**
(A) 74% occupancy of space	(p) cubic close packing of identical spheres.
(B) Coordination number = 6	(q) hexagonal close packing of identical spheres.
(C) 68% occupancy of space	(r) body centred cubic packing of identical spheres.
(D) Coordination number = 12	(s) simple cubic packing of identical spheres.
	(t) AB AB AB ..... type of close packing of identical spheres.

Integer Answer Type

10. This section contains 2 questions. The answer to each of the questions is a single digit integer, ranging from 0 to 9.

(i). The coordinate no. of barium ion Ba^{2+} in Ba F_2 is 8. What must be the C.N. of F^- ion.

(ii) The coordination number of each atom in the crystalline structure of Na is

BooSt YoUr PreViouS ConCept

11 **(a).** In the reaction, $xVO + yFe_2O_3 \longrightarrow FeO + V_2O_5$. What is the value of x and y respectively ?
(A) 1, 1 (B) 2, 3 (C) 3, 2 (D) None of these

(b). 20 mL of H_2O_2 solution is reacted with 80 mL of 0.05 M $KMnO_4$ in acidic medium then what is the volume strength of H_2O_2 ?
(A) 2.8 (B) 5.6 (C) 11.2 (D) None of these

PHYSICAL / INORGANIC CHEMISTRY

DPP
DAILY PRACTICE PROBLEMS

DPP No. 45

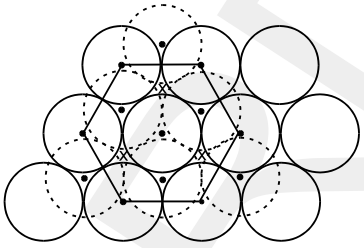
Total Marks : 50

Max. Time : 57 min.

Topic : Solid State

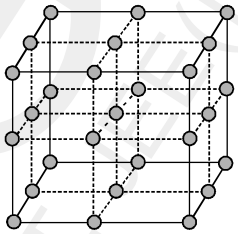
Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.2	(3 marks 3 min.)	[6, 6]
Multiple choice objective ('–1' negative marking) Q.3	(4 marks 4 min.)	[4, 4]
Comprehension ('–1' negative marking) Q.4 to Q.6	(3 marks 3 min.)	[9, 9]
Assertion and Reason (no negative marking) Q.7	(3 marks 3 min.)	[3, 3]
Subjective Questions ('–1' negative marking) Q.8 to Q.12	(4 marks 5 min.)	[20, 25]
Match the Following (no negative marking) Q. 13	(8 marks 10 min.)	[8, 10]

1. **(a)** In hexagonal close packing of sphere in three dimensions.



(A) In one unit cell there are 12 octahedral voids and all are completely inside the unit cell.
(B) In one unit cell there are six octahedral voids and all are completely inside the unit cell.
(C) In one unit cell there are six octahedral void and of which three are completely inside the unit cell and other three are partially inside the unit cell.
(D) In one unit cell there are 12 tetrahedral voids, all are completely inside the unit cell.

(b) The following diagram shows arrangement of lattice point with a = b = c and $\alpha = \beta = \gamma = 90^{\circ}$. Choose the correct options.

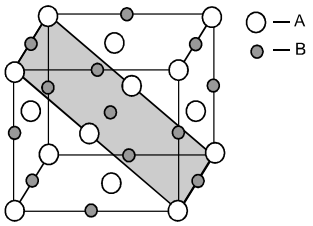


(A) The arrangement is SC with each lattice point surrounded by 6 nearest neighbours.
(B) The arrangement is SC with each lattice point surrounded by 8 nearest neighbours.
(C) The arrangement is FCC with each lattice point surrounded by 12 nearest neighbours.
(D) The arrangement in BCC with each lattice point surrounded by 8 nearest neighbours

2. **(a)** A crystal is made of particle X, Y & Z. X forms FCC packing, Y occupies all octahedral voids of X and Z occupies all tetrahedral voids of X, if all the particles along one body diagonal are removed then the formula of the crystal would be -

(A) XYZ_2 (B) X_2YZ_2 (C) $X_8Y_4Z_5$ (D) $X_5Y_4Z_8$

(b) A crystal is made of particles A and B. A forms FCC packing and B occupies all the octahedral voids. If all the particles along the plane as shown in figure are removed, then, the formula of the crystal would be :



(A) AB (B) A_5B_7
(C) A_7B_5 (D) None of these.

3.* In the fluorite structure if the radius ratio is $\left(\sqrt{\frac{3}{2}}-1\right)$, how many ions does each cation touch ?

(A) 4 anions (B) 12 cations (C) 8 anions (D) No cations

Comprehension # (Q.4 to Q.6)

Only those atoms which form four covalent bonds produce a repetitive three dimesional structure using only covalent bonds, e.g., diamond structure. The latter is based on a **FCC** lattice where lattice points are occupied by carbon atoms. Every atom in this structure is surrounded tetrahedrally by four others. Germanium, silicon and grey tin also crystallize in the same way as diamond. (Given : $N_A = 6 \times 10^{23}$, sin 54º44′ = 0.8164).

4. If edge length of the cube is 3.60Å, then radius of carbon atom is

(A) 0.78 Å (B) 0.92 Å (C) 0.64 Å (D) 0.35 Å.

5. If the edge length is 3.60Å, density of diamond crystal is :

(A) 3.92 gm/cc (B) 2.40 gm/cc (C) 3.37 gm/cc (D) 2.58 gm/cc.

6. Total number of diamond unit cells in 1.2 gm of diamond sample is :

(A) 6.0×10^{21} (B) 6.0×10^{22} (C) 7.5×10^{21} (D) 5.0×10^{22}.

7. **(a) Statement-1 :** In ZnS zinc blende structure Zn^{2+} form FCC while alternate tetrahedral voids are occupied by S^{2-}.

Statement-2 : Positions of Zn^{2+} and S^{2-} in zinc blende structure are similar.

(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.
(C) Statement-1 is True, Statement-2 is False.
(D) Statement-1 is False, Statement-2 is True.

(b) Statement-1 : In ZnS crystal, Zn^{2+} ions are placed at 50% of tetrahedral voids (at alternate positions) created by S^{2-} ion in c.c.p. lattice.

Statement-2 : Ratio of number of S^{2-} ion and number of tetrahedral voids is 2 : 1 where as ratio of number of S^{2-} ion and number of Zn^{2+} ion is 1 : 1 in zinc blende.

(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.
(C) Statement-1 is True, Statement-2 is False.
(D) Statement-1 is False, Statement-2 is True.

8. Lithium forms a b.c.c lattice. If the lattice constant is 3.50×10^{-10} m and the experimental density is 5.30×10^2 kg m^{-3} and, calculate the percentage occupancy of Li metal. (Li = 7)

9. In a cubic lattice, the closed packed structure of mixed oxides of the lattice is made up of oxide ions ; one eighth of the tetrahedral voides are occupied by divalent ions (A^{2+}) while one half of the octahedral voids are occupied by trivalent ions (B^{3+}). What is the formula of the oxides ?

10. A cubic unit cell contains manganese ions at the corners and fluoride ions at the centre of each edge.

(a) What is the empirical formula
(b) What is the C.N. of the Mn ion ?
(c) Calculate the edge length of the unit cell if the radius of a Mn ion is 0.65Å and that of F^- ion is 1.36Å.

11. Metallic gold crystallizes in the face-centred cubic lattice. The edge length of the cubic unit cell, a = 4. 070 Å. Calculate the closest distance between gold atoms and the density of gold. Atomic mass of Au = 197 amu.

12. A certain metal forms a face centered cubic lattice. The edge of unit cell is 4.07 Å and its density is 19.4 g/cm^3.

(i) What is the shortest distance between the metal atoms ?
(ii) How many nearest neighbours are there for each atom of the metal?
(iii) What is the molar mass of the metal?
(iv) What is the ratio of the volume occupied by the atoms of the total volume the unit cell?

13.

Column - I	**Column - II**
(A) 74% occupancy of space	(p) Coordination No. of cation in fluorite structure
(B) Coordination No -8	(q) Cubic close packing
(C) Ca^{2+} ion in CaF_2	(r) Hexagonal close packing
(D) Coordination No. – 12	(s) body centred cubic packing.

PHYSICAL / INORGANIC CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 46

Total Marks : 48

Max. Time : 51 min.

Topic : Solid State

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.3	(3 marks 3 min.)	[9, 9]
Multiple choice objective ('–1' negative marking) Q.4 to Q.6	(4 marks 4 min.)	[12, 12]
Comprehension ('–1' negative marking) Q.7 to Q.11	(3 marks 3 min.)	[12, 12]
Match the Following (no negative marking) Q.12	(8 marks 10 min.)	[8, 10]
Assertion and Reason (no negative marking) Q.13	(3 marks 3 min.)	[3, 3]

Integer Answer Type

Subjective Questions ('–1' negative marking) Q.14	(4 marks 5 min.)	[4, 5]

1. A hypothetical ionic compound AB (mol. wt. = 240 g/mole), having co-ordination number of anion equal to 6, has a closest anion-anion distance of $4\sqrt{2}$ Å. Determine the density of ionic compound AB in gm/cc.

(A) 6.24 (B) 3.12 (C) 1.56 (D) 0.78

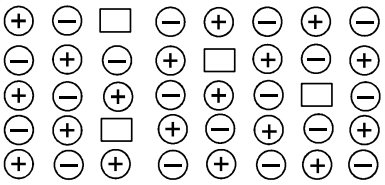
2. Which of the following is incorrect

(A) The defect is known as schottky defect

(B) Density of compound in the defect decreases

(C) NaCl(s) is example which generally shows this defect

(D) Stoichoimetry of compound will change slightly.



3. Analysis show that nickel oxide consist of nickel ion with 96% ions having d^8 configuration and 4% having d^7 configuration. Which amongst the following best represents the formula of the oxide.

(A) $Ni_{1.02}O_{1.00}$ (B) $Ni_{0.96}O_{1.00}$ (C) $Ni_{0.98}O_{0.98}$ (D) $Ni_{0.98}O_{1.00}$

4.* The correct statement(s) regarding defects solids is (are)

(A) Schottky defect is usually favoured by small difference in the sizes of cation and anion.

(B) Schottky defect lowers the density of solids.

(C) Compounds having F-centres are diamagnetic.

(D) Frenkel defect is a dislocation defect.

5.* Which of the following is/are incorrect for Rock salt crystal :

(A) If all Na^+ ions occupied at body centre are removed according to schottky defect then formula of resulting ionic compound would be Na_3Cl_4.

(B) If Na^+ ions would be present in alternate tetrahedral voids then formula would be Na_2Cl.

(C) If some Cl^- get displaced from the lattice in the presence of Na vapours then colour of compound will change.

(D) If interionic distance in crystal is 4.2 Å then edge length of unit cell becomes equal to 8.4 Å.

6.* Select the correct statement(s) related to hexagonal close packing of identical spheres in three dimensions:

(A) In one unit cell there are 12 octahedral voids and all are completely inside the unit cell

(B) In one unit cell there are six octahedral voids and all are completely inside the unit cell.

(C) In one unit cell there are six octahedral void and out of which three are completely inside the unit cell and other three are from contributions of octahedral voids which are partially inside the unit cell

(D) Co-ordination number of every sphere is 12 in hcp lattice.

Comprehension # (Q.7 to Q.11)

Sodium chloride structure is composed of Na^+ and Cl^-. Chloride ions are arranged in ccp while Na^+ ions are in octahedral holes. Each Na^+ is surrounded by six Cl^- ions while each Cl^- is surrounded by six Na^+. Cadamium oxide crystallizes in NaCl type of crystal lattice. The compound is however usually non stoichiometric with approximate formula $CdO_{0.95}$. The defect arise due to some cationic positions are occupied by neutral Cd-atom instead of Cd^{2+} ions and equivalent number of anion sites are vacant. (Mt.wt. of CdO = 128). Assume anion-anion contact.

7. What % of anion sites are vacant :

(A) 95% (B) 5% (C) 10% (D) 50%

8. If edge length of unit cell is 470 pm what would be the density of $CdO_{0.95}$ solid?

(A) $\frac{4\times128}{N_A\times(4.7)^3}$ gm/cc (B) $\frac{4\times128}{N_A\times(4.7)^3\times10^{-24}}$ gm/cc

(C) $\frac{4\times127.2}{N_A\times(4.7)^3}$ gm/cc (D) $\frac{4\times127.2}{N_A\times(4.7)^3\times10^{-24}}$ gm/cc

9. What will be the packing fraction of a NaCl type solid if ions along an axis connecting opposite face centres are absent :

(A) $\frac{\pi}{3\sqrt{2}}\left[\left(\frac{r^+}{r^-}\right)^3+1\right]$ (B) $\frac{\pi}{4\sqrt{2}}\left[\left(\frac{r^+}{r^-}\right)^3+1\right]$ (C) $\frac{\pi}{2\sqrt{2}}\left[\left(\frac{r^+}{r^-}\right)^3+1\right]$ (D) $\frac{4\pi}{3}\left[\left(\frac{r^+}{r^-}\right)^3+1\right]$

10. What will be the packing fraction of NaCl type solid if ions along an axis connecting opposite edge centres along one phase are absent :

(A) $\frac{7\pi}{24\sqrt{2}}\left[\left(\frac{r^+}{r^-}\right)^3+1\right]$ (B) $\frac{7\pi}{8\sqrt{2}}\left[\left(\frac{r^+}{r^-}\right)^3+1\right]$ (C) $\frac{7\pi}{12\sqrt{2}}\left[\left(\frac{r^+}{r^-}\right)^3+1\right]$ (D) $\frac{\pi}{12\sqrt{2}}\left[\left(\frac{r^+}{r^-}\right)^3+1\right]$

11. What will be the packing fraction when ions along opposite edge centres are missing :

(A) $\frac{\pi}{12\sqrt{2}}\left[\frac{5}{2}\left(\frac{r^+}{r^-}\right)^3+4\right]$ (B) $\frac{\pi}{12\sqrt{2}}\left[\frac{5}{2}\left(\frac{r^+}{r^-}\right)^3+2\right]$ (C) $\frac{7\pi}{24\sqrt{2}}\left[\left(\frac{r^+}{r^-}\right)^3+1\right]$ (D) $\frac{7\pi}{12\sqrt{2}}\left[\left(\frac{r^+}{r^-}\right)^3+1\right]$

12.

Column-I	**Column-II**
(A) Zinc blende structure	(p) Coordination number of cation and anion are equal.
(B) Rock salt structure	(q) $r_+ + r_- = \frac{a_{fcc}\sqrt{3}}{4}$
(C) Antifluorite structure	(r) Coordination number of cation < 6
(D) Cesium chloride structure	(s) $r_+ + r_- = \frac{a_{sc}\sqrt{3}}{2}$
	(t) Anion forms fcc lattice.

13. **Statement-1 :** In NaCl crystal each Na^+ ion is touching 6 Cl^- ions but these Cl^- ions do not touch each other.

Statement-2 : The radius ratio r_{Na^+}/r_{Cl^-} is greater than 0.414, required for exact fitting.

(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1
(C) Statement-1 is True, Statement-2 is False
(D) Statement-1 is False, Statement-2 is True

Integer Answer Type

14. This section contains 2 questions. The answer to each of the questions is a single digit integer, ranging from 0 to 9.

(i) In F.C.C. arrangement of identical spheres, distance between two nearest octahedral void is 8.51Å. The distance between two nearest tetrahedral voids would be ?

(ii) How many of the following ionic compounds have coordination number of either cation or anion equal to 6 or more : ZnS, KCl, K_2O, CsBr, NaBr, CaF_2

PHYSICAL / INORGANIC CHEMISTRY

DPP
DAILY PRACTICE PROBLEMS

DPP No. 47

Total Marks : 30

Max. Time : 30 min.

Topic : Chemical Kinetics

Type of Questions **M.M., Min.**
Single choice Objective ('–1' negative marking) Q.1 to Q.10 **(3 marks 3 min.)** **[30, 30]**

1. $2NO + 2H_2 \longrightarrow N_2 + 2H_2O$. The experimental rate law for above reaction is, Rate = k $[NO]^2$ $[H_2]$. When time is in minutes and the concentration is in moles/L, the units for k are

(A) $\frac{moles^3}{L^3 - min}$ (B) $\frac{moles}{L - min}$ (C) $\frac{moles^2}{L^2 - min}$ (D) $\frac{L^2}{moles^2 - min}$

2. The differential rate law equation for the elementary reaction $A + 2B \xrightarrow{K} 3C$, is :

(A) $-\frac{d[A]}{dt} = -\frac{d[B]}{dt} = \frac{d[C]}{dt} = k[A][B]^2$ (B) $-\frac{d[A]}{dt} = -\frac{1}{2}\frac{d[B]}{dt} = \frac{1}{3}\frac{d[C]}{dt} = k[A]^2[B]$

(C) $-\frac{d[A]}{dt} = -\frac{1}{2}\frac{d[B]}{dt} = \frac{1}{3}\frac{d[C]}{dt} = k[A][B]^2$ (D) None of these

3. For the reaction $2A \longrightarrow B + 3C$; if $-\frac{d[A]}{dt} = k_1[A]^2$; $\frac{d[B]}{dt} = k_2[A]^2$; $\frac{d[C]}{dt} = k_3[A]^2$, the correct relation between k_1, k_2, and k_3 is :

(A) $k_1 = k_2 = k_3$ (B) $2k_1 = k_2 = 3k_3$ (C) $4k_1 = k_2 = 3k_3$ (D) $\frac{k_1}{2} = k_2 = \frac{k_3}{3}$

4. Which of the following statement is incorrect?
(A) Unit of rate of disappearance is Ms^{-1} (B) Unit of rate of reaction is Ms^{-1}
(C) Unit of rate constant k is depend on order (D) Unit of k for first order reaction is Ms^{-1}

5. The rate expression for reaction A (g) + B(g) → C(g) is **rate = k$[A]^{1/2}$ $[B]^2$.** What change in rate if initial concentration of A and B increase by factor 4 and 2 respectively ?
(A) 4 (B) 6 (C) 8 (D) None of these

6. Reaction A → B follows second order kinetics. Doubling the concentration of A will increase the rate of formation of B by a factor of :
(A) 1/4 (B) 1/2 (C) 2 (D) 4

7. For the reaction $2NO_2 \longrightarrow N_2O_2 + O_2$, rate expression is as follows

$-\frac{d[NO_2]}{dt} = K[NO_2]^n$, where $K = 3 \times 10^{-3}$ mol^{-1} L sec^{-1}. If the rate of formation of oxygen is 1.5×10^{-4} mol L^{-1} sec^{-1}, then the molar concentration of NO_2 in mole L^{-1} is
(A) 1.5×10^{-4} (B) 0.0151 (C) 0.214 (D) 0.316

8. Sodium (Na = 23) crystallizes in bcc arrangement with the interfacial separation between the atoms at the edge 53.6 pm. The density of sodium crystal is:
(A) 2.07 g/cc (B) 2.46 g/cc (C) 1.19 g/cc (D) none of these

9. $TlAl(SO_4)_2 \cdot xH_2O$ is bcc with 'a' = 1.22 nm. If the density of the solid is 2.32 g/cc, then the value of x is (Given: $N_A = 6 \times 10^{23}$; at. wt. : Tl = 204, Al = 27, S = 32).
(A) 2 (B) 4 (C) 47 (D) 70

10. An atomic solid crystallizes in a body centre cubic lattice and the inner surface of the atoms at the adjacent corner are separated by 60.3 pm. If the atomic weight of A is 48, then density of the solid, is nearly:
(A) 2.7 g/cc (B) 5.07 g/cc (C) 3.5 g/cc (D) 1.75 g/cc

PHYSICAL / INORGANIC CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 48

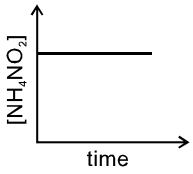
Total Marks : 35

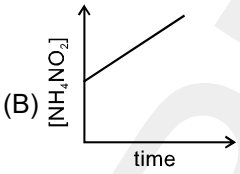
Max. Time : 35 min.

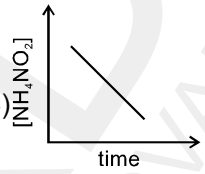
Topic : Chemical Kinetics

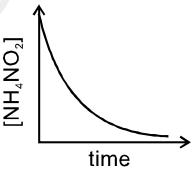
Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.9	(3 marks 3 min.)	[27, 27]
Multiple choice objective ('–1' negative marking) Q.10 to Q.11	(4 marks 4 min.)	[8, 8]

1. Decomposition of NH_4NO_2 (aq) into N_2 (g) and $2H_2O$ (ℓ) is first order reaction. Which of the following graph is correct?

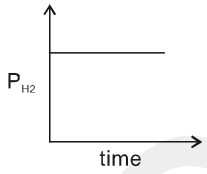
(A) 

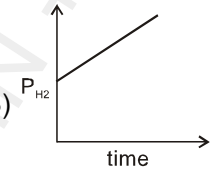
(B) 

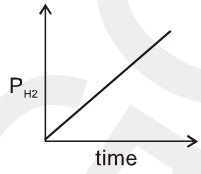
(C) 

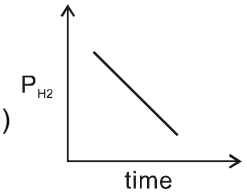
(D) 

2. Decomposition of HI (g) on Gold surface is zero order reaction. Initially, few moles of H_2 are present in container then which of the following graph is correct ?

(A) 

(B) 

(C) 

(D) 

3. A first order reaction is 75% completed in 100 minutes. How long time will it take for it's 87.5% completion?

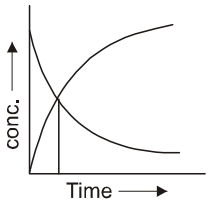
(A) 125 min (B) 150 min (C) 175 min (D) 200 min

4. For the zero order reaction A → B + C; initial concentration of A is 0.1 M. If A = 0.08 M after 10 minutes, then it's half-life and completion time are respectively :

(A) 10 min; 20 min (B) 2×10^{-3} min, 10^{-3} min

(C) 25 min, 50 min (D) 250 min, 500 min.

5. The accompanying figure depicts the change in concentration of species A and B for the reaction A ⟶ B, as a function of time, the point of intersection of the two curves represents



(A) $t_{1/2}$ (B) $t_{3/4}$

(C) $t_{2/3}$ (D) data insufficient to predict

6. For the reaction A $\longrightarrow$ products, the graph of the fraction of A remaining as a function of time (x–axis) is a straight line with –ve slope. The order of the reaction is therefore

(A) 1 (B) 2 (C) zero (D) –1

7. In the following reaction A $\rightarrow$ B + C, rate constant is 0.001 Ms^{-1}. If we start with 1 M of A then, conc. of A and B after 10 minutes are respectively :

(A) 0.5 M, 0.5 M (B) 0.6 M, 0.4 M (C) 0.4 M, 0.6 M (D) none of these

8. The rate law for the dimerisation of NO_2 into N_2O_4 is $-\frac{d[NO_2]}{dt} = k[NO_2]^2$.

Which of the following changes will change the value of the specific rate constant k ?

(A) Doubling the total pressure (B) Decreasing the pressure

(C) Changing the volume of the flask (D) Changing the temperature.

9. For an elementary reaction aA $\longrightarrow$ product, the graph plotted between $\log\left[\frac{-d[A]}{dt}\right]$ vs. time gives a straight line with intercept equal to 0.6 and showing an angle of 45° with origin, then :

(A) rate constant = 3.98 $time^{-1}$ and a = 1 (B) rate constant = 3.98 mol L^{-1} t^{-1} and a = 1

(C) rate constant = 1.99 $time^{-1}$ and a = 1 (D) rate constant = 1.99 mol^{-1} L^{1} t^{-1} and a = 2

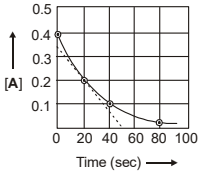
10. A certain reaction **A $\rightarrow$ B** follows the given concentration (Molarity)–time graph. Which of the following statement(s) is/are true ?

(A) The reaction is second order with respect to **A**

(B) The rate for this reaction at 20 second will be 7×10^{-3} M s^{-1}

(C) The rate for this reaction at 80 second will be 1.75×10^{-3} M s^{-1}

(D) The [B] will be 0.35 M at t = 60 second



11. For the reaction 2A + B $\longrightarrow$ C with the rate law $\frac{d[C]}{dt} = k[A]^1[B]^{-1}$ and started with A and B in stoichiometric proportion. Which is/are true?

(A) unit of k is Ms^{-1} (B) [A], [B] and [C] all will be linear functions of time

(C) [C] = 2kt (D) [C] = kt

PHYSICAL / INORGANIC CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 49

Total Marks : 35

Max. Time : 37 min.

Topic : Chemical Kinetics

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.9	(3 marks 3 min.)	[27, 27]
Match the Following (no negative marking) Q. 10	(8 marks 10 min.)	[8, 10]

1. A reaction, which is second order, has a rate constant of 0.002 L mol^{-1} s^{-1}. If the initial conc. of the reactant is 0.2 M. how long will it take for the concentration to become 0.0400 M ?

(A) 1000 s (B) 400 s (C) 200 s (D) 10,000 s

2. The decompostion NH_3 gas on a heated tungsten surface gave the following results :

Initial pressure (mm)	65	105	y	185
Half-life (sec)	290	x	670	820

Calculate approximately the values of x and y.

(A) x = 410 sec (B) x = 467 sec (C) x = 490 sec (D) x = 430 sec

3. A certain reaction obeys the three-half power law for its order. What function of the concentration may be plotted on the Y-axis against, t on the X-axis to get a linear plot ?

(A) $C^{\frac{1}{2}}$ vs t (B) $\frac{1}{C}$ vs t (C) C^{-2} vs t (D) $C^{-\frac{1}{2}}$ vs t

4. For the reaction A $\longrightarrow$ C + D, the initial concentration of A is 0.01 M. After 100 sec, the concentration of A is 0.001M. The rate constant of the reaction has the numerical value of 9.0. What is the unit of the reaction rate constant ?

(A) $M^{-1}s^{-1}$ (B) Ms^{-1} (C) s^{-1} (D) $M^{-1.5}$ s^{-1}

5. The half lives of decomposition of gaseous CH_3CHO at constant temperature but at initial pressure of 364 mm and 170 mm Hg were 410 second and 880 second respectively. Hence order of reaction is

(A) 2 (B) 3 (C) 1.5 (D) 1

6. If the fermentation of sugar in an enzymatic solution, that is 0.12 M , the concentration of the sugar is reduced to 0.06 M in 10 h and to 0.03 M in 20 h. What is the order of the reaction ?

(A) 1 (B) 2 (C) 3 (D) 0

7. The order of a reaction A $\rightarrow$ product in which half the reagent is reacted is half an hour, three quarters in one hour and seven - eighth in one and half hours is

(A) 2 (B) 1 (C) zero (D) – 1

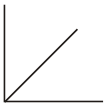
8. In a first order reaction, the concentrations of the reactant, 30 minutes and 40 minutes after the start are C_1 and C_2 (in moles/litre) respectively. What was C_0, intial concentration ?

(A) $C_0 = \left[\frac{C_1^3}{C_2^4}\right]$ (B) $C_0 = \left[\frac{C_1}{C_2}\right]^4$ (C) $C_0 = \left[\frac{C_1}{C_2}\right]^3$ (D) $C_0 = \left[\frac{C_1^4}{C_2^3}\right]$

9. Rate constant k = 2.303 min^{-1} for a particular reaction. The initial concentration of the reaction is 1 mol/litre then, rate of reaction after 1 minute is :

(A) 2.303 M min^{-1} (B) 0.2303 M min^{-1} (C) 0.1 M min^{-1} (D) none of these

10. Match the following for a 1st order reaction A $\longrightarrow$ products with time on the x axis.

Column I	**Column II**
(A) [A] v/s time	(p) 
(B) $\frac{-d[A]}{dt}$ v/s [A]	(q) 
(C) $\frac{-d[A]}{dt}$ v/s time	(r) 
(D) log [A] v/s time	(s) 

PHYSICAL / INORGANIC CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 50

Total Marks : 47

Max. Time : 52 min.

Topic : Chemical Kinetics

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.9	(3 marks 3 min.)	[27, 27]
Subjective Questions ('–1' negative marking) Q.10 to Q.14	(4 marks 5 min.)	[20, 25]

1. For a 1st order reaction (gaseous) (cont. V, T)

$a\,A \longrightarrow (b-1)\,B + 1\,C$ (with b > a), the pressure of the system rose by $50\left(\frac{b}{a}-1\right)$ % in a time of 10 min. The half life of the reaction is therefore.

(A) 10 min (B) 20 min (C) 30 min (D) 40 min

2. Two first order reaction have half-lives in the ratio 8 : 1. Calculate the ratio of time intervals $t_1 : t_2$. The time t_1 and t_2 are the time period for $\left(\frac{1}{4}\right)^{th}$ completion of 1st reaction and $\left(\frac{3}{4}\right)^{th}$ 2nd completion rxn repectively.

(A) 1 : 0.301 (B) 0.125 : 0.602 (C) 1 : 0.62 (D) none of these

3. Under the same reaction conditions, initial concentration of 1.386 mol dm^{-3} of a substance becomes half in 40 seconds and 20 seconds through first order and zero order kinetics, respectively. Ratio $\left(\frac{k_1}{k_0}\right)$ of the rate constant for first order (k_1) and zero order (k_0) of the reaction is.

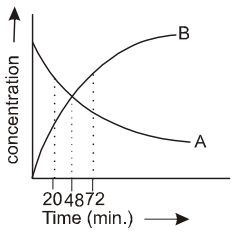
(A) 0.5 $mol^{-1}\,dm^3$ (B) 1.0 mol dm^{-3} (C) 1.5 mol dm^{-3} (D) 2.0 $mol^{-1}\,dm^3$

4. For a first order reaction, the ratio of time for the completion of 99.9% and half of the reaction is

(A) 8 (B) 10 (C) 9 (D) 12

5. For a first order reaction, $nA \longrightarrow B$ whose concentration vs time curve is as shown in the figure. If half life for the reaction is 24 minutes . Find out the value of n.

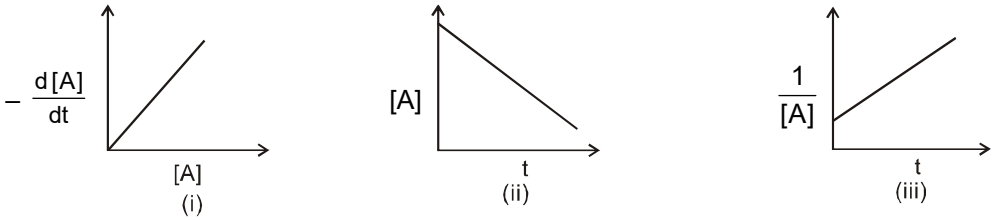
(A) 1
(B) 2
(C) 3
(D) 4



6. Number of natural life times (T_{av}) required for a first-order reaction to achieve 99.9% level of completion is:

(A) 2.3 (B) 6.9 (C) 9.2 (D) 0.105

7. Consider the plots for the types of reaction $nA \rightarrow B + C$



These plots respectively correspond to the reaction orders :

(A) 0, 2, 1 (B) 0, 1, 2 (C) 1, 1, 2, (D) 1, 0, 2

8. Reaction A + B → C + D follows rate law, $r = k[A]^{1/2}[B]^{1/2}$ starting with 1 M of A and B each. What is the time taken for concentration of A become 0.1 M ?
Given $k = 2.303 \times 10^{-2}$ sec^{-1}.
(A) 10 sec (B) 100 sec (C) 1000 sec (D) 434 sec

9. At high temperature (504ºC) dimethyl ether decomposes as per the reaction

$(CH_3)_2O(g) \longrightarrow CH_4(g) + H_2(g) + CO(g)$

time (sec.) :	0	400	1200	∞
p_{total} (mm) :	312	412	560	935

Determine the half life of the reaction during this run. ($\ln\left(\frac{623}{523}\right) = 0.175$, $\ln\left(\frac{623}{375}\right) = 0.5076$)

(A) 1311 sec (B) 1411 sec (C) 1511 sec (D) 1611 sec

10. A reaction between A and B is represented stoichiometrically by A + B → C. Observations on the rate of this reaction are obtained in three separate experiments as follows :

	initial concentrations			**final concentration**
	$[A]_0$, M	$[B]_0$, M	duration of experiment Δt, hr	$[A]_f$, M
(1)	0.1000	1.0	0.5	0.0975
(2)	0.1000	2.0	0.5	0.0900
(3)	0.0500	1.0	2.0	0.0450

What is the order of the reaction with respect to each reactant and what is the value of the rate constant?

11. The gas phase decomposition of NOBr is second-order in [NOBr], with $k = 0.810\ M^{-1}\ s^{-1}$ at 10ºC. We start with 4.00×10^{-3} M NOBr. in a flask at 10ºC. How many seconds does it take to use up 1.50×10^{-3} M NOBr?

$2NOBr(g) \longrightarrow 2NO(g) + Br_2(g)$; $Rate = k[NOBr]^2$

12. Let there be as first-order reaction of the type, $A \longrightarrow B + C$. Let us assume that all the three species are gases. We are required to calculate the value of rate constant based on the following data.

Time	0	T	∞
Partial pressure of A	P_0	P_t	–

13. Let there be a first order reaction, $A \longrightarrow B + C$. Let us assume all three are gases. We are required to calculate the value of rate constant based on the following data

Time	0	t	∞
Total pressure	P_0	P_t	–

Calculate the expression of rate constant.

14. $A(g) \longrightarrow B(g) + C(g)$

Time	0	t	∞
Total pressure of B + C	0	P_t	P_∞

Calculate the expression of rate constant.

PHYSICAL / INORGANIC CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 51

Total Marks : 47

Max. Time : 54 min.

Topic : Chemical Kinetics

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.5	(3 marks 3 min.)	[15, 15]
Multiple choice objective ('–1' negative marking) Q.6	(4 marks 4 min.)	[4, 4]
Subjective Questions ('–1' negative marking) Q.7 to Q.13	(4 marks 5 min.)	[28, 35]

1. The decomposition of N_2O_5 in chloroform was followed by measuring the volume of O_2 gas evolved : $2N_2O_5\ (CCl_4) \rightarrow 2N_2O_4\ (CCl_4) + O_2\ (g)$. The maximum volume of O_2 gas obtained was 100 cm^3. In 500 minutes, 90 cm^3 of O_2 were evolved. The first order rate constant (in min^{-1}) for the disappearance of N_2O_5 is :

(A) $\frac{2.303}{500}$ (B) $\frac{2.303}{500}\log\frac{100}{90}$ (C) $\frac{2.303}{500}\log\frac{90}{100}$ (D) $\frac{100}{10\times500}$

2. The reaction A(g) + 2B(g) $\rightarrow$ C(g) is an elementary reaction. In an experiment involving this reaction, the initial partial pressures of A and B are P_A = 0.40 atm and P_B = 1.0 atm respectively. When pressure of C becomes 0.3 atm in the reaction the rate of the reaction relative to the initial rate is :

(A) $\frac{1}{12}$ (B) $\frac{1}{50}$ (C) $\frac{1}{25}$ (D) none of these

3. A reaction is catalysed by H^+ ion;and in the rate law the dependence of rate is of first order with respect to the concentration of H^+ ions, in presence of HA rate constant is 2×10^{-3} min^{-1} and in presence of HB rate constant is 1×10^{-3} min^{-1}. HA and HB (both strong acids) have relative strength as :

(A) 0.5 (B) 0.002 (C) 0.001 (D) 2

4. The gaseous decomposition reaction, A(g) $\longrightarrow$ 2B(g) + C(g) is observed to first order over the excess of liquid water at 25ºC. It is found that after 10 minutes the total pressure of system is 188 torr and after very long time it is 388 torr. The rate constant of the reaction (in hr^{-1}) is : [Given : vapour pressure of H_2O at 25º is 28 torr (ln 2 = 0.7, ln 3 = 1.1, ln 10 = 2.3)]

(A) 0.02 (B) 1.2 (C) 0.2 (D) none of these.

5. The hydrolysis of cane sugar was studied using an optical polarimeter and the following readings were taken:

time (min.) :	0	84 min	∞
observed rotation (degrees) :	50	20	–10

When was the mixture optically inactive? (log 2 = 0.3, log 3 = 0.48)

(A) 118 min (B) 218 min (C) 318 min (D) 418 min

6. For a certain reaction A $\longrightarrow$ products, the $t_{½}$ as a function of $[A]_0$ is given as below :

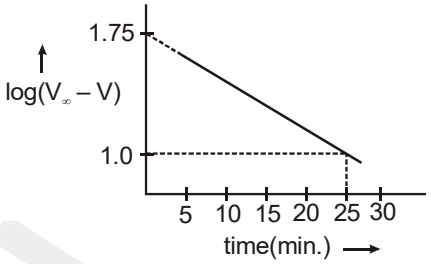
$[A]_0$ (M) :	0.1	0.025
$t_{1/2}$ (min.) :	100	50

Which of the following is/are true ?

(A) The order is $\frac{1}{2}$ (B) $t_{½}$ would be $100\sqrt{10}$ min for $[A]_0$ = 1 M

(C) The order is 1 (D) $t_{½}$ would be 100 min for $[A]_0$ = 1 M

7. The plot of log $(V_\infty - V)$ versus t (where V is the volume of nitrogen collected under constant temperature and pressure conditions) for the decomposition of $C_6H_5N_2Cl$ is given at 50°C with an amount of $C_6H_5N_2Cl$ equivalent to 58.3 cc N_2.



Calculate the rate constant for the reaction in hr^{-1} expressing your answer in a single significant digit.

8. Now, let us assume a first-order reaction, $A \longrightarrow B + C$, such that A, B and C, such that A, B and C are in solution. At time zero, a small amount of the solution is taken, cooled (to stop the reaction from proceeding) and titrated with a suitable reagent. Let us assume that the reagent reacts only with A and not with B and C. The same process is repeated at time t.

Time	0	t
Volume of reagent	V_0	V_t

Calculate the expression of rate constant.

9. $A(soln.) \longrightarrow B(soln.) + C(soln.)$
Reagent reacts with all species A, B and C.

Time	0	t	∞
Volume of reagent	V_0	V_t	V_∞

The n factor of A, B and C with the reagent and that of the reagent with A, B and C are not known. Calculate the expression of rate constant.

10. $A(soln.) \xrightarrow{D(soln.)} B(soln.) + C(soln.)$
D is catalyst present in the solution whose n-factor is not known. Catalyst have a constant concentration throughout the reaction.

Time	0	t	∞
Volume of reagent	V_0	V_t	V_∞

Calculate the expression of rate constant.

11. Now, let us assume that A, B and C are optically active compounds, which rotate the plane polarized light in the clockwise or anticlockwise direction.
$A(soln.) \longrightarrow B(soln.) + C(soln.)$

Time	0	t	∞
Total rotation in degrees	r_0	r_t	r_∞

Calculate the expression of rate constant.

12. For the reaction, $2NO + H_2 \longrightarrow N_2O + H_2O$ the value of -dp/dt was found to be 1.50 Torr s^{-1} for a pressure of 359 Torr of NO and 0.25 Torr s^{-1} for a pressure of 152 Torr, the pressure of H_2 being constant. On the other hand, when the pressure of NO was kept constant, –dp/dt was 1.60 Torr s^{-1} for a hydrogen pressure of 289 Torr and 0.79 Torr s^{-1} for a pressure of 147 Torr. Determine the order of the reaction.

13. Decomposition of N_2O_5 follows first-order kinetics, $2N_2O_5(g) \longrightarrow 4NO_2(g) + O_2(g)$. If pressure of the system at time, t and ∞ are P_t and P_∞ respectively, find the expression of rate contant (k).

PHYSICAL / INORGANIC CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 52

Total Marks : 31

Max. Time : 32 min.

Topic : Chemical Kinetics

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.9	(3 marks 3 min.)	[27, 27]
Subjective Questions ('–1' negative marking) Q.5 to Q.10	(4 marks 5 min.)	[4, 5]

1. For a certain reaction the variation of the rate constant with temperature is given by the equation

$$\ln k_t = \ln k_0 + 0.0693\, t (t \geq 0°C)$$

The value of the temperature coefficient of the reaction rate is, therefore

(A) 0.1 (B) 1.0 (C) 10 (D) 2

2. The activation energies of two reactions are E_a and E_a' with $E_a > E_a'$. If temperature of the reacting systems is increased from T_1 to T_2, predict which of the following alternatives is correct?
(Where k_1' and k_2' are rate constant at higher temperature).

(A) $\frac{k_1'}{k_1} = \frac{k_2'}{k_2}$ (B) $\frac{k_1'}{k_1} > \frac{k_2'}{k_2}$ (C) $\frac{k_1'}{k_1} < \frac{k_2'}{k_2}$ (D) $\frac{k_1'}{k_1} < 2\frac{k_2'}{k_2}$

3. Two reactions A $\longrightarrow$ products and B $\longrightarrow$ products have rate constants k_A and k_B at temperature, T and activation energies E_A and E_B respectively. If $k_A > k_B$ and $E_A < E_B$ and assuming that 'A', pre-exponential factor for both the reactions is same, then.

(A) at higher temperatures k_B will be greater than k_A

(B) at lower temperatures k_A and k_B will be close to each other in magnitude

(C) as temperature rises k_A and k_B will be close to each other in magnitude.

(D) at lower temperature $k_B > k_A$

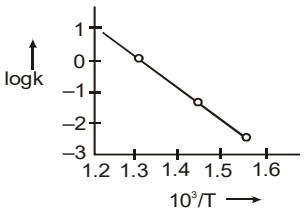
4. On introduction a catalyst at 500 K, the rate of a first order reaction increases by 1.718 times. If the activation energy in the presence of a catalyst is 4.15 kJ mol^{-1}. Then, the E_a in absence of catalyst is (R = 8.3 MKS)

(A) 4.15 kJ (B) 2.08 kJ (C) 2.718 kJ (D) 8.3 kJ.

5. What percentage fraction of the molecule will cross over the energy barrier at 1000 K temperature for 18.424 KJ activation energy (R = 8J mol^{-1} K^{-1})

(A) 10% (B) 20% (C) 90% (D) 80%

6. For the decomposition of HI the following logarithmic plot is shown : [R = 1.98 cal/mol-K]



The activation energy of the reaction is about

(A) 45600 cal (B) 13500 cal

(C) 24600 cal (D) 32300 cal

7. Decomposition of A follows first order kinetics by the following equation. $4A(g) \longrightarrow B(g) + 2C(g)$

If initially, total pressure was 800 mm of Hg and after 10 minutes it is found to be 650 mm of Hg. What is half-life of A ? (Assume only A is present initially)

(A) 10 mins (B) 5 mins (C) 7.5 mins (D) 15 mins

8. In a hypothetical reaction, $A(aq) \rightleftharpoons 2B(aq) + C(aq)$ (1^{st} order decomposition)

'A' is optically active (dextro-rototory) while 'B' and 'C' are optically inactive but 'B' takes part in a titration reaction (fast reaction) with H_2O_2. Hence, the progress of reaction can be monitored by measuring rotation of plane polarised light or by measuring volume of H_2O_2 consumed in titration.

In an experiment the optical rotation was found to be $\theta = 40°$ at t = 20 min and $\theta = 10°$ at t = 50 min. from start of the reaction. If the progress would have been monitored by titration method, volume of H_2O_2 consumed at t = 15 min. (from start) is 40 ml then volume of H_2O_2 consumed at t = 60 min will be:

(A) 60 ml (B) 75 ml (C) 52.5 ml (D) 90 ml

9. **S_1 :** The frequency factor has the same unit as the rate constant, k

S_2 : A plot ℓn rate vs ℓn C for the nth order reaction gives a straight line with slope –n and intercept k_n

S_3 : The order of a reaction A $\rightarrow$ product in which half the reagent is reacted in half an hour, three quarters in one hour and seven - eighth in one and half hours must be 1(unity).

S_4 : The unit of rate constant for a second order reaction will be $M^{-1}s^{-1}$.(M is representing the molarity of solution)

(A) T F T T (B) T T T T (C) F F T T (D) T F F T

10. The activation energy of $H_2 + I_2 \rightarrow 2HI$, in equilibrium, for forward reaction is 167 kJ mol^{-1} where as for the reverse reaction is 180 kJ mol^{-1}. The presence of catalyst lowers the activation energy by 80 kJmol^{-1}. Assuming that the reactions are made at 27ºC and the frequency factor for forward and backward reactions are 4×10^{-4} and 2×10^{-3} respectively. Calculate K_C .

Given : $e^{13/8.314 \times 0.3} = 183$.

PHYSICAL / INORGANIC CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 53

Total Marks : 36

Max. Time : 40 min.

Topic : Chemical Kinetics

Type of Questions		**M.M., Min.**
Single choice Objective ('–1' negative marking) Q.1 to Q.4	**(3 marks 3 min.)**	**[12, 12]**
Multiple choice objective ('–1' negative marking) Q.5 to Q.6	**(4 marks 4 min.)**	**[8, 8]**
Subjective Questions ('–1' negative marking) Q.7 to Q.10	**(4 marks 5 min.)**	**[16, 20]**

1. For a two step reaction

$A \underset{K_2}{\overset{K_1}{\rightleftharpoons}} R + B$ $\qquad$ $R + C \xrightarrow{K_3}$ Products

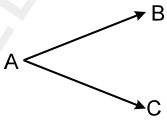
(where, R is a reactive intermediate, whose concentration is maintained at some low steady state throughout the reaction) the rate law expression will be

(A) $\frac{dx}{dt} = \frac{k_1[A]}{1+\frac{k_2[B]}{k_3[C]}}$ (B) $\frac{dx}{dt} = k_1[A]$ (C) $\frac{dx}{dt} = k_1[R][C]$ (D) $\frac{dx}{dt} = k_1[A][B][R]$

2. For $2A \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} B + 3C$, $2C \xrightarrow{k_2} 3D$, assuming all reactions to be single step (Elementary) reactions, which of the following is **correct**:

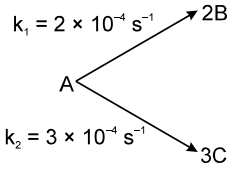
(A) $d[C]/dt = 3k_1[A]^2 - 3k_{-1}[B][C]^3 - 2k_2[C]^2$ (B) $d[B]/dt = k_1[A]^2$

(C) $d[A]/dt = 2k_{-1}[B][C]^3 - 2k_1[B][C]^3$ (D) None

3. For the following parallel chain reaction 

the overall half life of A is 12 hours. If rate of formation of C is 60% of a rate of decomposition of A then what will be half life of A while it is converting into B ?

(A) 40 hours (B) 60 hours (C) 50 hours (D) 30 hours

4. For the following parallel chain reaction 

if the sum of the concentration of B and C at any time is 2M then, what will be $[B]_t$ and $[C]_t$ respectively?

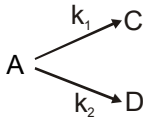
(A) $\frac{11}{12}M, \frac{13}{12}M$ (B) $\frac{3}{4}M, \frac{5}{4}M$ (C) $\frac{4}{5}M, \frac{6}{5}M$ (D) $\frac{8}{13}M, \frac{18}{13}M$

5. For the reaction $CH_4 + Br_2 \rightarrow CH_3Br + HBr$, the experimental data require the following rate equation:

$$\frac{d}{dt}[CH_3Br] = \frac{k_1[CH_4][Br_2]}{1+k_2[HBr]/[Br_2]}$$

Which of the following is/are true regarding this ?
(A) The reaction is a single step reaction
(B) The reaction is 2nd order in the initial stages {[HBr] ≈ 0}
(C) The reaction is 2nd order in the final stages {$[Br_2]$ ≈ 0}
(D) The molecularity of the reaction is two.

6. Consider the following case of COMPETING 1ST ORDER REACTIONS



After the start of the reaction at t = 0 with only A, the [C] is equal to the [D] at all times. The time in which all three concentrations will be equal is given by

7. For the reaction $Cl_2 + CO \rightarrow Cl_2CO$ the rate law is :

$$\frac{d[Cl_2CO]}{dt} = k[Cl_2]^{3/2}[CO]$$

The mechanism which is accepted is

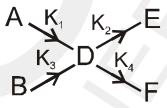
$Cl_2 + M \underset{}{\overset{K_1}{\rightleftharpoons}} 2Cl + M$ (fast)

$Cl + CO + M \overset{K_2}{\rightleftharpoons} ClCO + M$ (fast)

$ClCO + Cl_2 \xrightarrow{k_3} Cl_2CO + Cl$ (slow)

Find the expression relating k with the other constants given.

8. Write $\frac{dC_D}{dt}$ for the following parallel series 1st order reaction



9. For the reaction process A + B ⟶ products, the rate is first order w.r.t. A and second order w.r.t. B. If 1 mole each of A and B were introduced into a 1 L vessel and the initial rate was 1×10^{-2} (mol/L sec). Calculate the rate when half the reactants has been converted into products.

10. The catalysed decomposition of N_2O by gold at 900ºC and at an initial pressure of 200 mm, is 50% complete in 53 minutes and 73% complete in 100 minutes.
(A) What is the order of the reaction ?
(B) How much of it will decompose in 100 minutes at the same temperature but at initial pressure of 600 mm of Hg?

PHYSICAL / INORGANIC CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 54

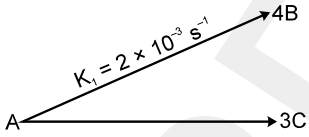
Total Marks : 38

Max. Time : 43 min.

Topic : Chemical Kinetics

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1	(3 marks 3 min.)	[3, 3]
Comprehension ('–1' negative marking) Q.2 to Q.6	(3 marks 3 min.)	[15, 15]
Subjective Questions ('–1' negative marking) Q.7 to Q.9	(4 marks 5 min.)	[12, 15]
Match the Following (no negative marking) Q.10	(8 marks 10 min.)	[8, 10]

1. For the following parallel chain reaction

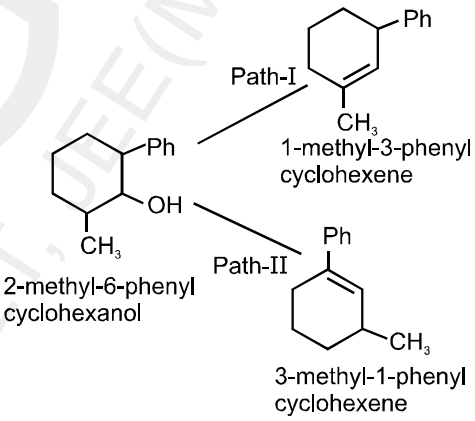


what will be that value of overall half-life of A in minutes? $\left[\text{Given that } \frac{[B]_t}{[C]_t} = \frac{16}{9}\right]$

(A) 3.3 (B) 6.3 (C) 3.6 (D) None

Comprehension # (Q.2 to Q.6)

Dehydration of 2-methyl-6-phenyl cyclohexanol is a first order kinetics. Dehydration of this cyclohexanol gives 3-methyl-1-phenyl cyclohexene and 1-methyl-3-phenyl cyclohexene. Yields of these products are different due to different rate constant of their respective parallel paths. 4×10^{-4}M sec^{-1} is the rate constant of first path in which 1-methy-3-phenyl-cyclohexene is formed. After 2303 seconds, 3M and 2M of 3-methyl-1-phenyl cyclohexene and 1-methyl-3-phenyl-cyclohexene are obtained respectively.



2. Which of the following is the value of rate constant of second path –

(A) 4×10^{-4} sec^{-1} (B) 6×10^{-4} sec^{-1} (C) 3×10^{-4} sec^{-1} (D) 2×10^{-4} sec^{-1}

3. The half life period of dehydration of 2-methyl-6-phenyl cyclohexanol is :

(A) 463 sec (B) 599 sec (C) 735 sec (D) 693 sec

4. The average life period of the above process is :

(A) 1000 sec (B) 1200 sec (C) 888.8 sec (D) 1271.92 sec

5. The initial concentration of 2-methyl-6-phenyl cyclohexanol taken is :

(A) 4.545 (B) 6.555 (C) 5.555 (D) 7.545

6. The rate of dehydration of alcohol at 2303 seconds is

(A) 5.55×10^{-4} mol/L-sec (B) 4×10^{-4} mol/L-sec

(C) 12×10^{-4} mol/L-sec (D) 6.55×10^{-4} mol/L-sec

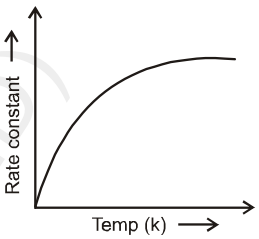
7. For the reaction A $\longrightarrow$ products, the following data is given for a particular run.

time (min.) :	0	5	15	35
$\frac{1}{[A]}$ (M^{-1}) :	1	2	4	8

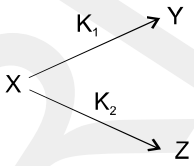
Determine the order of the reaction.

8. If for a first order reaction, rate constant varies with temperature according to the graph given below. At 27ºC, 1.5×10^{-4} percent of the reactant molecules are able to cross over the potential barrier.

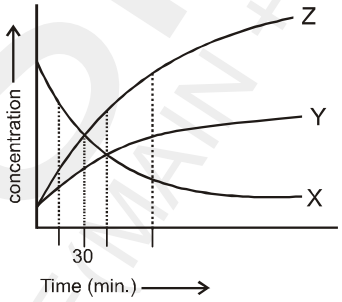
At 52ºC, the slope of this graph is equal to 0.2 K^{-1} sec^{-1}, calculate the value of rate constant at 52ºC, assuming that activation energy does not change in this temperature range.



9. For a Parallel first order reaction



Concentration of reactant and product change according to the graph given below.



Calculate the value of k_1 and k_2. Given, $\frac{k_1}{k_2} = \frac{1}{2}$

10. For a general reaction A $\rightarrow$ B let α = Degree of dissociation. Other notations have their usual meaning

Column – I	**Column – II**
(A) α (if order = 1)	(p) $1-e^{-kt}$
(B) α (if order = 2)	(q) $\frac{kt}{C_{A_0}}$
(C) α (if order = 0)	(r) $\frac{C_{A_0}kt}{C_{A_0}kt+1}$
(D) α (if order = 0.5)	(s) $1-\frac{C_{A_t}}{C_{A_0}}$

PHYSICAL / INORGANIC CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 55

Total Marks : 29

Max. Time : 31 min.

Topic : Metallurgy

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.7	(3 marks 3 min.)	[21, 21]
Match the Following (no negative marking) Q.8	(8 marks 10 min.)	[8, 10]

1. **(a)** Mg metal is extracted from

(A) Cryolite (B) Carnallite (C) Malachite (D) Cassiterite

(b) Match correctly

I	Bauxite	(a)	Lead
II	Carnallite	(b)	Copper
III	Malachite	(c)	Magnesium
IV	Galena	(d)	Hall Process

(A) I – a, II – b, III – c, IV – d (B) I – d, II – c, III – b, IV – a

(C) I – b, II – a, III – d, IV – c (D) I – d, II – b, III – c, IV – a

2. **(a)** Copper is extracted from :

(A) stefinite (B) dolomite (C) galena (D) malachite

(b) Corundum is :

(A) ZnO (B) Al_2O_3 (C) Fe_3O_4 (D) Ag_2O

3. **(a)** Important ore of Zinc is :

(A) calamine (B) magnetite (C) cryolite (D) Anglesite

(b) Which of the following ores is concentrated by magnetic separation method ?

(A) Bauxite (B) Haematite (C) Argentite (D) Dolomite

4. **(a)** Which of the following processes is used for the concentration of ores ?

(A) Bessemerisation (B) Electrolytic reduction

(C) Froth floatation process (D) Smelting

(b) When lime stone is heated, CO_2 gas is liberated. In metallurgy, this process is called as :

(A) calcination (B) roasting (C) ore dressing (D) sublimation

5. **(a)** Main function of frothers is:

(A) Stick to the ore and then take it to rise upto the top

(B) Convert the insoluble ore into soluble part

(C) Make the ore hydrophobic

(D) None

(b) Main function of the collectors in metallurgy is :

(A) Stick to the ore and then take it to rise upto the top

(B) Convert the insoluble ore into soluble part

(C) Make the ore hydrophobic

(D) None

6. **(a)** A metal obtained by a hydrometallurgical operation is :

(A) Silver (B) Iron (C) Tin (D) Aluminium

(b) When haematite ore is burnt in air with coke along with lime at 200°C, the process not only produces steel but also produces an important compound (A), which is useful in making building materials. The compound (A) is

(A) SiO_2 (B) $CaSiO_3$ (C) FeO (D) Fe_2O_3

7. **(a)** The substance which is used as flux in the extraction of iron from haematite ore is :

(A) silica (B) borax (C) lime stone (D) salt cake

(b) (i) The slag obtained during the extraction is lighter and has lower melting point than the metal (Fe or Cu).

(ii) Froth floatation process may be used to increase the concentration of mineral chalcopyrites.

(iii) High purify metals can be obtained by zone refining method if the impurity has lower melting point.

(A) T, T, T (B) T, F, T (C) F, T, T (D) F, F, F

8. Match the ionization processes listed in column-I with the changes observed as listed in column-II. For this use the codes given below :

Column-I	**Column-II**
(A) $N_2 \longrightarrow N_2^+$	(p) Bond order increases and magnetic property is changed
(B) $O_2^+ \longrightarrow O_2^{2+}$	(q) Bond order decreases and magnetic property is not changed
(C) $B_2 \longrightarrow B_2^+$	(r) Bond order increases and magnetic property is not changed
(D) $NO^- \longrightarrow NO$	(s) Bond order decreases and magnetic property is changed
	(t) Bond energy decreases and bond length increases.

Note : Here change in magnetic property refers to change from diamagentic to paramagentic or paramagnetic to diamagnetic.

PHYSICAL / INORGANIC CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 56

Total Marks : 44

Max. Time : 44 min.

Topic : Metallurgy

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.6	(3 marks 3 min.)	[18, 18]
Multiple choice objective ('–1' negative marking) Q.7	(4 marks 4 min.)	[4, 4]
Comprehension ('–1' negative marking) Q.8 to Q.10	(3 marks 3 min.)	[9, 9]
Assertion and Reason (no negative marking) Q.11	(3 marks 3 min.)	[3, 3]
Match the Following (no negative marking) Q.12	(8 marks 10 min.)	[8, 10]

1. Which one of the following statements is incorrect ?
(A) Tin is extracted by carbon reduction (smelting)
(B) Aluminium is extracted by Hall's process which involves carbon reduction.
(C) Extraction of lead does not involve bessemerisation
(D) Silver is extracted by cyanide process

2. In purification of bauxite ore, it is mixed with coke and heated at 1800 °C in presence of nitrogen. this is :
(A) Hall's process (B) Serpeck's process
(C) Baeyer's process (D) Electrolytic reduction.

3. Reducing agent of haematite in blast-furnace is
(A) Coke in furnace (B) Coke in upper part and CO in lower part of furnace.
(C) CO in most parts of the furnace (D) CO in the furnace.

4. $PbS \xrightarrow[\Delta]{air} X$, $X + PbS \longrightarrow Pb + SO_2$

'X' is :
(A) PbO (B) PbO_2 (C) PbO and $PbSO_4$ (D) PbO_2 and PbO

5. Select the incorrect statement
(A) Carbon is a better reducing agent below 983K than carbon monoxide.
(B) Sulphide ores generally roasted to oxide for the extraction of metals instead of being directly reduced.
(C) Zinc not extracted from zinc oxide through reduction using CO but instead coke is used.
(D) Leaching of native ores of silver/gold or of their sulphide ores and the extraction of metals (silver/gold), is an example of hydrometallurgy.

6. Consider the following metallurgical processes
(i) Heating impure metal with CO and distilling the resulting volatile carbonyl (boiling point 43ºC) and finally decomposing at 150ºC to 200ºC to get the pure metal.
(ii) Heating the sulphide ore in air until a part is converted to oxide and then further heating in the absence of air to let the oxide react with unchanged sulphide.
(iii) Electrolysing the molten electrolyte containing approximately equal amounts of the metal chloride and $CaCl_2$ to obtain the metal.
The process used for obtaining sodium, nickel and copper are, respectively,
(A) (i), (ii) and (iii) (B) (ii), (iii) and (i) (C) (iii), (i) and (ii) (D) (ii), (i) and (iii)

7.* Calcium silicate (slag) formed in the slag formation zone in extraction of iron from haematite ore :
(A) does not dissolve in molten iron (B) being lighter floats on the molten iron
(C) is used in cement industry (D) prevents the re-oxidation of molten iron

Comprehension # (Q.8 to Q.10)

Electrolytic purification of copper is required since the product of the Bessemer converter is impure. Sheets of pure copper are made the cathodes and blister copper is used as the anodes. The bath contains $CuSO_4$, H_2SO_4 and NaCl. Metallic copper goes into solution as Cu^{+2} ions at the anode and deposited at the cathode. Zinc and iron go into solution and do not deposit at the cathode alongwith copper. Silver goes into solution as Ag^+ ions, but forms a sludge in the electrolysis cell. The noble metals such as gold and platinum do not dissolve; they fall to the bottom when released from the copper anode. They help to pay for the copper refining process.

8. The different chemical behaviour of various metal ions (for example only Cu is deposited on the cathode) involved are explainable best using

(A) their amounts in impure copper
(B) the electrochemical series
(C) their ionization potentials
(D) their hydration energies

9. The voltage is kept low enough during the operation. This is to ensure that

(A) Fe^{+2} and Zn^{+2} ions are kept in solution only
(B) there is no risk of electric shock to the plant operators
(C) gold and platinum do not dissolve in solution and are recovered as solids
(D) temperature control is maintained to effect reaction rate control

10. The most important role of various electrolytes added to the electrorefining bath in this case is

(A) to reduce the temperature of bath
(B) to result in good electrical connectivity so as to have high production rates
(C) so that the anode acts as an attackable electrode
(D) to enhance the viscosity of electrolyte thus preventing leakage from bath.

11. **Statement-1 :** Haematite ore containing a small quantity of siderite ore is always calcined in presence of a limited supply of air.

Statement-2 : $FeCO_3 \longrightarrow FeO + CO_2$; $FeO + O_2 \longrightarrow Fe_2O_3$

Prevents the loss of iron as $FeSiO_3$.

(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.
(C) Statement-1 is True, Statement-2 is False.
(D) Statement-1 is False, Statement-2 is True.

12.

Column – I	**Column – II**
(A) Chalcopyrites	(p) Self – reduction
(B) Galena	(q) Sulphur containing ore
(C) Argentite	(r) Carbon reduction
(D) Malachite	(s) Leaching followed by displacement method.

PHYSICAL / INORGANIC CHEMISTRY

DPP
DAILY PRACTICE PROBLEMS

DPP No. 57

Total Marks : 42

Max. Time : 42 min.

Topic : Metallurgy

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.8	(3 marks 3 min.)	[24, 24]
Comprehension ('–1' negative marking) Q.9 to Q.11	(3 marks 3 min.)	[9, 9]

Revision Question

Comprehension ('–1' negative marking) Q.12 to Q.14	(3 marks 3 min.)	[9, 9]

1. In froth floatation process for the purification of ores, the particles of ore float because :
(A) their surface is not easily wetted by water (B) they are light
(C) they are insoluble (D) they bear electrostatic charge

2. The purpose of adding Na_3AlF_6 to Al_2O_3 during electrolysis is
(A) To decrease metling point of Al_2O_3 (B) To increase conductivity of electrolyte
(C) To provide reducing condition in the bath (D) A & B

3. Match List–I with List–II and select the correct answer using codes given below in the list :

	List–I		**List–II**
I	Cyanide process	(A)	Ultrapure Ge
II	Floation process	(B)	Pine oil
III	Electrolytic reduction	(C)	Extraction of Al
IV	Zone refining	(D)	Extraction of Au

(A) I – C, II – A, III – D, IV – B (B) I – D, II – B, III – C, IV – A
(C) I – C, II – B, III – D, IV – A (D) I – D, II – A, III – C, IV – B

4. Match list I with list II and select the correct answer using the codes given below the lists .

	List I		**List II**
A	van Arkel method	**1.**	Manufacture of caustic soda
B	Solvay process	**2.**	Purification of titanium
C	Cupellation	**3.**	Manufacture of Na_2CO_3
D	Poling	**4.**	Purification of copper
		5.	Refining of silver

	A	B	C	D		A	B	C	D
(A)	2	1	3	4	(B)	4	3	2	5
(C)	2	3	5	4	(D)	5	1	3	4

5. Match **List-I** with **List-II** and select the correct answer using the codes given below the lists.

	List-I (Metals)		**List-II (Process/methods involved in extraction process)**
(a)	Au	1.	Self reduction
(b)	Al	2.	Liquation
(c)	Pb	3.	Electrolysis
(d)	Sn	4.	Bayer's process

	(a)	**(b)**	**(c)**	**(d)**		**(a)**	**(b)**	**(c)**	**(d)**
(A)	3	1	2	4	(B)	3	4	1	2
(C)	1	2	4	3	(D)	3	2	4	1

6. In the Hoop's process of aluminium extraction , the fused materials remain in three different layers. These layers remain separated even in electrolytic reduction, because :
(A) upper layer is attracted by cathode and lower layer is attracted by anode
(B) cell has the arrangement for separating the layers
(C) all the layers have different densities
(D) all the layers are at different temperature

7. In steel making the impurities are removed by
(A) Oxidation
(B) reduction
(C) Converted into high melting compounds by addition of some elements
(D) Gasification

8. $\text{Impure} + I_2 \longrightarrow \underset{\text{Vapour}}{\text{Metal iodide}} \xrightarrow[\Delta]{\text{Heat}} \underset{\text{Reused}}{\text{Pure Metal}} + I_2$

The above method of purification is :
(A) Van – arkel process for Zr, Hg etc
(B) Distillation for Zn, Cd, Hg etc
(C) Electro refining for W, Ag, Au, etc
(D) Zone refining of germanium gallium, silicon etc.

Comperhension # (Q.9 to Q.11)

The choice of reducing agent for metal oxide is decided by thermodynamic principle of metallurgy. ΔG must be negative. Ellingham diagram is a plot of $\Delta_f G^\circ$ Vs T for the formation of oxides of varous elements. All the plots slope upwards when temeprature increases. Each plot is a straight line except when some change in phase takes place. A metal will reduce the oxide of other metals which lie above it in this diagram.

9. ΔG° vs T plot in the Ellingham's diagram slopes downward for the reaction

(A) $Mg + \frac{1}{2}O_2 \longrightarrow MgO$
(B) $2Ag + \frac{1}{2}O_2 \longrightarrow Ag_2O$
(C) $C + \frac{1}{2}O_2 \longrightarrow CO$
(D) $CO + \frac{1}{2}O_2 \longrightarrow CO_2$

10. Free energies of formation ($\Delta_f G^\circ$) of MgO(s) and CO(g) at 1273 K are – 941 and – 439 kJ mol^{-1} respectively. At this temperature the nature of the reaction :

$MgO(s) + C(s) \longrightarrow Mg(s) + CO(g)$ is

(A) reversible
(B) spontaneous
(C) non-spontaneous
(D) highly spontaneous

11. Why is zinc not extracted from zinc oxide through reduction using CO ?
(A) Out of C and CO, C is always a better reducing agent.
(B) The line for $\Delta_f G^\circ$ (CO, CO_2) in the Ellingham diagram is always higher than the line for $\Delta_f G^\circ$ (ZnO, Zn) at the temperature employed.
(C) The line for $\Delta_f G^\circ$ (CO, CO_2) in the Ellingham diagram is always lower than the line for $\Delta_f G^\circ$ (ZnO, Zn) at the temperature employed.
(D) None of these.

Revision Question

Comprehension # (Q.12 to Q.14)

Suppose Bohr theory is applicable to a negative particle of mass $2m_e$ and charge $2e^-$ revolving around the nucleus of charge Ze, Let r_1, v_1 and E_1 be the radius of the orbit, speed of the particle in the orbit and energy of the particle in the orbit respectively. The value for these variable for electron revolving in the corresponding Bohr's orbit are r, v and E respectively.

12. Which of the following expression regarding the ratio of radii is correct ?

(A) $\frac{r_1}{r} = 2$
(B) $\frac{r_1}{r} = \frac{1}{2}$
(C) $\frac{r_1}{r} = 4$
(D) $\frac{r_1}{r} = \frac{1}{4}$

13. Which of the following expressions regarding the ratio of speeds are correct ?

(A) $\frac{v_1}{v} = 2$
(B) $\frac{v_1}{v} = \frac{1}{2}$
(C) $\frac{v_1}{v} = 4.$
(D) $\frac{v_1}{v} = \frac{1}{4}$

14. Which of the following expressions regarding the ratio of energies is correct ?

(A) $\frac{E_1}{E} = 4$
(B) $\frac{E_1}{E} = \frac{1}{4}$
(C) $\frac{E_1}{E} = 8$
(D) $\frac{E_1}{E} = \frac{1}{8}$

PHYSICAL / INORGANIC CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 58

Total Marks : 40

Max. Time : 43 min.

Topic : Metallurgy

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.6	(3 marks 3 min.)	[18, 18]
Multiple choice objective ('–1' negative marking) Q.7	(4 marks 4 min.)	[4, 4]
Assertion and Reason (no negative marking) Q.8 to Q.9	(3 marks 3 min.)	[6, 6]

Integer Answer Type

Subjective Questions ('–1' negative marking) Q.10 to Q.12	(4 marks 5 min.)	[12, 15]

1.(a)_ The substance which is used as flux in the extraction of iron from haematite ore is :
(A) silica (B) borax (C) lime stone (D) salt cake

1.(b)_ The composition of matte is :
(A) Cu_2S and FeS (B) CuS and Fe_2S_3 (C) Cu_2S and FeO (D) Cu_2O and FeO

2.(a)._ Cyanide solution is used in the extraction of :
(A) Mg (B) Sn (C) Zn (D) Ag

2(b)._ In the extractive metallurgy of iron, the highest temperature in the blast furnance is found :
(A) in the upper most part where reduction takes place.
(B) in the lower part where fusion takes place.
(C) in the middle part where slag formation takes place.
(D) in the lower most part where combustion of carbon takes place.

3(a)._ Al is obtained in large quantity by :
(A) heating cryolite
(B) reduction of Al_2O_3 with carbon
(C) reduction of Al_2O_3 with potassium
(D) electrolytic reduction of Al_2O_3 dissolved in molten cryolite.

3(b)._ Chemical reduction method is not used for :
(A) the extraction of Mg from anhydrous magnesium chloride.
(B) the extraction of Cu from cuprite.
(C) the extraction of Fe from haematite.
(D) the extraction of Zn from zincite.

4(a)._ In the electrolytic redcution of fused mixture of Al_2O_3 and Na_3AlF_6 gas liberated at graphite anode is :
(A) F_2 (B) OF_2 (C) O_2 (D) O_3

4(b)._ Which of the following statements is incorrect?
(A) Silver glance mainly contains silver sulphide.
(B) Copper pyrites mainly contains $CuFeS_2$.
(C) Zinc blende mainly contains $ZnSO_4$.
(D) Magnetite is the mixed oxide of FeO and Fe_2O_3 i.e. Fe_3O_4.

5(a)._ In which of the following metallurgical processes leaching is not involved ?
(A) Al from Al_2O_3 (B) Ag from Ag_2S
(C) Mg from $MgCl_2$ (anhydrous) (D) From low grade copper ore and scrapes

5(b)._ Which of the following statements is incorrect?

(A) Beneficiation of ores involve the processes which are used for the removal of unwanted impurities.

(B) In metallurgy, flux is a substance which is used to convert infusible impurities to fusible mass.

(C) Aluminium is extracted by the electrolysis of alumina.

(D) In smelting processes the metal is obtained in fused state.

6._ Which of the following processes are used for the extraction of Mg and Ag respectively?

(A) Carbon reduction and cyanide process. (B) Cyanide process and electrolytic reduction.

(C) Electrolytic reduction and cyanide process. (D) Carbon monoxide reduction and cyanide process.

7.* Which of the following pair(s) of metals is/are correctly matched with their purification methods?

(A) Si, B – Zone refining (B) Ni, Zr – Vapour phase refining

(C) Zn, Hg – Distillation (D) Cu, Ag – Electrolytic refining

8. **Statement-1:** $Ag_2S + 4\,KCN \overset{O_2}{\rightleftharpoons} 2K[Ag(CN)_2] + K_2S$

Statement-2 : The reaction is carried out in presence of air or O_2 so that K_2S is oxidised to K_2SO_4 thereby shifting the equilibrium in forward direction.

(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.

(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1

(C) Statement-1 is True, Statement-2 is False

(D) Statement-1 is False, Statement-2 is True

9. **Statement-1 :** Oxide ores of iron are haematite, limonite and magnetite.

Statement-2 : Pig iron is obtained by carbon monoxide reduction of calcined haematite.

(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.

(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1

(C) Statement-1 is True, Statement-2 is False

(D) Statement-1 is False, Statement-2 is True

Integer Answer Type

This section contains 4 questions. The answer to each of the questions is a single digit integer, ranging from 0 to 9.

10. How many of the following ores are oxide ores?

haematite, limonite, magnetite, magnesite, cuprite, argentite, bauxite, sphalerite, zincite

11._ How many of the following metallurgies involve leaching?

$Al_2O_3 \longrightarrow Al$, ; $Ag_2S \longrightarrow Ag$; $Au \longrightarrow Au$; $CuFeS_2 \longrightarrow Cu$; $PbS \longrightarrow Pb$

$MgCl_2 \longrightarrow Mg$; $FeCO_3 \longrightarrow Fe$; Low grade copper ore $\longrightarrow Cu$; $HgS \longrightarrow Hg$

12. What is the coordination number of aluminium in mineral cryolite ?

PHYSICAL / INORGANIC CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 59

Total Marks : 33

Max. Time : 34 min.

Topic : Metallurgy

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.4	(3 marks 3 min.)	[12, 12]
Comprehension ('–1' negative marking) Q.5 to Q.7	(3 marks 3 min.)	[9, 9]
Assertion and Reason (no negative marking) Q.8	(3 marks 3 min.)	[3, 3]

Integer Answer Type

Subjective Questions ('–1' negative marking) Q.9 to Q.11	(4 marks 5 min.)	[12, 15]

1(a)._ Leaching the silver and gold metal with CN^- :

(A) is oxidation reaction (B) is complexation reaction

(C) is reduction reaction (D) is both (A) and (B)

1(b)._ Leaching of low grade copper ores is carried out by :

(A) sulphuric acid (B) sodium hydroxide (C) sodium sulphate (D) sodium nitrate

2(a)._ Which of the following reactions represents Goldschmidt aluminothermite process?

(A) $2Al + HCl \longrightarrow 2AlCl_3 + 3H_2$ (B) $Al_2O_3 + 2NaOH + 2H_2O \longrightarrow 2NaAlO_2 + 3H_2O$

(C) $2Al + N_2 \longrightarrow 2AlN$ (D) $2Al + Cr_2O_3 \longrightarrow 2Cr + Al_2O_3$

2(b)._ Calcium is extracted by the electrolysis of :

(A) fused mixture of $CaCl_2$ and CaF_2 (B) fused mixture of $CaCl_2$ and NaF

(C) aqueous solution of $CaCl_2$ (D) aqueous solution of $Ca_3(PO_4)_2$ solution

3(a)._ The materials which are added along with the calcined iron ore into the blast furnance in the extraction of iron from haematite ore are :

(A) coke and silica (B) coke and lime stone

(C) lime stone and silica (D) coke and borax

3(b). Match the method of concentration of the ore in column I with the ore in column II and select the correct alternate.

	Column I		**Column II**
(1)	Leaching.	(p)	Copper pyrite.
(2)	Calcination.	(q)	Magnesite.
(3)	Froth floatation.	(r)	Bauxite.
(4)	Magnetic separation.	(s)	Chromite.

	(1)	(2)	(3)	(4)		(1)	(2)	(3)	(4)
(A)	(s)	(q)	(p)	(r)	(B)	(r)	(q)	(p)	(s)
(C)	(p)	(q)	(r)	(s)	(D)	(q)	(r)	(p)	(s)

4(a). In which of the following pair of metals, both are commercially extracted from their respective ores by self reduction method ?

(A) Zn, Cu (B) Pb, Cu (C) Sn, Zn (D) Al, Ag

4(b)._ Which of the following is obtained by zone refining method?

(A) Highly pure ore (B) Highly pure aluminium

(C) Ultra pure oxide (D) Ultra pure metals used as semi-conductors

Comprehension # (Q.5 to Q.7)

Read the following comprehension carefully and answer the questions :

Main ore of lead is galena. This is mined and separated from other minerals by froth flotation. There are two methods of extracting the lead.

(i) First method involves the roasting of ore followed by reduction with coke or CO.

(ii) Second method involves the partial roasting of ore followed by self reduction.

5. Partial roasting of galena gives :

(A) only PbS (B) only PbO (C) PbS + PbO (D) PbO + Pb

6. In self reduction process, the species which bring about the reduction is :

(A) O_2 (B) S^{2-} (C) O^{2-} (D) H_2S

7. Which of the following statements is incorrect about the extraction of lead from galena ?

(A) Galena is a sulphide ore and therefore, it is concentrated by froth flotation process.

(B) Self reduction takes place in absence of air.

(C) Complete roasting of galena gives PbO which is then reduced by coke or CO to give metallic lead.

(D) $FeSiO_3$ is obtained as slag.

8. **Statement-1 :** Dow's process is the extraction of magnesium from sea water.

Statement-2 : Hydrated magnesium chloride is made anhydrous by heating in a current of dry HCl gas.

(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.

(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.

(C) Statement-1 is True, Statement-2 is False.

(D) Statement-1 is False, Statement-2 is True.

Integer Answer Type

This section contains 4 questions. The answer to each of the questions is a single digit integer, ranging from 0 to 9.

9. How many water of crystallisation is present in the ore carnallite ?

10. The number of reducing agents involved in the extraction of iron (as pig iron) using blast furnace from ore haematite is(are).

11. Among the following metals how many metals are extracted by self-reduction method from their respective ores. Hg, Zn, Cu, Al, Mg, Pb, Fe, Sn.

12. The number of different metals present in the ore copper pyrites is :

PHYSICAL / INORGANIC CHEMISTRY

DPP
DAILY PRACTICE PROBLEMS

DPP No. 60

Total Marks : 37

Max. Time : 37 min.

Topic : Surface Chemistry

Type of Questions		M.M., Min.
Multiple choice objective ('–1' negative marking) Q. 1	(4 marks 4 min.)	[4, 4]
Single choice Objective ('–1' negative marking) Q.2 to Q.12	(3 marks 3 min.)	[33, 33]

1.* Which of the following statements is correct?
(A) The efficiency of a heterogeneous catalyst depends upon its surface area.
(B) Catalyst operates by providing alternate path for the reaction that involves a lower activation energy.
(C) Catalyst lowers the energy of activation of the forward direction without affecting the energy of activation of the backward direction.
(D) Catalyst does not affect the overall enthalpy change of the reaction.

2. Most effective ion to coagulate a negative sol is :
(A) PO_4^{3-} (B) Al^{3+} (C) Ba^{2+} (D) K^+

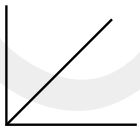
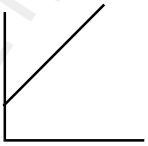
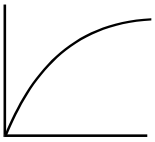
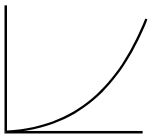
3. Which one is colloid :
(A) NaCl (B) Urea (C) Cane Sugar (D) Blood

4. Oil soluble dye is mixed with water in oil emulsion. Then :
(A) dispersion medium is coloured (B) different phase is coloured
(C) both coloured (D) none is coloured

5. Sorption is term used when :
(A) adsorption takes place (B) absorption takes place
(C) both (A) and (B) (D) None of these

6. Negatively charged colloidal solution is obtained from $AgNO_3$ & KI , when moles of :
(A) $AgNO_3$ are more (B) KI are more
(C) both $AgNO_3$ and KI are more (D) can't say

7. Zeolites have shape selectivity depending on :
(A) pore structure (B) atomic structure
(C) molecular structure (D) none of these

8. The variation of $\frac{p}{(x/m)}$ as a function of p when Langmuir's's isotherm is valid is :
(A)  (B)  (C)  (D) 

9. The removal of grease, dirt by soap during washing is an example of
(A) adsorption (B) emulsification (C) coagulation (D) dissolution

10. The difference in color of colloidal particles of gold obtained by different methods is related to
(A) variable valency of gold (B) different concentration of gold particles
(C) different types of impurity present (D) different size of colloidal particles

11. Sulphur sol contains
(A) discrete sulfur atoms (B) discrete sulfur molecules (S_8)
(C) large aggregates of S_8 molecules (D) water dispersed in solid sulfur

12. Among the following sols the one which is hydrophobic is
(A) gum (B) sulfur (C) starch (D) gelatin

PHYSICAL / INORGANIC CHEMISTRY

DPP
DAILY PRACTICE PROBLEMS

DPP No. 61

Total Marks : 33

Max. Time : 33 min.

Topic : Surface Chemistry

Type of Questions **M.M., Min.**

Single choice Objective ('–1' negative marking) Q.1 to Q.11 **(3 marks 3 min.)** **[33, 33]**

1. The protein which acts as an emulsifying agent in milk is named
(A) casein (B) lactose (C) fat (D) lactic acid

2. Which of the following natural polymers has the highest gold number ?
(A) gelatin (B) albumin (C) gum arabic (D) potato starch

3. Which of the following is not true of Brownian motion ?
(A) the movement is more vigorous for smaller particles.
(B) the movement does not change with time and remains the same for months and years.
(C) the moment does not depend on the temperature
(D) it can be sometimes seen with naked eyes or using a simple microscope at most.

4. A colloidal solution has which of the following properties which is not shown by a true solution.
(A) Homogeneity (B) Filterability (C) Tyndall effect (D) Osmotic pressure

5. If a bag made of a dialyzing material and containing a mixture of water, dissolved salt, and colloidally dispersed protein were placed in a beaker of pure water, the water would eventually contain
(A) dissolved salt (B) protein
(C) both salt and protein (D) no additional material

6. Identify the incorrect statement
(A) Brownian motion and tyndall effect is shown by colloidal particles
(B) Gold number is a measure of the protective power of a lyophilic colloid
(C) The colloidal solution with both the dispersed phase and the dispersion medium in liquid state is called a gel.
(D) Hardy-Schulze rule is related with coagulation

7. On adding a few drops of dil HCl to freshly precipitated ferric hydroxide, a red colored colloidal solution is obtained, this is an example of
(A) Protective action (B) dissolution (C) peptisation (D) dialysis

8. At the cmc the surfactant molecules
(A) decompose (B) dissociate (C) associate (D) become soluble

9. Colloidal particles in a sol can be coagulated by
(A) Heating (B) adding an electrolyte
(C) adding oppositely charged sol (D) any of the above

10. A colloidal solution of a solid as dispersed phase and liquid as dispersion medium is known as :
(A) Gel (B) Sol (C) Solid foam (D) Emulsion

11. Which of the following process is not based on adsorption?
(A) catalysis (B) chromatography
(C) printing of photograph (D) decolorization of sugar

PHYSICAL / INORGANIC CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 62

Total Marks : 41

Max. Time : 41 min.

Topic : Surface Chemistry

Type of Questions		M.M., Min.
Subjective Questions ('–1' negative marking) Q.1,2, 5,6,7	(4 marks 5 min.)	[20, 20]
Single choice Objective ('–1' negative marking) Q.3,4,8,9,11,12	(3 marks 3 min.)	[18, 18]
Assertion and Reason (no negative marking) Q.10	(3 marks 3 min.)	[3, 3]

1. Give reasons for the following in one or two sentences only :
$BeCl_2$ can be easily hydrolysed.

2. A white solid is either Na_2O or Na_2O_2. A piece of red litmus paper turns white when it is dipped into a freshly made aqueous solution of the white solid.
(i) Identify the substance and explain with balanced equation.
(ii) Explain what would happen to the red litmus if the white solid were the other compound.

3. **Statement-1 :** LiCl is predominantly a covalent compound.
Statement-2 : Electronegativity difference between Li and Cl is too small.
(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1
(C) Statement-1 is True, Statement-2 is False
(D) Statement-1 is False, Statement-2 is True

4. Highly pure dilute solution of sodium in liquid ammonia :
(A) show blue colour (B) exhibits electrical conductivity
(C) produces sodium amide (D) produces hydrogen gas

5. Arrange the following sulphates of alkaline earth metals in order of decreasing thermal stability :
$BeSO_4$, $MgSO_4$, $CaSO_4$ $SrSO_4$

6. The crystalline salts of alkaline earth meals contain more water of crystallisation than the corresponding alkaline metal salts. Why ?

7. Element A burns in nitrogen to give an ionic compound B. Compound B reacts with water to give C and D. A solutions of C becomes 'milky' on bubbling carbon dioxide. Identify A, B, C and D.

8. A dilute aqueous solution of Na_2SO_4 is electrolysed using platinum electrodes. The products at the anode and cathode are
(A) O_2, H_2 (B) $S_2O_8^{2-}$, Na (C) O_2, Na (D) $S_2O_8^{2-}$, H_2

9. The following compounds have been arranged in order of their increasing thermal stabilities. Identify the correct order.
K_2CO_3 (I) $MgCO_3$ (II) $CaCO_3$ (III) $BeCO_3$ (IV)
(A) I < II < III < IV (B) IV < II < III < I (C) IV < II < I < III (D) II < IV < III < I

10. **Statement-1 :** The alkali metals can form ionic hydrides which contain the hydride ion H^-.
Statement-2 : The alkali metals have low electronegativity; their hydrides conduct electricity when fused and liberate hydrogen at the anode.
Evaluate the above statement and the explanation.
(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1
(C) Statement-1 is True, Statement-2 is False
(D) Statement-1 is False, Statement-2 is True

11. Which is not correctly matched ?
(1) Basic strength of oxides $Cs_2O < Rb_2O < K_2O < Na_2O < Li_2O$
(2) Stability of peroxides $Na_2O_2 < K_2O_2 < Rb_2O_2 < Cs_2O_2$
(3) Stability of bicarbonates $LiHCO_3 < NaHCO_3 < KHCO_3 < RbHCO_3 < CsHCO_3$
(4) Melting point $NaF < NaCl < NaBr < NaI$
(A) 1 and 4 (B) 1 and 3 (C) 1 and 2 (D) 2 and 3

12. $Li + N_2 \xrightarrow{\Delta} A \xrightarrow{H_2O} B + (C)\ gas$
Then the correctly matched pair for A, B, C are

	A	B	C		A	B	C
(A)	LiN_3	LiOH	NH_3	(B)	LiN_3	LiH	NO_2
(C)	Li_3N	LiOH	NO_2	(D)	Li_3N	LiOH	NH_3

PHYSICAL / INORGANIC CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 63

Total Marks : 30

Max. Time : 30 min.

Topic : s-block

Type of Questions **M.M., Min.**

Single choice Objective ('–1' negative marking) Q.1 to Q.10 (3 marks 3 min.) [30, 30]

1. Sodium and potassium react with water much more vigorously than lithium because :
(A) sodium and potassium have high values of hydration energy as compared to that of lithium.
(B) sodium and potassium have higher melting point than that of lithium.
(C) sodium and potassium have lower melting point than that of lithium.
(D) sodium and potassium have lower hydration energy than that of lithium.

2. The following compounds have been arranged in order of their increasing thermal stabilities. Identify the correct order. K_2CO_3 (I), $MgCO_3$ (II), $CaCO_3$ (III), $BeCO_3$(IV)
(A) I < II < III < IV (B) IV < II < III < I (C) IV < II < I < III (D) II < IV < III < I.

3. Identify the correct statement :
(A) Sodium metal can be prepared by the electrolysis of an aqueous solution of NaCl.
(B) Sodium metal can be kept under ethyl alcohol.
(C) Sodium metal is insoluble in liquid NH_3 at low temperature.
(D) Elemental sodium is easily oxidised.

4. Which of the following statements are true about the alkali metals ?
(1) All alkali-metal salts impart a characteristic colour to the Bunsen flame.
(2) The correct order of increasing thermal stability of the carbonates of alkali metals is $Li_2CO_3 < Na_2CO_3 < K_2CO_3 < Rb_2CO_3 < Cs_2CO_3$.
(3) Among the alkali metals, cesium is the most reactive.
(4) The reducing character of the alkali metal hydrides follow the order : LiH > NaH > KH > RbH > CsH.
(A) (1), (2) and (3) (B) (1), (3) and (4) (C) (2), (3) and (4) (D) (1), (2), (3) and (4)

5. **Statement-1 :** Solubilities of alkali metal fluorides and carbonates increase down the group.
Statement-2 : Hydration energies of alkali metal halides decrease down the group with increase in size of cations.
(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1
(C) Statement-1 is True, Statement-2 is False
(D) Statement-1 is False, Statement-2 is True

6. The melting point of lithium (180°C) is almost double the melting point of sodium (97°C) because :
(A) down the group, the hydration energy decreases
(B) down the group, the ionization energy decreases
(C) down the group, the cohesive energy decreases
(D) none of these

7. Which of the following statement (s) is/are true for the solutions of alkali metals and alkaline earth metals in ammonia (ℓ) ?
(A) Concentrated solutions of alkali metals in ammonia are copper - bronzed coloured and have a metallic lusture.
(B) Dilute solutions of alkaline earth metals are deep bule-black in colour due to the spectrum from the solvated electron.
(C) Concentrated solutions of the alkaline earth metals in ammonia are bronze coloured.
(D) Evaporation of the ammonia from solutions of alkali metals yields the metal, but with alkaline earth metals evaporation of ammonia gives hexammoniates of the metals.

8. **Statement-1 :** Lithium is the most powerful reducing agent and sodium is the least powerful reducing agent amongst the alkali metals in aqueous solutions.
Statement-2 : Lithium has the highest hydration enthalpy and the sodium the least value.
(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1
(C) Statement-1 is True, Statement-2 is False
(D) Statement-1 is False, Statement-2 is True

9. Which of the following statements is incorrrect ?
(A) The superoxide ion (i.e. O_2^-) is stable only in presence of larger cations such as K^+, Rb^+, Cs^+.
(B) Alkali metals are normally kept in kerosene oil.
(C) All the alkali metal hydrides are ionic solids with high melting points.
(D) The concentrated solution of alkali metals in liquid ammonia is paramagnetic in nature.

10. Property of the alkaline earth metals that increases with their atomic number is :
(A) Ionisation energy
(B) solubility of their hydroxides
(C) solubility of their sulphates
(D) Electronegativity

PHYSICAL / INORGANIC CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 64

Total Marks : 47

Max. Time : 39 min.

Topic : p-block (Boron and Carbon family)

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.9	(3 marks 3 min.)	[27, 27]
Comprehension ('–1' negative marking) Q.10 to Q. 13	(3 marks 3 min.)	[12, 12]
Match the Following (no negative marking) Q. 14	(8 marks 10 min.)	[8, 10]

1. Which metal container is used for contains concentrated HNO_3.

(A) Al (B) Cr (C) Fe (D) Sn

2. Which of the following compounds does not undergo hydrolysis completely

(A) BF_3 (B) BCl_3 (C) BBr_3 (D) All

3. Which is not correct about the alums

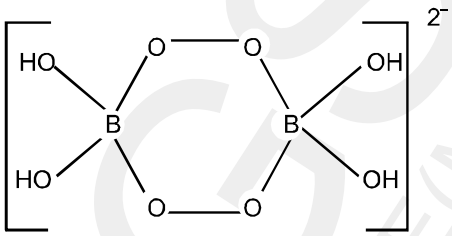
(A) They are used as mordants (B) They are used as coagulants

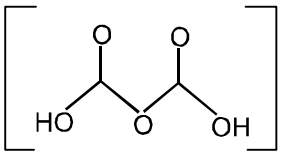
(C) Their aq. solutions all acidic (D) $(NH_4)SO_4.FeSO_4.6H_2O$ is not an alum

4. The correct order of basic strength will be

(A) BN > AlN (B) AlN > GaN (C) BN > GaN (D) Mg_3N_2 >AlN

5. H_2O_2 can react with aq. $NaBO_2$ to produce.

(A) 

(B) Na_2 

(C) $Na_2B_4O_7$. 10 H_2O (D) $NaBO_3$

6.* Which of the following species does not exist

(A) TlI_3 (B) $TlBr_3$ (C) $[CO_4]^{4-}$ (D) $PbBr_4$

7. Which of the following will produced metal oxide on heating?

(A) $NaHCO_3$ (B) $AlCl_3$. $6H_2O$ (C) Na_2CO_3 (D) $Al_2(CO_3)_3$

8. General formula of boranes can be

(A) B_nH_{2n+n} (B) $B_n H_{n+4}$ (C) $B_n H_{n+6}$ (D) $B_n H_{2n+4}$

9. Which of the following is correct about $Al_2(CH_3)_6$

(A) each 'B' atom is sp^3 hybridised

(B) It consists of two-"3 centre 2 electron bonds"

(C) The two bridging C-atoms are in the plane of the molecules

(D) all the above are correct

Comprehension # (Q. 10 to 13)

The highest oxidation state of p–block element is equal to the group number minus 10. Moving down the group, the oxidation state two less than the highest group oxidation state becomes more stable in groups 13 to 16 due to inert pair effect.

10. Which of the following statement is incorrect ?
(A) PbI_4 does not exist.
(B) Boron shows +3 oxidation state.
(C) $TlCl_3$ does not undergo disproportionation reaction.
(D) In thallium +3 oxidation state is more stable than +1.

11. The strongest reducing agent among the following is :
(A) Ge (II) chloride (B) Sn (II) chloride (C) Pb (II) chloride (D) None

12. The strongest oxidising agent among the following is :
(A) Pb (IV) oxide (B) Si (II) oxide (C) Sn (II) oxide (D) Ge (II) oxide

13. Which of the following compound exist at room temperature
(A) BiF_5 (B) $MnCl_7$ (C) $Tl(CH_3)_3$ (D) $BiCl_5$

14. **Match the Column :**

Column-I	**Column-II**
(A) $B_3O_3H_3$	(p) Six members ring
(B) $B_3N_3H_6$	(q) Eight members ring
(C) $Na_2B_4O_7.10H_2O$	(r) Hetero atomic ring
(D) P_4O_{10}	(s) Oxygen atom not present in ring
	(t) Even number atoms ring

PHYSICAL / INORGANIC CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 65

Total Marks : 50

Max. Time : 52 min.

Topic : p-block (Boron and Carbon family)

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.10	(3 marks 3 min.)	[30, 30]
Comprehension ('–1' negative marking) Q.11 to Q. 14	(3 marks 3 min.)	[12, 12]
Match the Following (no negative marking) Q. 15	(8 marks 10 min.)	[8, 10]

1. **(a)** Pyrosilicate ion is :

(A) SiO_4^{4-} (B) SiO_4^{2-} (C) $Si_2O_6^{4-}$ (D) $Si_2O_7^{6-}$

(b) In group IVA or 14 of the extended from of the periodic table with increases in atomic number, the oxidising power of tetravalent species increases in the order :

(A) Ge > Pb > Sn (B) Ge > Sn > Pb (C) Pb > Ge > Sn (D) Pb > Sn > Ge

2. CO forms a volatile compound with :

(A) nickel (B) copper (C) sodium (D) aluminium

3. H_2SO_4 is not used for the prepartion of CO_2 from marble chips because :

(A) It does not react

(B) huge amount of heat is evolved

(C) the reaction is vigorus

(D) calcium sulphate is sparingly soluble and get deposited on marble chips and stops the reaction

4. $(Me)_2 SiCl_2$ gives on hydrolysis :

(A) $(Me)_2 Si(OH)_2$ (B) $(Me)_2 Si = O$

(C) $-[—O—(Me)_2 Si—O—]_n—$ (D) $Me_2SiCl(OH)$

5. Corondum is :

(A) SiC (B) $SiCl_4$ (C) Al_2O_3 (D) CCl_4

6. Which is formed when $SiCl_4$ vapours are passed over hot Mg ?

(A) Si (B) $MgCl_2$ (C) Mg_2Si (D) $MgSiCl_6$

7. The carbide which gives propyne on hydrolysis :

(A) Al_4C_3 (B) CaC_2 (C) Fe_3C (D) Mg_2C_3

8. Which among the following carbide is methanide ?

(A) Al_4C_3 (B) CaC_2 (C) Be_2C (D) SiC

9. $[CF_6]^{2-}$ is not possible but $[SiF_6]^{2-}$ is possible due to :

(A) large difference inthe electronegativity of carbon and silicon

(B) large difference in size of carbon and silicon atoms

(C) the inbility of carbon to exapand its octet

(D) The inability of silicon to form double bonds

10. The formula of white lead is :

(A) $Pb(OH)_2.PbCO_3$ (B) $2PbCO_3.Pb(OH)_2$

(C) $Pb(OH)_2.Pb(CH_3COO)_2$ (D) $PbCO_3.PbO$

Comprehension # (11 to 14)

Pb insolbule in H_2O due to passive layer of oxide but soluble in excess of oxygen is called plumbosolvency.

Plumbosolvency can be increase by NO_3^-, HCO_3^-, ions & decreases by PO_4^{2-} , Cl^- ions.

11. Which of the following metal does not react with H_2O :

(A) Lead (B) Boron (C) Sodium (D) Tin

12. Plumbosolvency can be increase by :

(A) SO_4^{2-} (B) PO_4^{3-} (C) Cl^- (D) CH_3COO^-

13. Pb insoluble in water because :

(A) it is hard metal (B) it has less SRP

(C) due to passive layer of oxide (D) none

14. Which of the following statement is not correct ?

(A) Lead salts are slow poisons

(B) Lead metal is used in accumulators

(C) Plumbosolvency increases by the presence of carbonates, sulphates, phosphates, etc.

(D) Lead is a soft metal

15. Match the following :

Column-I	**Column-II**
(A) Si	(p) Forms Na_2MO_2 with NaOH
(B) Ge	(q) Forms mono & dioxide both
(C) Sn	(r) solid at room temperature
(D) Pb	(s) Shows +2, +4 oxidation state
	(t) shows –4 oxidation state

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DPP

FOR CLASS 12th

Set Your Target and Keep Try in Until You Reach It.

DPP 1 TO 65

ANSWER KEY

DPP No. # 1

1.	(D)	**2.**	(A)	**3.**	(D)	**4.**	(C)		
5.*	(A,B,D)	**6.***	(A,C,D)	**7.**	3	**8.**	(A)	**9.**	(A)
10.	(B)								

DPP No. # 2

1.	(B)	**2.**	(C)	**3.**	(C)	**4*.**	(ABE)
5*.	(ABD)	**6*.**	(BCD)	**7*.**	(ACD)	**8.**	440 mm of Hg.
10.	[A – q, r] ; [B – s] ; [C – p] ; [D – q].						

DPP No. # 3

1.	(D)	**2.**	(C)	**3.**	(C)	**4.**	(C)	**5.**	(D)
6.	(C)	**7.***	(ABC)	**8.***	(ABC)	**9.**	4		
10.	[A – p] ; [B – q,r] ; [C – p] ; [D – r,s].								

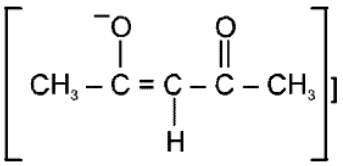
DPP No. # 4

1.	(B)	**2.**	(C)	**3.**	(A)	**4.**	(D)	**5.**	(C)
6.	0.9247, 27.796 g/mole.			**7.**	M = 24,600	**8.**	(C)	**9.**	(D)
10.	(B)	**11.**	(B)	**12.**	(D)				

DPP No. # 5

1.	C	**2.**	A	**3.**	C	**4.**	D

5. (a) Sodium pentacyanido-C-nitrosoniumferrate(II) (Sodium nitroprusside-diamagnetic)
(b) Bis (dimethylglyoximato) nickel (II)
(c) Ammonium dinitrosyltetrathiocyanato-S chromate (III)
(d) Diaquadiiodidodinitrito-O palladium (IV)
(e) Tetraamminechloridothiocyanato-N cobalt (III) ion
(f) Potassium tetraoxidoferrate (IV)
(g) Potassium tetraazidocobaltate (II) [N_3^- is azide]
(h) Dichloridobis(triphenylphosphine) nickel (II)

(i) Tris(acetylacetonato)chromium (III) [$(acac)^-$ is ]

(j) Tetrakis(pyridine)platinum(II) tetrachloridoplatinate (II)

6. (a) $Fe^{2+} + 6H_2O + Cl^- \longrightarrow [Fe(H_2O)_6]^{2+}\ Cl^-$
Cation is a complex ion and carries + 2 charge, hence its structure is
$[Fe^{II}(H_2O)_6]Cl_2$
Oxidation state of the metal ion has been given in the structure. Students may omit it.

(b) $K^+ + Ag^{3+} + 4F^- \longrightarrow K^+ [AgF_4]^-$
cation
anion is a complex $K^+ [Ag^{III}F_4]^-$

(c) $[Ti^{II}Cl_5]^{3-}$ (d) $[Co^{III}(NH_3)_4Cl_2]Cl$
(e) $[Ag^{I}(CN)_2]^-$ (f) $[Ni(NH_3)_2Cl_4]^{2-}$

(g) $[Cu^{II}(en)_3]SO_4$ (h) $Na[Al^{III}(H_2O)_2(OH)_4]$
(i) $[Cr^{III}(NH_3)Cl(en)_2]SO_4$ (j) $K_2[Zn^{II}(CN)_4]$

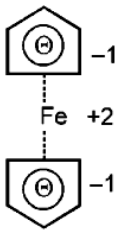
7. (A – p,q,r) ; (B – p,r) ; (C – p,q,r) ; (D – p,q,s,t)

DPP No. # 6

1. D **2.** ABC

3. (a) Hexaamminecobalt(III) pentachloridocuprate(II)
(b) Hexaaquavanadium(III) chloride
(c) Ammonium tri(oxalato)cobaltate(III)
(d) Tetraamminecobalt(III)-di- μ-hydroxidobis(ethylenediamine)cobalt(III) chloride
(e) Bis (ethylenediamine) cobalt (III)-μ-imido-μ-hydroxidobis(ethylenediamine) cobalt (IV) ion
(f) Sodium hexafluoridosilicate(IV)
(g) Potassium tetraoxidochromate(VI)
(h) μ-hydroxidobis-(pentaamminechromium(III)) chloride
(i) Tris(ethylene diamine) iron (III) tetracarbonyl iron (–III) (metal in this complex can also be iron (II))
(j) Tetrachloridobis(diethylether)titanium(IV)
(k) Decacarbonyldimanganese(0)
(l) Bis(acetylacetonato)oxidovanadium(IV)
(m) Iron (III) hexacyanido-C-ferrate(II) (also called Prussian blue)

4. (a) $[Cr^{III}(NH_3)_6]_2[Cu^{II}Cl_4]_3$ (b) $[Pt^{II}Cl_2(NH_3)_2]$
(c) $[Ni^0(CO)_4]$ (d) $[Pt^{II}(NH_3)_4][Pt^{II}Cl_3NH_3]_2$
(e) $Na_3[Ag^I(S_2O_3)_2]$ (f) $K_4[Ni^0(CN)_4]$
(g) $Fe[\eta^5 - C_5H_5]_2$
η^5 means that all the five carbon atoms of cyclopentadienyl anion are coordinated to the metal ion



(h) $[Zn^{II}(NCS)_4]^{2-}$ (i) $K[Mn^{VII}O_4]$ (j) $K_3[Al^{III}(C_2O_4)_3]$ (k) $[Pt^{II}(Py)_4][Pt^{II}Cl_4]$.

5. $[Co(NH_3)_4Cl_2]Cl$ Tetramminedichloridocobalt(III) chloride.

DPP No. # 7

1. C **2.** C **3.** D **4.** B **5.** D

6. C **7.** C

8. $Co(H_2O)_4(NO_2)_3$ $[Co(H_2O)_3(NO_2)_3]$. H_2O does not conduct electricity because no ion is generated in aq. sol. $[Co(H_2O)_4(NO_2)_2]NO_2$ will conduct electricity.

9. (i) $K_4[Fe(CN)_6]$ will produce 5 ions while $K_3[Fe(CN)_6]$ will produce 4 ions in aq. solution. So, higher molar conductivity.
(ii) $[Pt(NH_3)_2Cl_2]$ produce no ions but $[Pt(NH_3)_6]Cl_4$ produce 5 ions in aqueous solution. So, higher molar conductivity.
(iii) $[CoCl_3(NH_3)_3]$ will not produce any ion in aq. solution. So, conductivity. is zero.

10. Electrical conductivity depends on number of ions produced.
$[Co(NH_3)_6]Cl_3 > [Co(NH_3)_5Cl]Cl > [Co(NH_3)_3Cl_3]$

11. $CoCl_3\ 4NH_3$
Since only one Cl^- ion is precipiteated by Ag^+ ion. This implies that only one Cl^- ion outside coordination sphere.

DPP No. # 8

1. B **2.** C **3.** A **4.** C **5.** A

6. **(a)** A **(b)** C **7.** **(a)** C **(b)** C **8.** B **9.** A **10.** C

11. B **12.** B

DPP No. # 9

1. D **2.** B **3.** **(a)** C **(b)** A **4.** C **5.** B

6. B **7.** D **8.** ABCD

9. Stronger field ligand will split more so, more energy is required to transition of electrons from t_{2g} to e_g so, smaller wavelength light is required.

10. – 226, – 67. **11.** B **12.** B **13.** (A-p,q,r,s); (B-p,q); (C-p,q,r); (D-p,r,s)

DPP No. # 10

1. C **2.** A **3.** D **4.** A **5.** BC

6. ABC **7.** AC **8.** $K_f = 10^{10}$. **9.** C **10.** A

11. D **12.** [A - p,q,r] ; [B - p]; [C - p,r] ; [D - s,r] **13.** A **14.** B

DPP No. # 11

1. D **2.** A **3.** C **4.** ABCD **5.** AC

6. A **7.** $[Cd^{2+}] = 1.25 \times 10^{-11}$. **8.** 10 **9.** 6

10. 7 **11.** (A – p, q, s) ; (B – p, r, s) ; (C – p, q) ; (D – p, s)

DPP No. # 12

1. B **2.** B **3.** D **4.** B **5.** BCD

6. ABD **7.** 4 **8.** 1 **9.** 2 **10.** 6

DPP No. # 13

1. **(a)** (B) **(b)** (A) **(c)** (C) **2.** **(a)** (A) **(b)** (A)

3. **(a)** (B) **(b)** (B) **4.** **(a)** (B) **(b)** (B)

5. **(i)** (i) $HNO_2(aq) \rightleftharpoons H^+(aq) + NO_2^-(aq)$
Since, HNO_2 ionises to give H^+ hence, it is a Arrhenius acid.
(ii) $HNO_2(l) + H_2O(aq) \rightleftharpoons H_3O^+(aq) + NO_2^-(aq)$
acid 1 base 2 acid 2 base 1
HNO_2 donates a proton hence, it is an acid and changes to NO_2^- (conjugate base). $H_2O(l)$ accepts the proton hence, it is a base and change to H_3O^+ (conjugate acid). Thus HNO_2 is a Bronsted Lowry acid.

(ii) (a) $H_2SO_4 + H_2O \rightleftharpoons H_3O^+ + HSO_4^-$
acid 1 base 2 acid 2 base 1 (conjugatete)

(iii) (A) to the left (B) to the right
Reaction proceed to words the side favoring formation of weak acid and weak base.

(vi) (B) **(vii)** (A)

6. (i) strongest acid,HF; weakest acid HS^-. (ii) fluoride F^-.
(iii) The strongest acid (HF) has the weakest conjugate base.
(iv) The weakest acid (HS^-) has the stongest conjugate base.

7. (i) strongest base,NH_3; weakest base C_5H_5N. (ii) $C_5H_5NH^+$.
(iii) C_5H_5N has the strongest conjugate acid, and NH_3 has the weakest conjugate acid.

8. $\sqrt{12.5}$.

DPP No. # 14

1. **(a)** (C) **(b)** (B) **2.** **(a)** (C) **(b)** (B) **3.** **(a)** (B) **(b)** (D)

4. **(a)** $K_b\,[CN^-] = 2 \times 10^{-5}$ **(b)** 1.8×10^{-5}

5. **(a)** $K_a = 1.56 \times 10^{-10}$ **(b)** 1.8×10^{-5} **6.** $[OH^-] = 5 \times 10^{-9}$ M **7.** 0.02.

8. (a) pH = 3.3 (b) pH = 11.2 **9.** 10^{-9}.

10. (i) $[H_3O^+] = 6 \times 10^{-4}$ M (ii) 3% ionised at 0.02 M (iii) 3.22

11. 10. **12.** 2.438 mole/litre ; 1.562 mole/litre ; 1.562 mole/litre.

DPP No. # 15

1. **(a)** (B) **(b)** (C) **2.** **(a)** (A) **(b)** (C) **3.** (C)

4. (a) 2 (b) 1.7 (c) 12 (d) 12.3 **5.** (a) $[OH^-] = [NaOH] = 10^{-4}$; (b) $[OH^-] = 5 \times 10^{-3}$ M

6. 3.75×10^{-5} moles **7.** **(a)** 1.6. **(b)** 1.7.

8. (a) 0.15 N acidic, (b) 0.133 N acidic, (c) neutral, (d) neutral, (e) 0.05 N basic, (f) neutral, (g) 0.05 N basic

9. 12.5. **10.** 4.5×10^{-5} **11.** **(a)** pH = 2.92, $K_a = 1.44 \times 10^{-5}$ **(b)** 2.5×10^{-3}

12. (a) $K_a = 10^{-8}$ (b) $K_b = 10^{-6}$

DPP No. # 16

1. **(a)** (A) **(b)** (A) **2.** (C) **3.** (A,C,D)

4. (a) pOH will increase so pH decrease (b) $[H^+]$ will decrease so pH increase (c) No change (remains same)

5. (a) pH = 11.08 (b) pH = 13 (c) $K_b = 1.44 \times 10^{-5}$ (d) will suppress it.

6. **(a)** 900 mL. **(b)** 2.37, V = 2.5×10^4 litres. **7.** $[Sac^-] = 4 \times 10^{-12}$ M

8. 4.52. **9.** $[HC_2O_4^-] = 0.06$ M, (ii) $[C_2O_4^{2-}] = 6.4 \times 10^{-7}$ M.

10. (i) $[H^+] = 0.03$ M ; (ii) $[H_2PO_4^-] = 0.03$ M ; (iii) $[HPO_4^{2-}] = 6.2 \times 10^{-8}$, (iv) $[PO_4^{3-}] = 7.44 \times 10^{-19}$

11. (i) pH = 1.1 ; (ii) $[SO_3^{2-}] = K_{a2} = 6 \times 10^{-6}$ M.

12. (i) $[OH^-] = 9 \times 10^{-5}$ M, $[N_2H_5^+] = 9 \times 10^{-5}$; (ii) pOH = 4.04, $[N_2H_6^{2+}] = 9 \times 10^{-16}$.

DPP No. # 17

1. **(a)** (B) **(b)** (A) **2.** **(a)** (D) **(b)** (B) **(c)** (C)

3. $[S^{2-}] = 2.5 \times 10^{-15}$ **4.** (i) $[H_3O^+] = 5 \times 10^{-3}$ M (ii) $[H_3O^+] = 5 \times 10^{-3}$ M.

5. $[H^+] = 6.6 \times 10^{-5}$, $[HCO_3^-] = 6.06 \times 10^{-5}$, $[CO_3^{2-}] = 4.8 \times 10^{-11}$. **6.** $C_1 = 6$ M.

7. 2×10^{-11}. **8.** pH = 10.6. **9.** $[HS^-] = 4 \times 10^{-8}$ M ; $[S^{2-}] = 2.08 \times 10^{-20}$ M.

DPP No. # 18

1. (A) **2.** (A)

3.

	K_h	pH	%Hydrolysis
(i)	5×10^{-10}	8.7	0.01%
(ii)	5×10^{-10}	5.7	0.025%
(iii)	10.0	13.68	95%
(iv)	2.5×10^{-5}	11.60	0.625%
(v)	2.5×10^{-5}	7.0	0.5%
(vi)	1.25	9.35	52.8%

4. 9.08 **5.** 2.76×10^{-5} mol Lt^{-1}. **6.** 1.44×10^{-5} M. **7.** (a) 4.92 (b) 7.56

8. 0.3 mole of C_5H_5NHCl should be added to 500 ml solution of C_5H_5N.

DPP No. # 19

1. (B) **2.** **(a)** (A) **(b)** (C) **3.** **(a)** (D) **(b)** (C) **4.** 4.52, 5.48.

5. 3.25 **6.** 2.95×10^{-6} **7.** 3.162×10^{-5} **8.** **(i)** (D) **(ii)** (B) **(iii)** (C)

9. **(i)** (D) **(ii)** (A) **(iii)** (B)

DPP No. # 20

1. **(a)** (D) **(b)** (B) **2.** (B) **3.** (B) **4.** (C)

5. 10^{-5} mol L^{-1} **6.** 1.1×10^{-12}. **7.** 0.38 gm.

8. **(i)** 1.6×10^{-5} mol/lit. **(ii)** 2.56×10^{-9} mol/lit.

9. $s = 1.5 \times 10^{-8}$ mol/l^{-1} **10.** $s = 8 \times 10^{-8}$ M. **11.** $K_{sp} = 3.2 \times 10^{-11}$, $[Ca^{2+}] = 3.2 \times 10^{-9}$ mole/litre.

12. **(i)** 4×10^{-5} mole per litre **(ii)** 1.6×10^{-8} mol per litre.

DPP No. # 21

1. (D) **2.** (B) **3.** (B) **4.** (C)

5. 4×10^{-6} M, 2×10^{-4} M, 50 times.

6. (a) Will dissolve, 32% saturation (b) will not dissolve, 100% saturation.

7. $[Ag^+] = 5 \times 10^{-7}$M , $[IO_3^-] = 2 \times 10^{-2}$M, $[K^+] = 2 \times 10^{-2}$M. **8.** 15 ml. **9.** 10^{-6} M, 10^{-10} M.

10. $K_{sp} = 5 \times 10^{-7}$. **11.** 2×10^{-3}. **12.** $[F^-] = 3 \times 10^{-3}$M. **13.** 1.1×10^{-5} M.

DPP No. # 22

1. (A) **2.** (A) **3.** (C) **4.** (A) **5.** (C)

6. (D) **7.*** (B,D) **8.*** (A,B,C,D) **9.** 9 **10.** 5

11. 05 **12.** True **13.** **(i).** (A) **(ii).** (B) **(iii).** (A)

DPP No. # 23

1. (A) **2.** (A) **3.** (B) **4.** (B) **5.** (B)

6. (C) **7.** (C, D) **8.** (A,C,D) **9.** (3) **10.** 4

11. 03 **12.** (A – q,s,t) ; (B – p,q,t) ; (C – p,r) ; (D – q,s).

DPP No. # 24

1. **(a)** (B) **(b)** (D) **(c)** (D) **2.** (D) **3.** (D)

4. (C) **5.** (D) **6.** (D) **7.** (A)

8. **(a)** (A,B,C) **(b)** (A,B,C) **(c)** (C,D) **9.** (B,C,D) **10.** 6 J/K

11. **(a)** (i) 84.41 JK^{-1} mol^{-1} ; (ii) –84.14 JK^{-1} mol^{-1} **(b)** –11.50 KJ/mol.

12. **(a)** 481 K. **(b)** $\Delta H_{min} = T\Delta S = 36.06$ KJ. **13.** $\Delta S_{total} = 4980.6$ JK^{-1} $mol^{-1} > 0$

DPP No. # 25

1. **(a)** (B) **(b)** (D) **2.** (D) **3.** (B) **4.** (C) **5.** (B)

6. (A) **7.** (C) **8.** (B) **9.*** (A,B,C,D) **10.*** (A,B,C)

11.* (A,B,D) **12.** 8 **13.** $\Delta G° = 38.48$ KJ/mol ; $\Delta S° = -33.6$ JK^{-1} mol^{-1}.

DPP No. # 26

1. (A) **2.** (B) **3.** (A) **4.** (B) **5.** (B)

6. (D) **7.** (A) **8.** (D) **9.** (B) **10.** (B)

11. (A) **12.** (D) **13.** (ABC) **14.** (A) **15.** (C)

DPP No. # 27

1. (A) **2.** (C) **3.** (A) **4.** (B) **5.** (A)
6. (C) **7.** (B) **8.** (D) **9.** (B) **10.** (D)
11. (A,D) **12.** $E° = -1.59$ V, non-spontaneous **13.** $E = -2.4191$ V.

DPP No. # 28

1. (B) **2.** (A) **3.** (A) **4.** (C) **5.** (C)
6. (D) **7.** (B) **8.** (A,B,D) **9.** 3 **10.** 5

DPP No. # 29

1. (C)
2. $E°_{cell} = +0.01$ V, $E_{cell} = -0.0785$ V, correct representation is $Pb \mid Pb^{2+}(10^{-3}\ M) \mid\mid Sn^{2+}(1M) \mid Sn$.
3. $\log K_{eq.} = \frac{2 \times 0.777}{0.0591}$, $K_{eq.} = 2.18 \times 10^{26}$ **4.** $K_c = 1.864 \times 10^{107}$, $\Delta G° = -611.8$ kJ
5. $E° = 0.7826$ V **6.** (C) **7.** (C) **8.** (B) **9.** 8 **10.** 5

DPP No. # 30

1. (A) **2.** (B) **3.** (D) **4.** (D) **5.** (D)
6. 0.2204 V **7.** 5×10^{-12}. **8.** $\Delta S° = -241.45\ JK^{-1}$, $\Delta H° = -3.3437 \times 10^2$ kJ.
9. (A) - p,r; (B) - q,s; (C) - p,r ; (D) - q,s **10.** (B) **11.** (B)

DPP No. # 31

1. **(a)** (A) **(b)** (B) **2.** **(a)** (C) **(b)** (D) **3.** (B) **4.** (A) **5.** (C)
6. (C) **7.** (D) **8.** (C) **9.** (A) **10.** (A)
11. (A)

DPP No. # 32

1. (A) **2.** (B) **3.** (A) **4.** 0.02486 Molar.
5. 6.4×10^{-4} cm **6.** 1.4 A. **7.** (A) **8.** (C) **9.** (D)
10. (B)

DPP No. # 33

1. (D) **2.** (B) **3.** (B) **4.** (D) **5.** (B)
6. (A) **7.** (B) **8.** 40 Ω^{-1} cm^2 eq^{-1} **.9.** 1 **10.** 5

DPP No. # 34

1. (D) **2.** (D) **3.** (B) **4.** (D)
5. (A) $\rightarrow$ p, q, r, t ; (B) $\rightarrow$ p, q, r, t ; (C) $\rightarrow$ p, q, r, s, t ; (D) $\rightarrow$ p, q, r, t **6.** 2
7. 2 **8.** 6 **9.** K_{SP} $BaSO_4 = 1.167 \times 10^{-10}$ **10.** 0.69 cm^{-1}, 0.425.

DPP No. # 35

1. (B) **2.** **(a)** (C) **(b)** (B) **3.** (D) **4.** (D)
5. **(a)** (A) **(b)** (D) **6.** (D) **7.** (A) **8.** (B,C,D) **9.** (A)
10. (B)
11. $\underset{(A)}{(NH_4)_2Cr_2O_7} \longrightarrow N_2 + \underset{(C)}{Cr_2O_3} + 4\underset{(B)}{H_2O}$

Orange solid

$N_2 + 3\,Mg \xrightarrow{\Delta} Mg_3N_2$ (D)

$Mg_3N_2 + 6\,H_2O \longrightarrow 3\,Mg(OH)_2 + 2\,NH_3$ (E)

$NH_3 + HCl \longrightarrow NH_4Cl$ (white fumes)

12. **(a)** (i) Nitrogen exists as a diatomic molecule with triple bond (high bond enthalpy), where as phosphoru form single bond as P–P.

(ii) Due to its small size, high electronegativity, high ionisation enthalpy and non–availability of d–orbitals

(b) (i) Nitrogen → pπ–pπ multiple bond (very high bond enthalpy).

(ii) In phosphorus their atomic orbitals are so large and diffuse that they cannot have effective over lappin

(c) Basic character decreases down the group as size of atom increases and thus electron density decrease leading to decrease in electron donor capacity. Due to decrease in bond (E–H) dissociation enthalpy dow the group may act as acid rather than a base.

13. **(a)** $3CaO + 8P + 9H_2O \longrightarrow 3Ca(H_2PO_2)_2 + 2PH_3$

(b) (a) $AlN + 3H_2O \longrightarrow Al(OH)_3 + NH_3$

(b) $P_4O_6 + 6H_2O(cold) \longrightarrow 4H_3PO_3$

$P_4O_6 + 6H_2O\,(hot) \longrightarrow 3H_3PO_4 + PH_3$

(c) $C + 4\,HNO_3 \longrightarrow CO_2 + 4\,NO_2 + 2\,H_2O$

14. **(a)** Slow oxidation in air raises its temperature and when exceeds 30°c ignition tempt. catches fire

(b) Impure sample becomes inflammable owing to the presence of P_2H_4 or P_4 vapours.

$P_4 + 5O_2 \longrightarrow P_4O_{10}$

(c) $2PH_3 \xrightarrow{\text{decomposes}} 2P\,(red) + 3H_2$

15. **(i)** 6 **(ii)** 3 **(iii)** 2

DPP No. # 36

1. (D) **2.** (A) **3.** **(a)** (C) **(b)** (D) **4.** (B) **5** (A,D)

6. (A) **7.** (D) **8.** (A)

9. (a) High interelectronic repulsion of the non–bonding electrons owing to the small bond length $(\dot{\dot{N}} \equiv \dot{\dot{N}})$.

(b) Least $\Delta_{dissociation}H(E-H)$ bond.

(c) SbH_3 higher molecular weight leading to higher vander Waal's force of attraction (by magnitude).

10. **(a)** $3\,HNO_2 \longrightarrow H\,NO_3 + H_2O + 2\,NO$

$4\,H_3PO_3 \longrightarrow 3\,H_3PO_4 + PH_3$

(b) (A) $P_4 + 8SOCl_2 \longrightarrow 4PCl_3 + 4SO_2 + S_2Cl_2$

(B) $SO_2 + PCl_5 \longrightarrow SOCl_2 + POCl_3$

11. (A – p, q, s); (B – p, q, s) ; (C – p, s); (D – r, s) **12.** (B) **13.** (A) **14.** V = 1.763 L

DPP No. # 37

1. **(a)** (D) **(b)** (D) **2.** (D) **3.** **(a)** (A) **(b)** (C) **4.** **(a)** (B) **(b)** (C) **5.** (C)

6. **(a)** (C) **(b)** (A) **7.** **(a)** (B,C,D) **(b)** (A,C,D)

8. **(a)** (B) **(b)** **S_1 : (True) ; S_2 : (false)** **9.** (D)

10. **(a)** On the basis of atomicity, oxygen diatomic where as sulphur is polyatomic.

(b) $Na_2S_2O_3 + 2H^+ \longrightarrow 2Na^+ + H_2SO_3 + S\downarrow$ (colloidal sulphur)

(c) S_2 (in vapour state) has two unpaired electrons, like O_2

11. (A - p, q); (B - p, q, r) (C - p, q, r); (D - p, q)

DPP No. # 38

1. (A) **2.** (A) **3.** (B) **4.** **(a)** (D) **(b)** (C)

5. (A,B) **6.** (B) **7.** (A) **8.** (B)

9. (a) $2H_3PO_2 \longrightarrow H_3PO_4 + PH_3$ (b) $P_4O_{10} + 6\,PCl_5 \longrightarrow 10POCl_3$

10. **(i)** 0 **(ii)** 4 **(iii)** 4

DPP No. # 39

1. **(a)** (C) **(b)** (D) **2.** **(a)** (B) **(b)** (C) **(c)** (C) **3.** (A,C,D) **4.** (A,C)

5. (C) **6.** (A) **7.** (B) **8.** **(a)** (C) **(b)** (A) **(c)** (A)

9. **(a)** (D) **(b)** (D) **(c)** (B) **(d)** (A) **10.** (B) **11.** (A) **12.** (B)

13. $2KI(aq.) + Cl_2 \longrightarrow 2KCl(aq.) + I_2$
In the reaction Cl_2 oxidises iodide ion (–1 oxidation state) to I_2 (0 oxidation state). Cl_2 has higher reduction potential then I_2 and thus oxidises iodide to iodine getting itself reduced to chloride ion. Similarly,
$2KI + X_2 \longrightarrow 2KX + I_2$; (X = Cl, Br, F)

14. **(i)** 3 **(ii)** 6

DPP No. # 40

1. **(a)** (A) **(b)** (B) **2.** **(a)** (D) **(b)** (A) **3.** (C) **4.** **(a)** (C) **(b)** (A)

5. **(a)** (A) **(b)** (B) **(c)** (B) **6.** (C) **7.** (C) **8.** (A)

9. (A) $SiO_2 + 2F_2 \longrightarrow SiF_4 + O_2$.
(B) $Na_2S_2O_3 + H_2O + Cl_2 \longrightarrow Na_2SO_4 + 2HCl + \downarrow$
(C) $I_2 + 6H_2O + 5Cl_2 \longrightarrow 2HIO_3 + 10\,HCl$
(D) $2\,IO_3^- + 5\,HSO_3^- \longrightarrow 3HSO_4^- + 2SO_4^{2-} + I_2 + H_2O$
(E) $2KMnO_4 + 16HCl \longrightarrow 2KCl + 2MnCl_2 + 5Cl_2 + SH_2O$.

10. (A-p,q,r,s) ; (B-p,q,r) ; (C-q,s) ; (D-q) **11.** (A-q, s) ; (B-p) ; (C-q, r) ; (D-p, q, t) **12.** 8

DPP No. # 41

1. (B) **2.** **(a)** (C) **(b)** (A) **3.** **(a)** (B) **(b)** (B) **4.** **(a)** (D) **(b)** (A)

5. **(a)** (A) **(b)** (B) **6.** **(a)** (C) **(b)** (D) **7.** (C) **8.** (C)

9. **(a)** (B) **(b)** (A) **10.** **(a)** (D) **(b)** (C) **11.** (A) - (q) ; (B) - (p) ; (C) - (s) ; (D) - (r)

DPP No. # 42

1. (C) **2.** **(a)** (C) **(b)** (B) **3.** (C) **4.** (A) **5.** (C)

6. **(a)** (B) **(b)** (A) **7.** (A) **8.** (A) **9.** (B)

10. P_zQ_y **11.** 8, 4, 100%. It has fluorite (CaF_2) structure. **12.** 5.6 Å, 3.95Å

13. (A) 4.5 Å, (B) 5.2, (C) 8, (D) 6, (E) 0.92 g/mL **14.** 3.09×10^{22}

DPP No. # 43

1. (A) **2.** (A) **3.** (D) **4.** (C) **5.** (D)

6. (A) **7.** (A) **8.** 12 **9.** $8R^3$, 52.38% **10.** 0.53Å

11. **(i)** 4 **(ii)** 4 **12.** (D) **13.** (D) **14.** (B)

DPP No. # 44

1. (B) **2.** (D) **3.** (D)

4. AX : bcc structure, volume = 12.3 pm^3
AY : octahedral, volume = 216 pm^3

5. 2.178×10^{23}

6. Since the solid A^+B^- has NaCl type close packed structure, it belongs to a system of coordination number 6. In such case, the ratio of the cation to anion radii is given by

$$\frac{r_+}{r_-} = 0.414$$

Since r_- = 250 pm

$\therefore$ r_+ = 0.414 × 250pm = 103.5 pm = Radius of the cation

For any tetrahedral site the ratio of cation to anion radii should be between 0.225 and 0.414

Now $\frac{r_+}{r_-} = \frac{180 \text{ pm}}{250 \text{ pm}} = 0.72$

Since this ratio does not fall within the limit, the cation C^+ having a radius of 180 pm cannot be slipped/ accommodated into the tetrahedral site of the crystal A^+B^-.

7. (a) 1.268 Å, (b) 2.537 Å, (c) 2, (d) $4/3\ \pi\ (1.268)^3$ Å^3.

8. (a) 2.878 Å, (b) 4.07, (c) 12, (d) 6, (e) 19.4, (f) 0.74 **9.** (A - p,q,t) ; (B - s) ; (C - r) ; (D - p,q,t)

10. **(i)** 4 **(ii)** Na crystallizes in bcc structure in which coordination number of each atom is 8.

11. **(a)** (B) **(b)** (b)

DPP No. # 45

1.	**(a)** (B) **(b)** (A)	**2.**	**(a)** (D) **(b)** (A)	**3.***	(B,C)	**4.**	(A)	**5.**	(C)
6.	(C)	**7.**	**(a)** (A) **(b)** (C)	**8.**	97.78 %.	**9.**	AB_2O_4		
10.	(a) MnF_3 (b) 6 (c) a = 2(1.36 + 0.65) = 4.02 Å					**11.**	2.878 Å, 19.40 g /cc.		
12.	(i) 2.878 Å, (ii) 12, (iii) 197, (iv) 0.74			**13.**	(A $\rightarrow$ q,r) ; (B $\rightarrow$ p,s) ; (C $\rightarrow$ q) ; (D $\rightarrow$ q,r)				

DPP No. # 46

1.	(B)	**2.**	(D)	**3.**	(D)	**4.***	(A,B,D)	**5.***	(A,B)
6.*	(B,D)	**7.**	(B)	**8.**	(D)	**9.**	(B)	**10.**	(A)
11.	(A)	**12.**	(A $\rightarrow$ p,q,r,t) ; (B $\rightarrow$ p,t) ; (C $\rightarrow$ q,r,t) ; (D $\rightarrow$ p,s)			**13.**	(A)		
14.	**(i)** 6Å **(ii)** 5								

DPP No. # 47

1.	(D)	**2.**	(C)	**3.**	(D)	**4.**	(D)	**5.**	(C)
6.	(D)	**7.**	(D)	**8.**	(C)	**9.**	(C)	**10.**	(D)

DPP No. # 48

1.	(D)	**2.**	(B)	**3.**	(B)	**4.**	(C)	**5.**	(A)
6.	(C)	**7.**	(C)	**8.**	(D)	**9.**	(A)	**10.***	(BD)
11.*	(ABC)								

DPP No. # 49

1.	(D)	**2.**	(B)	**3.**	(D)	**4.**	(A)	**5.**	(A)
6.	(A)	**7.**	(B)	**8.**	(D)	**9.**	(B)		
10.	[A – r] ; [B – q] ; [C – r] ; [D – p].								

DPP No. # 50

1.	(A)	**2.**	(C)	**3.**	(A)	**4.**	(B)	**5.**	(C)
6.	(B)	**7.**	(D)	**8.**	(B)	**9.**	(D)		

10. Rate = $k[A]^1[B]^2$, $k = 5 \times 10^{-2}\ M^{-2}\ hr^{-1}$ **11.** t = 92.6 s.

12. $k = \frac{1}{t}\ln\left(\frac{P_0}{P_t}\right)$ **13.** $k = \frac{1}{t}\ln\left(\frac{P_0}{2P_0 - P_t}\right)$ **14.** $k = \frac{1}{t}\ln\left(\frac{P_\infty}{P_\infty - P_t}\right)$

DPP No. # 51

1. (A) **2.** (C) **3.** (D) **4.** (B) **5.** (B)

6. (A, B) **7.** 4 **8.** $k = \frac{1}{t}\ln\left(\frac{V_0}{V_t}\right)$ **9.** $k = \frac{1}{t}\ln\left(\frac{V_\infty - V_0}{V_\infty - V_t}\right)$

10. $k = \frac{1}{t}\ln\left(\frac{V_\infty - V_0}{V_\infty - V_t}\right)$ **11.** $k = \frac{1}{t}\ln\left(\frac{r_\infty - r_0}{r_\infty - r_t}\right)$ **12.** 3 **13.** $k = \frac{1}{t}\ln\left(\frac{3P_\infty}{5(P_\infty - P_t)}\right)$

DPP No. # 52

1. (D) **2.** (B) **3.** (C) **4.** (D) **5.** (A)

6. (A) **7.** (B) **8.** (B) **9.** (A) **10.** $K_C = 36.6$

DPP No. # 53

1. (A) **2.** (A) **3.** (D) **4.** (D) **5.*** (BC)

6. (AB) **7.** $k = k_3K_2\sqrt{K_1}$ **8.** $\frac{dC_D}{dt} = K_1C_A + K_3C_B - K_2C_D - K_4C_D$.

9. $1.25 \times 10^{-3}\ Ms^{-1}$ **10.** 1st order , 73%.

DPP No. # 54

1. (A) **2.** (B) **3.** (D) **4.** (A) **5.** (C)

6. (A) **7.** 2. **8.** $K = 5.25\ sec^{-1}$.

9. $k_1 = \frac{1}{90}\ln(2.5)min^{-1}$; $k_2 = \frac{1}{45}\ln(2.5)min^{-1}$. **10.** (A – p,s) ; (B – r, s) ; (C – q, s) ; (D – s)

DPP No. # 55

1. **(a)** (B) **(b)** (B) **2.** **(a)** (D) **(b)** (B) **3.** **(a)** (A) **(b)** (B) **4.** **(a)** (C) **(b)** (A)

5. **(a)** (A) **(b)** (C) **6.** **(a)** (A) **(b)** (B) **7.** **(a)** (C) **(b)** (A) **8.** (A - s, t) ; (B - p) ; (C - q, t) ; (D - r)

DPP No. # 56

1. (B) **2.** (B) **3.** (C) **4.** (C) **5.** (A)

6. (C) **7.*** (ABCD) **8.** (B) **9.** (A) **10.** (B)

11. (A) **12.** (A → p,q, r) ; (B → p, q, r) ; (C → q, s) ; (D → r).

DPP No. # 57

1. (A) **2.** (D) **3.** (B) **4.** (C) **5.** (B)

6. (C) **7.** (A) **8.** (A) **9.** (C) **10.** (C)

11. (B) **12.** (D) **13.** (A) **14.** (C)

DPP No. # 58

1. **(a)** (C) **(b)** (A) **2.** **(a)** (D) **(b)** (D) **3** **(a)** (D) **(b)** (A) **4** **(a)** (C) **(b)** (C)

5 **(a)** (C) **(b)** (C) **6.** (C) **7.*** (ABCD) **8.** (A) **9.** (B)

10. 6. **11.** 4 **12.** 6

DPP No. # 59

1	**(a)** (D) **(b)** (A)	**2**	**(a)** (D) **(b)** (A)	**3**	**(a)** (B) **(b)** (B)	**4**	**(a)** (B) **(b)** (D)				
5.	(C)	**6.**	(B)	**7.**	(D)	**8.**	(B)	**9.**	6		
10.	2	**11.**	3	**12.**	2						

DPP No. # 60

1.*	(ABD)	**2.**	(B)	**3.**	(D)	**4.**	(A)	**5.**	(C)
6.	(B)	**7.**	(A)	**8.**	(B)	**9.**	(B)	**10.**	(D)
11.	(C)	**12.**	(B)						

DPP No. # 61

1.	(A)	**2.**	(D)	**3.**	(C)	**4.**	(C)	**5.**	(A)
6.	(C)	**7.**	(C)	**8.**	(C)	**9.**	(D)	**10.**	(B)
11.	(C)								

DPP No. # 62

1. $BeCl_2$ is hydrolysed due to high polarising power and presence of vacant p-orbitals in Be-atom. (Be = $1s^2, 2s^2 2p_x^1\ 2p_y^0 2p_z^0$)

2. (i) Na_2O_2 is powerful oxidant and bleaching agent and bleaches red litmus paper to white in aqueous solution according to the following reaction,

$$Na_2O_2 + 2H_2O \longrightarrow 2NaOH + H_2O + [O]$$

$$[O] + \text{Litmus} \longrightarrow \text{White (bleaching)}$$

(ii) The other compound Na_2O will give NaOH on dissolution in water according to the following reaction.

$$Na_2O + H_2O \longrightarrow 2NaOH\ .$$

The red litmus will turn to blue due to stronger alkaline nature of NaOH

3. (C) **4.*** (AB) **5.** $SrSO_4 > CaSO_4 > MgSO_4 > BeSO_4$

6. Lower the size of cation, higher will be hydration tendency because hydration energy of cation is inversely proportional to size of cation. The size of alkaline earth metal ions are lower than the size of alkali metal ions. So in crystalline form the salts of alkaline earth metals have more water molecules than those of alkali metals.

7. Ba, Ba_3N_2, $Ba(OH)_2$ $BaCO_3$

8.	(A)	**9.**	(B)	**10.**	(A)	**11.**	(A)	**12.**	(D)

DPP No. # 63

1.	(C)	**2.**	(B)	**3.**	(D)	**4.**	(A)	**5.**	(B)
6.	(C)	**7.**	(ABCD)	**8.**	(C)	**9.**	(D)	**10.**	(B)

DPP No. # 64

1.	(A)	**2.**	(A)	**3.**	(D)	**4.**	(D)	**5.**	(A)
6.	(CD)	**7.**	(BD)	**8.**	(BC)	**9.**	(AB)	**10.**	(D)
11.	(A)	**12.**	(A)	**13.**	(A)				

14. (A – p,t,r); (B - p,s,t,r) ; (C- p,q,r,t) ; (D- p,q,r,t)

DPP No. # 65

1.	**(a)** (D) **(b)**	(D)		**2.**	(A)	**3.**	(D)	**4.**	(C)
5.	(C)	**6.**	(C)	**7.**	(D)	**8.**	(A)	**9.**	(C)
10.	(B)	**11.**	(A)	**12.**	(D)	**13.**	(C)	**14.**	(C)

15. (A– r, t); (B – p, q, r, s, t) ; (C – p, q, s, r) ; (D – p, q, s, r)

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GGSRDN

PHYSICAL & INORGANIC CHEMISTRY

DPP

FOR CLASS 12th

Set Your Target and Keep Try in Until You Reach It.

SOLUTIONS

DPP No. # 1

1. $M = \dfrac{0.2 \times 3}{\left(\dfrac{250}{1000}\right)} = 2.4$ M.

2. Vapour pressure is depend upon temperature
So at equilibrium, partial pressure of $H_2O(g)$ is equal to aqueous tension at that temperature.

3. The vapour pressure of a mixture of two immiscible liquids is the sum of their vapour pressures in the pure states, independent of their relative amounts. Hence, B.Pt. of the mixture will be less than that of either of the liquids, remaining constant throughout.

4. Mole fraction of more volatile substance is greater in vapour phase.

5.* Temperature ↑ , vapour pressure ↑.

6.* (A) $i = 1 + (n - 1)\alpha$
$i = 1 + (4 - 1) \times 0.8 = 3.4$
(B) For $BaCl_2$, $i = 1 + (3 - 1) \times 0.9 = 2.8$
(C) For Na_3PO_4, $i = 1 + (4 - 1) \times 0.9 = 3.7$
(D) For $K_4[Fe(CN)_6]$, $i = 1 + (5-1) \times 0.7 = 3.8$

7. $P = X_A P_A^0 + X_B P_B^0 = (P_A^0 - P_B^0)X_A + P_B^0$
So $P_B^0 = 265$
$P_A^0 - P_B^0 = -130$ $\qquad P_A^0 = 135$
$P_A^0 + P_B^0 = 300.$
$(P_A^0 + P_B^0) / 100 = 3.$

8. If terpinene is designated by A, and water by B, it follows that at 95°C, the boiling point of the mixture, p_B^0 is 634 mm, and hence p_A^0 is equal to $P - p_B^0$, i.e,

$744 - 634 = 110$ mm.

now using equation (3), $\dfrac{55}{45} = \dfrac{110 \times M_A}{634 \times 18} \Rightarrow M_A = 127$

9. Only immiscible liquids are efficiently steam distilled ethanol dissolves in water.

10. $P_{t°C} = P^0_{\text{water},t°C} + P^0_{\text{subs.},t°C}$
$P_{t = 98.5C} = 720.15 + 7.8 = 727.95$ mm of Hg
$P_{t = 99°C} = 733.24 + 7.97 = 741.21$ mm of Hg

temp. at which $P_t = 740$ mm of Hg $= 98.5 + \dfrac{(740 - 727.95)}{(741.21 - 727.95)} \times 0.5 = 98.95°C.$

DPP No. # 2

1. For gas,

$\dfrac{P_1V_1}{T_1} = \dfrac{P_2V_2}{T_2}$

$\dfrac{760 \times 91.9}{273} = \dfrac{P_2 \times 100}{288} \Rightarrow P_2 = 736.8$ mm of Hg

$P_{\text{total}} = P_{2,\text{gas}} + \text{V.P.} \Rightarrow \text{V.P.} = 750 - 736.8 = 13.2$ mm of Hg

2. $P = X_A P_A^0 + X_B P_B^0 = (P_A^0 - P_B^0)X_A + P_B^0$
So $P_B^0 = 254$
$P_A^0 - P_B^0 = -119$ $\qquad P_A^0 = 135$

3. For immiscible solution $= P_T = P_A^0 + P_B^0$
$= 400 + 200 = 600.$

4. For ideal solution, $\Delta V_{mix} = 0$, $\Delta H_{mix} = 0$, $\Delta S_{mix} = +$ ve, $\Delta G_{mix} = -$ ve,

5. $x_A P_A^\circ + x_B P_B^\circ = 700$ ...(i)
$x_A'' P_A^\circ + x_B'' P_B^\circ = 0.30\, P_A^\circ + 0.70\, P_B^\circ = 600$ ...(ii)
if moles of A & B initially are x & y then

$$x = 0.75 \times \frac{2}{3}(x+y) + 0.30 \times \frac{1}{3}(x+y)$$

& $x_A = \frac{x}{x+y}$ or $x_B = \frac{y}{x+y}$

Solving gives

$x_A = 0.6$, $x_B = 0.4$, $P_A^\circ = \frac{2500}{3}$ torr & $P_B^\circ = 500$ torr.

6. 1 mole glucose is present in 1000 ml solution
180 gm glucose is present in 1000×1.18 gm solution
180 gm glucose is present in 1180 – 180 gm solvent

$$\text{molality} = \frac{1}{1000} \times 1000 = 1$$

$$\%\ \text{w/v} = \frac{180}{1000} \times 100 = 18$$

$$\%\ \text{w/w} = \frac{180}{1180} \times 100 = 15.25$$

7. Only single solution have all these
means 100 ml solution have 5.85 gm NaCl = 0.1 mole
and 5.55 gm $CaCl_2$ = 0.05 mole
and 6 gm NaOH = 0.15 mole

$$[Cl^-] = \frac{(0.1+0.05\times 2)\times 1000}{100} = 2\ M \quad \Rightarrow \quad [Na^+] = \frac{(0.1+0.15)\times 1000}{100} = 2.5\ M$$

$$[Ca^{2+}] = \frac{0.05}{100} \times 1000 = 0.5\ M \quad \Rightarrow \quad [OH^-] = 1.5\ M$$

8. For vessel X
$400 \times 1.5 = P_X \times 4 \Rightarrow P_X = 150$ mm Hg
For vessel Y,
$208 \times 2.5 = 4 \times P_Y = 130$ mm of Hg
Total pressure $P_T = 150 + 130 + 160$
$= 440$ mm of Hg.

9. Millimoles of $Na_2SO_4 = 20 \times 0.5 = 10$
Millimoles of $H_2SO_4 = 50 \times 0.2 = 10$
Millimoles of $Al_2(SO_4)_3 = 30 \times 0.4 = 12$
$\Rightarrow$ Millimoles of $Na^+ = 20$
Millimoles of $H^+ = 20$
Millimoles of $Al^{3+} = 24$
Millimoles of $SO_4^{2-} = 10 + 10 + 36 = 56$
Total volume $= 20 + 50 + 30 = 100$ ml

$$[Na^+] = \frac{20}{100} = 0.2\ M$$

$$[H^+] = \frac{20}{100} = 0.2\ M$$

$$[Al^{3+}] = \frac{24}{100} = 0.24\ M$$

$$[SO_4^{2-}] = \frac{56}{100} = 0.56\ M$$

10. (a) $[Cl^-] = \frac{50\times3+150\times1\times3}{200} = \frac{600}{200} = 3\ M$ & $[H^+] = \frac{50\times3}{200} = 0.75\ M$

(b) Molality $= \frac{0.1}{0.9\times18}\times1000 = 6.17\ m$

(c) Molality $= \frac{\frac{10}{60}}{90}\times1000 = 1.85\ m$

(d) Molarity of HCl $= \frac{\frac{10.95}{36.5}}{100}\times1000 = 3\ M \Rightarrow [H^+] = [Cl^-] = 3M$

DPP No. # 3

1. $i = 1 + (n-1)\alpha$

(A) For KCl, $i = 1 + 0.5 = 1.5$

(B) For K_2SO_4, $i = 1 + 2\times0.4 = 1.8$

(C) For $SnCl_4$, $i = 1 + 4\times0.2 = 1.8$

(D) For $FeCl_3$, $i = 1 + 3\times0.3 = 1.9$

2. Osmotic pressure will be same for equimolar solutions if Van't Hoff factor is same.

$K_4[Fe(CN)_6] \rightarrow i = 1 + (n-1)\alpha = 1 + 4 = 5$

$Al_2(SO_4)_3 \rightarrow i = 1 + (n-1)\alpha = 1 + 4 = 5$

3. The loss in weight should be proportional to vapour pressure above that solution :

So, $P_{S_A} \propto 2gm \Rightarrow P_{S_B} \propto 1.5gm \Rightarrow P_{S_C} \propto 2.5gm$

So, maximum vapour pressure is above C solution hence, it is having minimum lowering and hence minimum mole fraction (hence minimum number of moles of solute) So max. molar mass of substance.

4. Boiling point of solution = boiling point + $\Delta T_b = 100 + \Delta T_b$

Freezing point of solution = freezing point $- \Delta T_f = 0 - \Delta T_f$

Difference in temperature (given) $= 100 + \Delta T_b - (-\Delta T_f)$

$103.57 = 100 + \Delta T_b + \Delta T_f = 100 + \text{molality}\times K_b + \text{molality}\times K_f$

$= 100 + \text{molality}\ (0.52 + 1.86)$

$$\text{Molality} = \frac{103.57-100}{2.38} = \frac{3.57}{2.38} = 1.5\ m$$

and molality $= \frac{\text{moles}\times1000}{W_{gm\ (solvent)}}$; $1.5 = \frac{\text{moles}\times1000}{500}$

$$\text{Moles of solute} = \frac{1.5\times500}{1000} = 0.75\ \text{moles}$$

Ans. 750 mmoles

5. $\Delta T_f = iK_f\ m$

$0.74 = i\times1.36\times0.4 \Rightarrow i = 0.9945 \approx 1 \Rightarrow i = 1 + \alpha \approx 1 \Rightarrow \alpha \approx 0$

6. Suppose V_1 litres of the solution contains n moles of the solute at 12°C which was diluted to V_2 litres at 27°C.

Thus we have

$$\frac{500}{760} = \frac{n}{V_1} \times 0.082 \times 285 \qquad ...(i)$$

and $$\frac{100}{760} = \frac{n}{V_2} \times 0.082 \times 300$$

Dividing (1) by (2), we get $\frac{V_2}{V_1} = 5.3$.

8.* The substance which will produce maximum particles pergram will be most efficient.

Particles produced by 1 g of LiCl = $\frac{1}{42.5} \times 2 = 0.047$

Particles produced by 1 g of NaCl = $\frac{1}{58.5} \times 2 = 0.034$

Particles produced by 1 g of glucose = $\frac{1}{180} \times 2 = 0.011$

Particles produced by 1 g of $CaCl_2$ = $\frac{1}{111} \times 3 = 0.027$

Answer is LiCl.

9. $\Delta T_f = K_f m$

$$0.19 = 4.9 \times \frac{\frac{1}{M}}{\frac{86}{1000}}.$$

$$0.19 = 4.9 \times \frac{1000}{M \times 86}. \quad \Rightarrow \quad M = \frac{4.9 \times 1000}{86 \times 0.19} = 300. \quad \Rightarrow \quad \text{Atomicity} = \frac{300}{75} = 4.$$

10. Hexane & Heptane solution do not form azeotrope, but have different boiling points, so can be separated by fractional distillation. Acetione & chloroform form maximum boiling azeotrope ethanol & water form minimum boiling azeotrope. Azeotropes cannot be separated completely by fractional distillation chlorobenzene & bromobenzene do not form azeotrope but have different boiling points. so can be separated by fractional distillation.

DPP No. # 4

1. (b) $\pi \propto$ No. of particles/ions.
$BaCl_2$ = 3, NaCl = 2 glucose = 1
So. order of π = $BaCl_2$ > NaCl > glucose

2. $Na_2SO_4 \rightleftharpoons 2Na^+ + SO_4^{2-}$
$a(1-\alpha)$ $2a\alpha$ $a\alpha$

$i = \frac{a(1+2\alpha)}{a} = 1 + 2\alpha$

Where α is degree of dissociation of Na_2SO_4
Solution of Na_2SO_4 & glucose are isotonic

So $\pi_{Na_2SO_4} = \pi_{glucose}$

$\Rightarrow$ $i \times 0.004 \times R \times T = 0.010 \times R \times T$

$\Rightarrow$ $(1+ 2\alpha) = \frac{10}{4}$

$1 + 2\alpha = 2.5$

$\alpha = 0.75$

$\Rightarrow$ % dissociation = 75 %

3. Experimental molarity = 3 × 0.05 = 0.15; So osmotic pressure = 1.5P.

4. $\Delta T_f = K_f m$
$10^{-2} = 0.1 \times m \Rightarrow m = 0.1$ m

$$\text{molality} = \frac{2.56 \times 1000}{M \times 100} = 0.1 \Rightarrow M = 256 \quad \Rightarrow \quad \text{atomicity} = \frac{256}{32} = 8.$$

5. On addition of non volatile solute, freezing point decreases.
Entropy of solution is more than entropy of pure solvent.

6. $\Delta T_f = 0.0358^\circ C$
$\Delta T_f = i \times K_f \times m$
$0.0358 = i \times 1.86 \times 0.01$
$i = 1.9247$
For NH_4Cl. $i = (1 + \alpha)$
$\Rightarrow 1 + \alpha = 1.9247$
$\alpha = 0.9247$

$$\& \quad i = \frac{M_T}{M_{ob}}$$

$$\Rightarrow M_{ob} = \frac{53.5}{1.9247} = 27.796 \text{ g/mole}$$

7. 0.2 percent solution means 0.2 g of cellulose acetate dissolved in 100 ml of solution.
Osmotic pressure = 2.58 cm of acetone

$$P = 2.58 \times \frac{0.80}{13.6} \text{ cm of Hg} = 0.152 \text{ cm of Hg}$$

$$P = \frac{0.152}{76} \text{ atm} = 2 \times 10^{-3} \text{ atm (1atm = 76 cm of Hg)}$$

suppose M is the molecular weight of cellulose acetate.

$$n = \frac{0.2}{M}, V = 100 \text{ ml} = 0.1 \text{ litre}; R = 0.082$$

and T = 300 K

$$\text{Now } P = \frac{n}{V} RT$$

$$2 \times 10^{-3} = \frac{0.2/M}{0.1} \times 0.082 \times 300$$

M = 24,600

8. Cryoscopic constant $K_f = \Delta T_f$ of solution having unit molality of normal solutes

$$\text{Molality of glucose solution in (c)} = \frac{9 \times 1000}{(59 - 9) \times 180} = 1$$

9. Since the solution has greater entropy (disorder) than the pure liquid, so former has lesser tendency to freeze i.e., the temperature has to be lowered to freeze the solution.

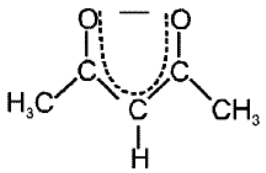
10. $2Na^+ (aq) + 2I^- (aq) + HgI_2(s) \longrightarrow 2Na^+ (aq) + HgI_4^{2-} (aq)$
The number of mole particle decreases from 4 ($2Na^+ + 2I^-$) to 3 ($2Na^+ + HgI_4^{2-}$). Hence, the colligative property will decrease and, the vapour pressure will increase to a constant value until NaI is completely consumed.

11. $K_f = \frac{RT_f^{02}M}{1000\Delta H_{fus}}$ would be larger for larger value of T°_f and smaller value of enthalpy of fusion of the solid solvent.

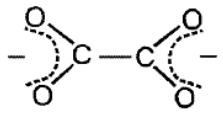
12. The vapour pressure of a mixture of two immiscible liquids is the sum of their vapour pressures in the pure states, independent of their relative amounts. Hence, B.Pt. of the mixture will be less than that of either of the liquids, remaining constant throughout.

DPP No. # 5

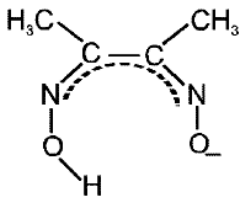
7. (A) Acetyl acetonato ($CH_3COCHCOCH_3^-$)



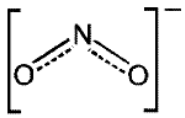
(B) Oxalato ($C_2O_4^{2-}$)



(C) Dimethylglyoximato ($HONCC(CH_3)C(CH_3)NO^-$)



(D) Nitrito (NO_2^-)
It may link to central metal ion either through nitrogen or oxygen ; so it is ambidentate ligand.



DPP No. # 6

1. By defination.

2. Azide ion (N_3^-) does not act as bidenate ligand because it is linear and it is not possible to donate both the electrons simultaneously to same metal ion/atom.

DPP No. # 7

1. $Co(NH_3)_5 NO_2 Cl_2$
1 mole of this complex gives 3 moles of ions in aq. solution.
1 mole of this complex gives 2 mole of AgCl $\Rightarrow$ $2Cl^-$ outside the coordination sphere.
$\therefore$ $[Co(NH_3)_5 NO_2] Cl_2$
$Co(NH_3)_5 NO_2 Cl_2$

2. $[Cr Cl_2 (H_2O)_4] Cl.2H_2O$ will liberate $\frac{1}{3}$ of the total chloride ions for precipitation.

3. Eq. conductance at infinite dilution depends on no. of ions produced in the sol.
$[Pt(NH_3)_6] Cl_4 > [Pt(NH_3)_3 Cl]Cl_3 > [Pt(NH_3)_4 Cl_2] Cl_2 > [Pt(NH_3)_3 Cl_3] Cl \longrightarrow$ no. of ions produced in the solution.

4. (B) E.A.N. = 26 – 2 + 12 = 36

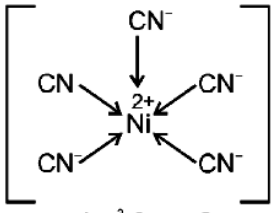
5. In $[CuCl_2]^-$ EAN = 28 + 4 = 32

6. According rule of bridging ligand(s) naming

7. Bridging ligands are NH_2^- and OH^-

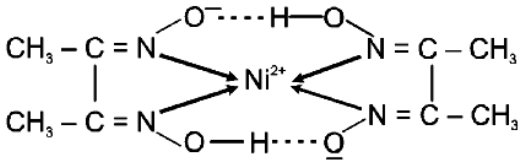
DPP No. # 8

1. According to the question, $k_3[Ni(CN)_5]$ is diamagnetic and square pyramidal with non-zero dipole moment.



dsp^3 & $\mu \neq 0$
square pyramidal

2. The complex is



square planar (dsp^2)

3. **(A)** On the basis of number of electrons the correct order is P > Q > R > S.

	Complex	**No. of unpaired electrons.**
(P)	$[FeF_6]^{3-}$	5
(Q)	$[CoF_6]^{3-}$	4
(R)	$[V(H_2O)_6]^{3+}$	2
(S)	$[Ti(H_2O)_6]^{3+}$	1.

4. **(C)** In the first complex, ligand is O_2^{2-} which is oxidised into O_2^{1-} hence, O – O bond length decreases.

5. SeF_4 and XeO_2F_2 are both sp^3d hybridized, trigonal bipyramidal and see-saw shaped with 1 lone pair of electrons each.
SF_4 has 1 lone pair, XeF_2 has 3 lone pairs. $XeOF_4$ is square pyramidal with 1 lone pair, TeF_4 is see-saw shaped with 1 lone pair, $SeCl_4$ has see-saw shape with 1 lone pair, XeF_4 has planar shape with 2 lone pairs.

6. **(a)** Increase Order of ligands Strength $I^- < H_2O < NH_3 < CN^-$

(b) SFL $d^6 = t_{2g}^{2,2,2} eg^{0,0}$ – diamagnetic
WFL $d^6 = t_{2g}^{2,1,1} eg^{1,1}$ – Paramagnetic.

7. **(a)** Since this is a d^1 system.

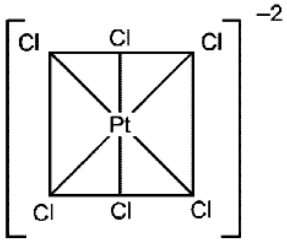
(b) In $[Fe(CN)_6]^{4-}$; Fe(II) is t_{2g}^6 , e_g^0 due to strong ligands.

8. CFSE depends on the strength of ligands which follows order
$CN^- > NH_3 > H_2O > F^-$.
On the basis of nature of ligands the correct order is Q > R > S > P.

9. $2[Ag(CN)_2]^- + Zn \longrightarrow 2Ag + [Zn(CN)_4]^{2-}$.
$Zn^{2+} \longrightarrow 3d^{10}$, Shape of $[Zn(CN)_4]^{2-}$ is tetrahedral.

10. $2KCl + PtCl_4 \longrightarrow K_2[PtCl_6]$

11.



d^2sp^3

12. Meq. of complex = Meq. of base

$$\frac{0.319}{268.5} \times 1000 \times \text{V.F.} = 0.125 \times 28.5 \times 1$$

V.F. ≈ 3

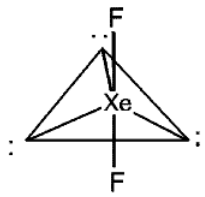
DPP No. # 9

1. The given complex is actually.

$$\left[\overset{+2}{\text{Fe}}\,(\overset{-1}{\text{Cl}})\,(\overset{-4}{\text{CN}})_4\,(\overset{-1}{\text{O}_2})\right]^{4-}$$

hence Fe(II) is t_{2g}^6, e_g^0 due to effect of strong ligands but it is paramagnetic due to O_2^{-1} ligand.

2.



3. **(a)** The options can give CFSE = – 0.6 Δ_0 with weak field ligands ⇒ d^4 and d^9.
(b) Ammonia is a stronger field ligand than water.
So, CFSE of $[Ni(NH_3)_6]^{2+}$ is greater than $[Ni(H_2O)_6]^{2+}$

4. In A, NO^+ has no unpaired e^-s. So, complex is diamagnetic but in B, NO is odd e^- molecule, having one odd e^-. So, B is paramagnetic.

5. Diamagnetic complexes shows decrease in weight when placed in magnetic balance.
$Ni(CO)_4 \rightarrow$ Tetrahedral & diamagnetic
$K[AgF_4] \rightarrow$ Square planar & diamagnetic
$Na_2[Zn(CN)_4] \rightarrow$ Tetrahedral & diamagnetic

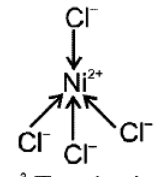
6. It is not showing geometrical isomerism ⇒ Tetrahedral & paramagnetic.

7. The complex is actually

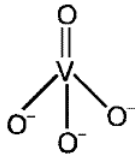
$$k_2\left[\overset{(I)}{\text{Cr}}(\text{CN})_4\,(\text{NH}_3)(\overset{+}{\text{NO}})\right]$$ in which Cr(I) is d^2sp^3 hybridised with one unpaired electron.

8. (A) $H_3N \rightarrow Ag^+ \leftarrow NH_3$ (linear & sp hybridisation)

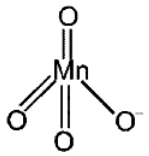
(B)



sp^3 Tetrahedral

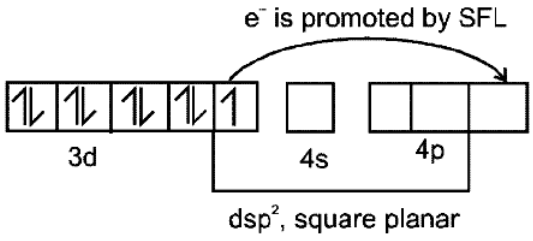


sp^3 Tetrahedral



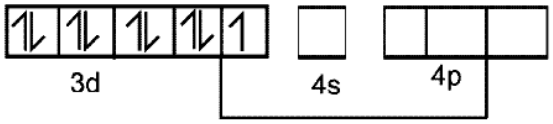
sp^3 Tetrahedral

(C) $[Cu(NH_3)_4]^{2+} \rightarrow$ $Cu^{2+} \rightarrow 3d^9, 4s^0$



dsp^2, square planar

$[Ni(CN)_4]^{2-}$ → $Ni^{2+} \rightarrow 3d^8, 4s^0$



dsp^2, square planar

$[Pt(NH_3)_4]^{2+}$

4d & 5d metals always forms square planar with 4 ligands.

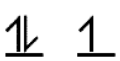
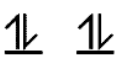
(D) $Fe(CO)_5$; $Fe \rightarrow 3d^6, 4s^2$

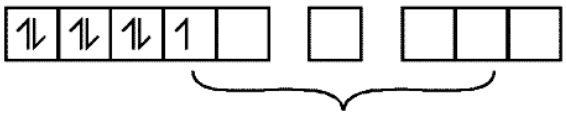
dsp^3, TBP

9. Stronger field ligand will split more so, more energy is required to transition of electrons from t_{2g} to e_g so, smaller wavelength light is required.

10. CFSE of V^{2+} = – 3917 – (– 3691).
= – 226 kJ/mol.
CFSE of Fe^{2+} = observed L.E. – L.E. (in absence of CFSE).
= – 3923 – (– 3856) = – 67 kJ/mol.

11. Ti^{+3} is $3d^1$ system, $\Delta_0 = 6.63 \times 10^{-34} \times 3 \times 10^8 \times 20300 \times 10^2$ J/ion
$= 6.63 \times 10^{-34} \times 3 \times 10^8 \times 20300 \times 10^2 \times 10^{-3} \times 6.02 \times 10^{23}$ kJ/mol = 243 kJ/mol.
Now, CFSE $= 0.4 \times \Delta_0 = 0.4 \times 243 = 97.2$ kJ/mol.

12. (1)  D (0) , (2)  P (4) , (3)  P(3),

(4) 

P(1)

dsp^2

13. (A) $[Cr(H_2O)_6]Cl_3$ (aq) $\rightleftharpoons$ $[Cr(H_2O)_6]^{3+}$ (aq) + $3Cl^-$ (aq)
$[Cr(H_2O)_5Cl]\ Cl_2.H_2O$ (aq) $\rightleftharpoons$ $[Cr(H_2O)_5Cl]^{2+}$ (aq) + $2Cl^-$ (aq)

(B) $[Co(NH_3)_5Br]SO_4$ (aq) $\rightleftharpoons$ $[Co(NH_3)_5Br]^{2+}$ (aq) + SO_4^{2-} (aq)
$[Co(NH_3)_5SO_4]Br$ (aq) $\rightleftharpoons$ $[Co(NH_3)_5SO_4]^+$ (aq) + Br^- (aq)

(C) $[Co(NH_3)_5Cl]Cl_2$ (aq) $\rightleftharpoons$ $[Co(NH_3)_5Cl]^{2+}$ (aq) + $2Cl^-$ (aq)
$[Co(NH_3)_6]Cl_3$ (aq) $\rightleftharpoons$ $[Co(NH_3)_6]^{3+}$ (aq) + $3Cl^-$ (aq)

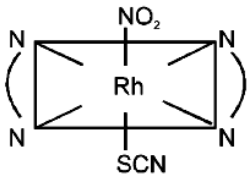
(D) $[Cu(H_2O)_4]SO_4.H_2O$ (aq) $\rightleftharpoons$ $[Cu(H_2O)_4]^{2+}$ (aq) + SO_4^{2-} (aq)
$[Cu(H_2O)_6](NO_3)_2$ (aq) $\rightleftharpoons$ $[Cu(H_2O)_6]^{2+}$ (aq) + $2NO_3^-$ (aq)

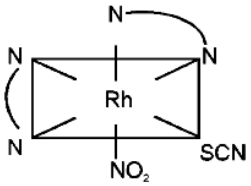
DPP No. # 10

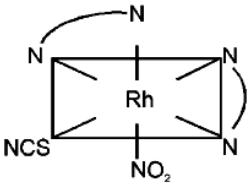
1. (A) is tetrahedral. So, No G.I.
(B) is square planar [Pt(II) complex]. So, No optical isomerism
(C) is Fe(I) complex, contains three unpaired e^-s.

2. Pt(II) is $5d^8$, forms square planar complex which is diamagnetic. $[PtCl_2(NH_3)(OH_2)]$ will show geometrical isomerism.

3.







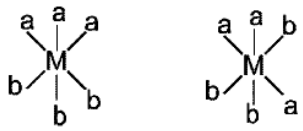
(1) NO_2 / SCN
(2) ONO / SCN
(3) NO_2 / NCS
(4) ONO NCS

(5) NO_2 / SCN
(6) ONO / SCN
(7) NO_2 / NCS
(8) ONO / NCS

(9)
(10)
(11)
(12)
} Mirror images of (5), (6), (7), (8)

* Only cis isomer is optically active.

4.

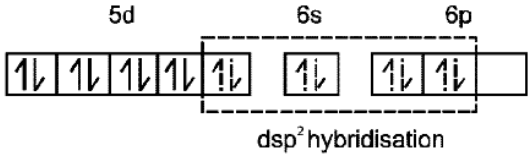


5. I and IV have POS.

6. (A) Both cation & anion are complex.
(B) SCN^- is ambidentate ligand. So, linkage isomerism.
(C) Anion are acting as ligand. So, it can show ionization isomerism.

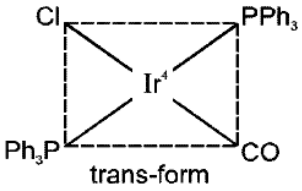
7. (A) $[IrCl(CO)(PPh_3)_2]$ carbonylchloridobis(triphenylphosphine)iridium(I).
(B) Coordination number of Ir is four. Ir is in (+1) oxidation state with $4d^8$ configuration. It is trans isomer, so its geometry should be square planar.

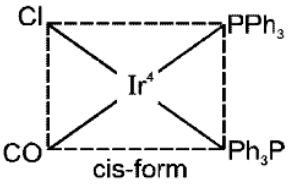
$[IrCl(CO)(PPh_3)_2]$



(C) All electrons are paired ; so magnetic moment is zero.

(D)





The complex has plane of symmetry, so it does not show optical isomerism.

8.
$[Fe(H_2O)_6]^{3+} + en \rightarrow [Fe(H_2O)_4en]^{3+}$ $\quad K_{eq} = K_1$
$[Fe(H_2O)_4 en]^{3+} + en \rightarrow [Fe(H_2O)_2 (en)_2]^{3+}$ $\quad K_{eq} = K_2$
$[Fe(H_2O)_2 (en)_2]^{3+} + en \rightarrow [Fe (en)_3]^{3+}$ $\quad K_{eq} = K_3$
$[Fe(H_2O)_6]^{3+} + 3en \rightarrow [Fe (en)_3]^{3+}$ $\quad K_f = K_1 \times K_2 \times K_3$

$\log K_f = \log K_1 + \log K_2 + \log K_3$
$= 4.44 + .41 + 2.15 = 10 \quad \Rightarrow K_f = 10^{10}$

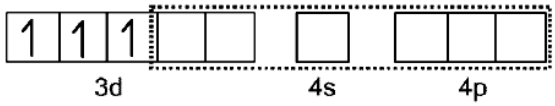
9. $[Co(NH_3)_5(NO_2)]Cl_2$ & $[Co(NH_3)_5(ONO)]Cl_2$ have different color

10. In this, donor atom can be 'N' or 'O' i.e. NO_2^-, ONO^-

11. NO_2^-, ONO^- are ambidentate ligands.

12. (A) $[Cr(NH_3)_6]^{3+}$

$Cr^{3+} \longrightarrow 3d^3, 4s^0$



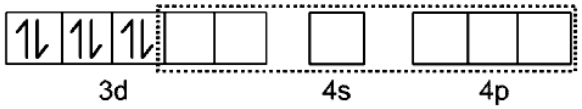
d^2sp^3 hybridisation

$CFSE = -3 \times (-0.4\ \Delta_0) = -1.2\ \Delta_0$

(B) $[Co(en)_3]^{3+}$

$Co^{3+} \longrightarrow 3d^6, 4s^0$

en is a SFL. so, pairing will take place.



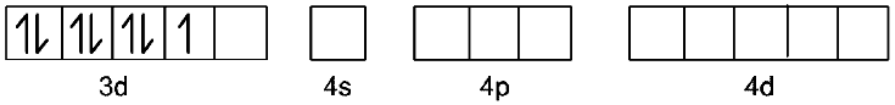
d^2sp^3 diamagnetic

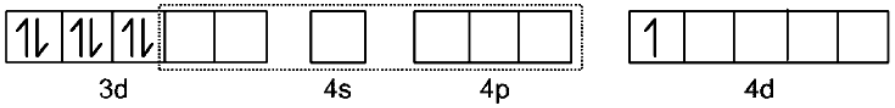
CFSE = $6 \times (-0.4\ \Delta_0) + 2p = -1.2\ \Delta_0 + 2p$

(C) $[Co(NO_2)_6]^{4-}$

$Co^{2+} \longrightarrow 3d^7, 4s^0$

NO_2^- is a SFL, so, pairing will take place and 1 electron is promoted to higher d-orbitals

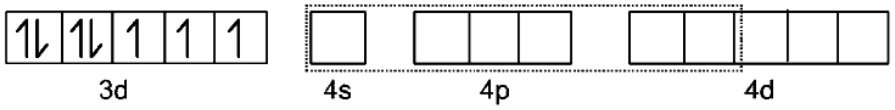




d^2sp^3 Paramagnetic

(D) $[Co(H_2O)_6]^{2+}$

$Co^{2+} \longrightarrow 3d^7, 4s^0$



sp^3d^2 Paramagnetic

13. In Tetrahedral All bond angle are 109°.28' So It is symmetrical

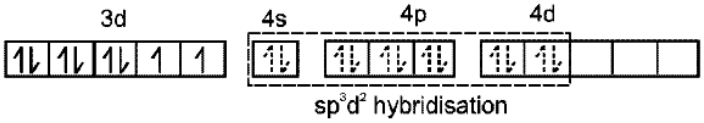
14. $[NiF_6]^{4-} \longrightarrow F^-$ is a weak ligand, so high spin complex with two unpaired electron.
$[NiF_6]^{2-} \longrightarrow$ Low spin complex even with weak field ligands. On d^6 arrangment with +4 oxidation state will have higher CFSE leading to pairing of electrons and complex will be diamagnetic.

DPP No. # 11

1. (A) $[Pt(NH_3)_2Cl(NO_2)]$ and $[Pt(NH_3)_2Cl(ONO)]$ are linkage isomers.
(B) $[Pt(NH_3)_2Cl\ (NH_2CH_3)]Br$ and $[Pt(NH_3)_2Br\ (NH_2CH_3)]Cl$ are ionisation isomers.
(C) $[Cr(H_2O)_5Cl]Cl_2.H_2O$ and $[Cr(H_2O)_6]Cl_3$ are hydrate isomers.
(D) $[Co(NH_3)_6][Cr(CN)_6]$ and $[Cr(NH_3)_6][Co(CN)_6]$ are coordination isomers.
Correct IUPAC name is hexaamminechromium(III) hexacyanidocobaltate(III).

2. (a) $_{28}Ni$ is in +2 oxidation state with electron configuration $[Ar]^{18}\ 3d^8\ 4s^0$, so

$[Ni\ (NH_3)_6]^{2+}$

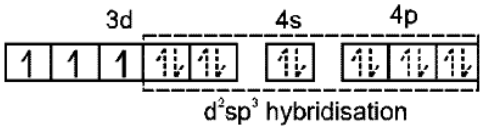


sp^3d^2 hybridisation

Number of unpaired electrons = 2

(b) $_{24}Cr$ is in +3 oxidation state with electron configuration $[Ar]^{18}\ 3d^3\ 4s^0$; so

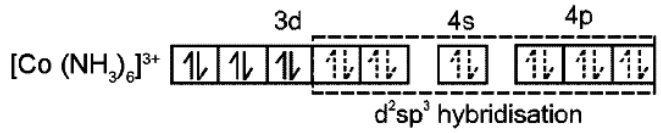
$[Cr\ (NH_3)_6]^{3+}$



d^2sp^3 hybridisation

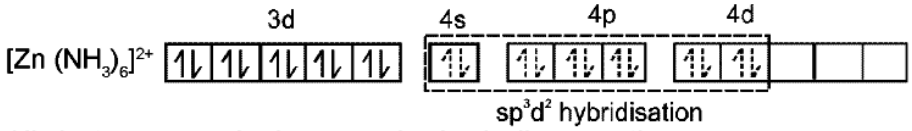
Number of unpaired electrons remains three, whether ligand is strong field or weak field ligand when electron configuration is $3d^3$.

(c) $_{27}Co$ is in +3 oxidation state with electron configuration $[Ar]^{18}\ 3d^6\ 4s^0$, so



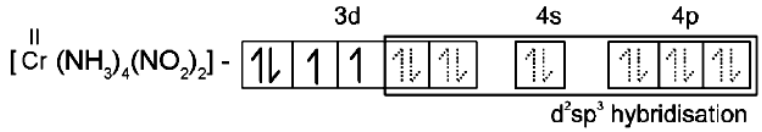
All electrons are paired, so complex ion is diamagnetic.

(d) $_{30}Zn$ is in +2 oxidation state with electron configuration $[Ar]^{18}\ 3d^{10}\ 4s^0$, so



All electrons are paired, so complex ion is diamagnetic.

3. $_{24}Cr$ is in +2 oxidation state with $[Ar]^{18}3d^4$ configuration. It is inner orbital complex, so ;



Number of d-electrons is four and number of unpaired electrons is two.

It shows geometrical and linkage isomers.

$NO_2 - NO_2$ cis-trans.

$NO_2 - ONO$ cis-trans.

$ONO - ONO$ cis-trans.

Total number of isomers = 6.

4. (A) $[Co(NH_3)_5(NO_2)]Cl$ and $[Co(NH_3)_5(ONO)]Cl$ - linkage isomerism

$[Co(NH_3)_5(NO_2)]Cl$ and $[Co(NH_3)_5Cl]NO_2$ - ionization isomerism

(B) $[Co(NH_3)_5(H_2O)](NO_2)_3$ and $[Co(NH_3)_5(NO_2)](NO_2)_2.H_2O$ - hydrate isomerism

$[Co(NH_3)_5(NO_2)](NO_2)_2.H_2O$ and $[Co(NH_3)_5(ONO](NO_2)_2.H_2O$

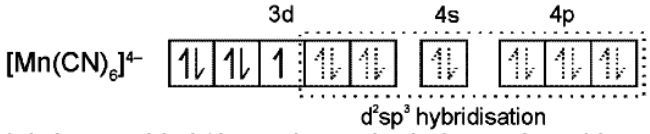
(C) $[Pt(NH_3)_4]^{2+}[Pt(SCN)_4]^{2-}$ and $[Pt(NH_3)_3(SCN)]^{+}[Pt(NH_3)(SCN)_3]^{-}$ - coordination isomerism

$[Pt(NH_3)_4]^{2+}[Pt(SCN)_4]^{2-}$ and $[Pt(NH_3)_4]^{2+}[Pt(NCS)_4]^{2-}$ - linkage isomerism

(D) $[Cr(NH_3)_4(NO_2)_2](NO_3)_2$ and $[Cr(NH_3)_4(NO_3)_2](NO_2)_2$ - ionization isomerism

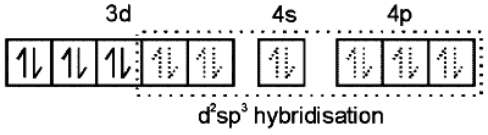
$[Cr(NH_3)_4(NO_2)_2](NO_3)_2$ and $[Cr(NH_3)_4(ONO)_2](NO_3)_2$ - linkage isomerism

5. (i) $_{25}Mn$ is in + II oxidation state. The electronic configuration of Mn^{2+} is $[Ar]^{18}\ 3d^5\ 4s^0$. The CN^- is strong field ligand, so



It is inner orbital / low spin octahedral complex with one unpaired electron.

Similarly for $[Fe(CN)_6]^{4-}$

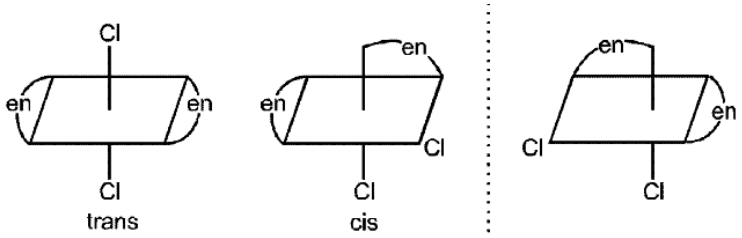


It is inner orbital / low spin octahedral complex with no unpaired electron.

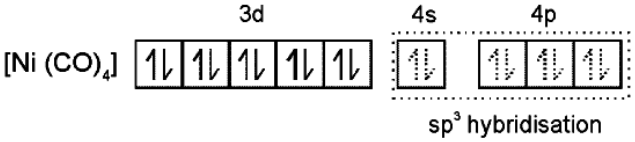
(ii) As the negative charge on the metal increases from the manganese complex to vanadium complex, it is delocalised on to the ligands by the π back bonding. This strengthen the metal-carbon bond and weaken the C–O bond (as bond order of CO decreases).

(iii) $[RhCl(PPh_3)_3]$ is Wilkinson's catalyst. Because of $4d^8$ configuration its higher CFSE favours square planar low spin complex (i.e. dsp^2). It is used as homogeneous catalyst for the hydrogenation of alkenes.

(iv) False statement : trans $[Co(en)_2Cl_2]^+$ has a centre and several planes of symmetry but the cis-form has neither, and (+) and (–) forms of cis $[Co(en)_2Cl_2]^+\ Cl^-$ have been separated.



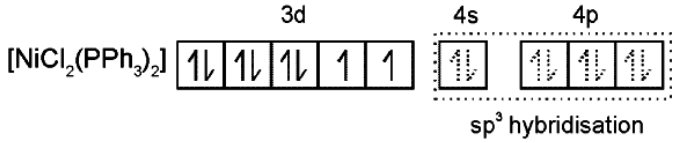
(v) In $Ni(CO)_4$, the Ni is in zero oxidation state. The CO is strong field ligand, so



It is outer orbital complex with $\mu_s = 0$. EAN = 28 + 8 = 36

In $[NiCl_2(PPh_3)_2]$ the Ni is in + II oxidation state.

Ligand triphenyl phosphine inspite of strong field ligand favours tetrahedral geometry on account of its bulkier nature. So



It is also outer orbital complex with $\mu_s = \sqrt{8}$ B.M. ~ 2.73.

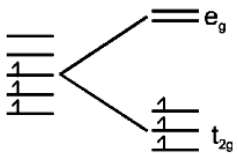
EAN = 26 + 8 = 34.

6. **S_1 :** Correct statement.

S_2 : As electron density on metal ion increases, the back donation into antibonding π orbitals of CO weakens the C–O bond and thus there is increase in inter atomic distance. Hence, C–O bond length is biggest in $[V(CO)_5]^{3-}$.

S_3 : Correct statement.

S_4 : Electron distribution of $3d^3$ configuration of Cr^{3+}



So, t_{2g} orbitals contain 3 electrons.

7. $Cd^{2+} + 4NH_3 \rightleftharpoons [Cd(NH_3)_4]^{2+}$ $\qquad K_f = \frac{1}{K_d}$.

10^{-3} $\qquad$ 2

≈ 0 $\qquad$ $2-4\times10^{-3}\approx2$ $\qquad$ 10^{-3}.

$[Cd^{2+}]_0 = 10^{-3}$ M $\qquad$ $[NH_3]_0 = 2$ M.

$$K_f = \frac{[Cd(NH_3)_4]^{2+}}{[Cd^{2+}][NH_3]^4} = \frac{10^{-3}}{[Cd^{2+}][2]^+} = \frac{10^7}{2}.$$

$$\Rightarrow \quad [Cd^{2+}] = \frac{1}{8} \times 10^{-10} = \mathbf{1.25 \times 10^{-11}\ M.}$$

8. NO_2–NO_2 ⟶ 2 (cis/trans)

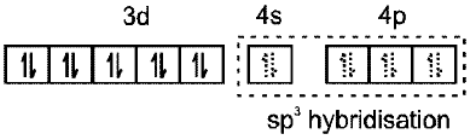
NO_2–ONO ⟶ 2 (cis/trans)

ONO–ONO ⟶ 2 (cis/trans)

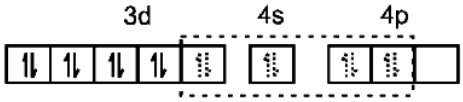
NO_2–NO_3 ⟶ 2 (cis/trans)

ONO–NO_3 ⟶ 2 (cis/trans)

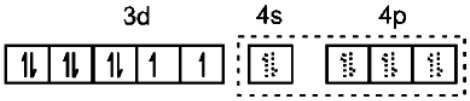
Total = 10 isomers.

9. $[Ni(CO)_4]$, 

sp^3 hybridisation

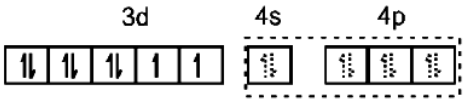
$[Ni(CN)_4]^{2-}$, 

dsp^2 hybridisation

$[NiCl_2(PPH_3)_2]$, 

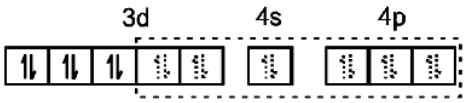
$\mu_{B.M.} = \sqrt{2(2+2)} = 2.83$

sp^3 hybridisation

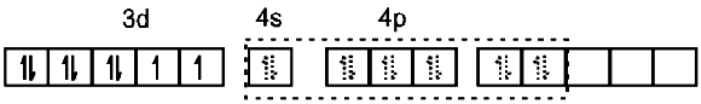
$[NiCl_4]^{2-}$, 

$\mu_{B.M.} = \sqrt{2(2+2)} = 2.83$

sp^3 hybridisation

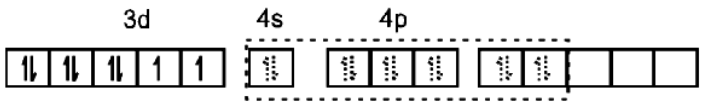
$[NiF_6]^{2-}$, 

d^2sp^3 hybridisation

$[NiF_6]^{4-}$, 

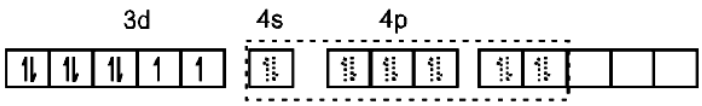
$\mu_{B.M.} = \sqrt{2(2+2)} = 2.83$

sp^3d^2 hybridisation

$[Ni(NH_3)_6]^{2+}$, 

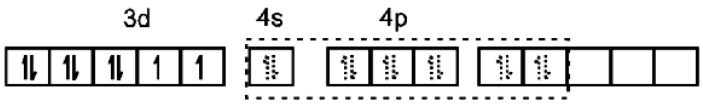
$\mu_{B.M.} = \sqrt{2(2+2)} = 2.83$

sp^3d^2 hybridisation

$[Ni(en)_3]^{2+}$, 

$\mu_{B.M.} = \sqrt{2(2+2)} = 2.83$

sp^3d^2 hybridisation

$[Ni(H_2O)_6]^{2+}$, 

$\mu_{B.M.} = \sqrt{2(2+2)} = 2.83$

sp^3d^2 hybridisation

Note : With coordination number six and oxidation state +2, two (n–1) d-orbitals are not available for d^2sp^3 hybridisation.
Hence, nd orbitals participitate in hybridisation.

10. (A) (NO_2) (NO_2) → cis + trans
(B) (ONO) (NO_2) → 3
(C) (ONO) (ONO) → cis + trans

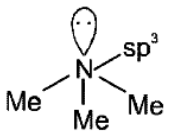
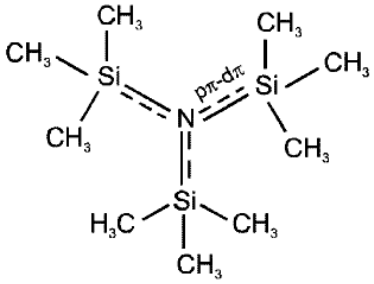
DPP No. # 12

1. According to IUPAC nomenclature.

2. For all three EAN = 36

3. In $K_4[VO_4]$ vanadium is d^1 and paramagnetic.

4. **S_1 :** I^- ion is a stronger reducing agent than Cl^- ion. It reduces Cu^{2+} to Cu^+ ion.
S_2 : Both diamagnetic but $[Ni(CO)_4]$ is tetrahedral and $[RhCl(Ph_3P)_3]$ is square planar.

S_3 :   not isostructural

5. $\lambda_{ab} = \frac{1}{38500} = 259 \times 10^{-7}$ cm = 259 nm (U.V. region).

and $t_{2g}^{2,1,1}\, eg^{0,0}$

C.F.S.E = $-1.6\Delta_0 + P = 1.6 \times 38500 + 28000 = -33600$ cm^{-1}

6. (A) Cr^{3+}–$3d^3$ configuration $(t_{2g}^{1,1,1}.e_g^{0,0})$; Mn^{3+} – $3d^4$ configuration $(t_{2g}^{2,1,1}.e_g^{0,0})$; V – $3d^5$ configuration $(t_{2g}^{2,2,1}.e_g^{0,0})$

(B) $\Delta_o \propto$ strength of ligand for same oxidation state of central metal.

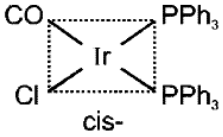
(C) In carbonylate anion, the metal has a greater electron density to be dispersed, with the result that M–C, π bonding is enhanced in strength. Hence the correct order is $[Ni(CO)_4] < [Co(CO)_4]^- < [Fe(CO)_4]^{2-}$ for strength of M–C, π bond.

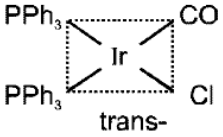
(D) Chelate effect.

7. $[MnCl_4]^{2-}$, $[Ni(H_2O)_6]Cl_2$, $[Co(NH_3)_2(H_2O)_4]Cl_2$, $K_3[Cr(CN)_6]$.

8. The O.N. of Fe in $[\overset{x}{Fe}(\overset{0}{H_2O})\overset{+1}{NO}]^{2+}\, SO_4^{2-}$ is x + 0 + 1 = +2 or x = +1

9. In complex, Ir with +1 oxidation state has $5d^8$ configuration. Hence, the complex would be square planar and diamagnetic. It will have two geometrical isomers as given below.


cis-


trans-

10. $[Mn(CN)_6]^{4-}$ - $3d^5$, d^2sp^3; +2 oxidation sate
$[Ni(NH_3)_6]^{2+}$ - $3d^8$, sp^3d^2; +2 oxidation sate
$[Co(ox)_3]^{3-}$ - $3d^6$, d^2sp^3; +3 oxidation sate
$[Cu(NO_2)_6]^{4-}$ - $3d^9$, sp^3d^2; +2 oxidation sate
$[AgF_4]^-$ - $4d^8$, dsp^2; +3 oxidation sate
$[Ni(CN)_4]^{2-}$ - $3d^8$, dsp^2; +2 oxidation sate
$[PdCl_4]^{2-}$ - $4d^8$, dsp^2; +2 oxidation sate
$[Pd(CN)_4]^{2-}$ - $4d^8$, dsp^2; +2 oxidation sate
$[Co(SCN)_4]^{2-}$ - $3d^7$, sp^3; +2 oxidation sate

DPP No. # 13

2. **(a)** At 45ºC

$K_w = 4 \times 10^{-14} = [H^+]\,[OH^-]$. $\Rightarrow$ $[H^+] = 2 \times 10^{-7}$. $\Rightarrow$ pH = 7 – log2 = 6.7.

(b) For H_2O $K_w \propto T$.

$\therefore$ $[H^+] \propto T$.

$\therefore$ $pH \propto \frac{1}{T}$.

4. **(a)** $NH_3 + NH_3 \rightleftharpoons NH_4^+ + NH_2^-$.
in self ionisation of NH_3.
$[NH_4^+] = [NH_2^-]$.
$K_{(Amm)} = [NH_4^+]\,[NH_2^-] = 1 \times 10^{-30}$.

(b) $K = [HCOOH_2^+][HCOO^-] = 10^{-6}$.
$[HCOO^-] = 10^{-3}$ mol/L.
1 liter solution of HCOOH has = 1150 g mass.

moles of (HCOOH) in 1 litre solution = $\frac{1150}{46}$ = 25 mol.

out of 25 mol HCOOH 10^{-3} mol are ionised into $HCOO^-$ ions.

$\therefore$ % dissociation = $\frac{10^{-3}}{25} \times 100 = 0.004\%$.

5.

(i). (i) $HNO_2(aq) \rightleftharpoons H^+(aq) + NO_2^-(aq)$
Since, HNO_2 ionises to give H^+ hence, it is a Arrhenius acid.
(ii) $HNO_2(l) + H_2O(aq) \rightleftharpoons H_3O^+(aq) + NO_2^-(aq)$
acid 1 base 2 acid 2 base 1
HNO_2 donates a proton hence, it is an acid and changes to NO_2^- (conjugate base). $H_2O(l)$ accepts the proton hence, it is a base and change to H_3O^+ (conjugate acid). Thus HNO_2 is a Bronsted Lowry acid.

(ii) (a) $H_2SO_4 + H_2O \rightleftharpoons H_3O^+ + HSO_4^-$
acid 1 base 2 acid 2 base 1 (conjugatete)

(iii) (A) to the left (B) to the right
Reaction proceed to words the side favoring formation of weak acid and weak base.

(vi) (a) Acid strength $H_2SO_4 > H_2CO_3$.
Basic strength $HCO_3^- > HSO_4^-$.
(b) Acid strength $HCl > HF$.
Basic strength $F^- > Cl^-$.
(c) Acid strength $HF > NH_4^+$
Basic strength $NH_3 > F^-$.
(d) Acid strength $HSO_4^- > HCN$.
Basic strength $CN^- > SO_4^{2-}$.
c and d will move to the right.

8. Relative acidic strength of weak acids = $\sqrt{\frac{K_{a_1}}{K_{a_2}}} = \sqrt{\frac{2\times10^{-4}}{1.6\times10^{-5}}} = \sqrt{\frac{20}{1.6}} = \sqrt{12.5}$.

DPP No. # 14

11. $3A_2(g) + XY_2(g) \rightleftharpoons 2A_2Y(g) + A_2X(g)$.
$4-3x$ $1-x$ $2x$ x $\therefore$ $[n_T = 5 - x]$

$\frac{4+1}{5-x} = \frac{1.25}{1.05} \Rightarrow x = 0.8 \Rightarrow n_T = 4.2$.

$$K_P = \frac{\left(\frac{2x}{n_T}P_{eq}\right)^2\left(\frac{x}{n_T}P_{eq}\right)}{\left(\frac{4-3x}{n_T}P_{eq}\right)^3\left(\frac{1-x}{n_T}P_{eq}\right)} = \frac{4x^3}{(4-3x)^3(1-x)} \times \frac{n_T}{P_{eq}} = 10.$$

DPP No. # 15

2. **(a)** Initially pH = 7
finally $[NaOH] = 10^{-3}$ so pOH = 3
pH = 11
so $\Delta(pH) = 4$

6. pH + pOH = 14
pOH = 14 –10.48 = 3.52
$[OH^-] = 3 \times 10^{-4}$ mol/litre

NO. of OH^- moles in 250 ml = $\frac{3\times10^{-4}}{4} = 7.5 \times 10^{-5}$

No. of moles of $Ca(OH)_2$ dissolved = $\frac{1}{2} \times 7.5 \times 10^{-5} = 3.75 \times 10^{-5}$

DPP No. # 16

1. **(b)** $pH = \frac{1}{2}\{pK_a - \log C\}$

so, $\Delta(pH) = \frac{1}{2}[\log C_i - \log C_f] = \frac{1}{2}\{-1 + 2\} = 0.5$ [pH will increase].

3. Degree of dissocation of WA & WB will increase.
$[H^+]$ in WA and $[OH^-]$ in WB will decrease so pH of WA and pOH of WB will increase.

6. **(a)** Initially degree of dissociation $\alpha = \sqrt{\frac{K_a}{C}}$

Now degree of dissociation, $\alpha_1 = 2\alpha = \sqrt{\frac{4K_a}{C}} = \sqrt{\frac{K_a}{C_1}}$

so $C_1 = \frac{C}{4}$ $\Rightarrow$ Hence we have

$300 \times 0.2 = V_f \times \frac{0.2}{4}$ so $V_f = 1200$ ml

Hence water added = 1200 – 300 = 900 ml

(b) $pH = \frac{1}{2}\{pK_a - \log C\} = \frac{1}{2}\{5 - \log 2 - \log 1\} = \frac{4.7}{2} = 2.35.$

Now on dilution pH will increase degree of dissociation a will also increase so we might not be able to use the approximate formula hence

where $a = \sqrt{\frac{K_a}{C}} = \sqrt{K_a}$

$K_a = \frac{C_1\alpha_1^2}{(1-\alpha_1)} = \frac{C\alpha^2}{(1-\alpha)}$ ...(1)

Also we must have $pH_f = 2pH_i$
so $-\log [H^+]_f = -2\log [H^+]_i$
$\Rightarrow$ $-\log [C_1\alpha_1] = -2\log (C\alpha) = -\log \alpha^2$
so $C_1\alpha_1 = \alpha^2$ ...(2)

From (1) equation $K_a = \frac{C_1\alpha_1^2}{(1-\alpha_1)} = \frac{(C_1\alpha_1)\alpha_1}{(1-\alpha_1)} = \frac{\alpha^2-\alpha_1}{(1-\alpha_1)} = \frac{K_a\cdot\alpha_1}{(1-\alpha_1)}$

Hence $\alpha_1 = \frac{1}{2}$

so we get $2 \times 10^{-5} = \frac{C_1 \times 1/4}{1/2} = \frac{C_1}{2}$

so $C_1 = 4 \times 10^{-5}$
Now $M_1V_1 = M_2V_2$ gives $\Rightarrow$ $1 \times 1 = 4 \times 10^{-5} V_f$
so $V_f = 2.5 \times 10^4$ litre

7. Calculation of $[H^+]$ and [HSac] at start

$[HSac] = \frac{4\times10^{-4}\times1000}{200} = 0.002$ M

The dissociation of HSac is as below

	HSac	H^+	+	Sac^-
At start	0.002	0.001		0
At equi.	0.002-x	0.001 + x		x

$$\therefore K_a = \frac{[H^+][Sac^-]}{[HSac]} = \frac{(0.01+x)x}{0.002-x} = 2\times10^{-12}$$

$x = 4\times10^{-12}$ M

$[Sac^-]_{equi.} = 4\times10^{-12}$ M.

8. $K_{a_1} >> K_{a_2}$

$[H^+] = [HS^-] = \sqrt{CK_{a_1}} = \sqrt{0.01\times9\times10^{-8}}$

$[H^+] = 3\times10^{-5}$.

pH = 4.52.

DPP No. # 17

1. **(b)** $H_2PO_4^- \rightleftharpoons HPO_4^{2-} + H^+$.

$$8\times10^{-8} = \left(\frac{HPO_4^{2-}}{H_2PO_4^-}\right)\times4\times10^{-8}. \quad \Rightarrow \quad \left(\frac{HPO_4^{2-}}{H_2PO_4^-}\right) = \frac{2}{1}.$$

3. $K_a = \frac{[H^+]^2[S^{2-}]}{(H_2S)} \Rightarrow 10^{-21} = \frac{4\times10^{-8}\times[S^{2-}]}{10^{-1}}$

so $[S^{2-}] = \frac{1}{4}\times10^{-14} = 2.5\times10^{-15}$ M.

6. $C_1\alpha_1 = C_2\alpha_2$

$\sqrt{K_{a_1}C_1} = \sqrt{K_{a_2}C_2}$

$2\times10^{-5}\times C_1 = 2.4\times10^{-4}\times0.5 = \quad C_1 = 6$ M.

When two weak acids are mixed in such concentration that their $[H^+]$ ions are same the % dissociation of both the acids will not change.

9.

$H_2S \rightleftharpoons H^+ + HS^-$ .....(i)

$0.1-x \quad 0.25 \quad x$

$HS^- \rightleftharpoons H^+ + S^-$ .....(ii)

$x-y \quad 0.25 \quad y$

$HCl \longrightarrow H^+ + Cl^-$ .....(iii)

0.25

(i) $10^{-7} = \frac{0.25\times[HS^-]}{0.1-x}$ $[HS^-] = 4\times10^{-8}$.

(ii) $1.3\times10^{-13} = \frac{0.25\times[S^{2-}]}{4\times10^{-8}-y}$ $[S^{2-}] = 2.08\times10^{-20}$.

DPP No. # 18

1. From the information, $\frac{[salt]}{[acid]} = 2$; so, $pH = pKa + \log\frac{[salt]}{[acid]} = 5.05$.

2. $7.4 = (7 - \log 4.2) + \log\frac{[B]}{[A]} \Rightarrow \log\frac{[B]}{[A]} = 1.03 \Rightarrow \frac{[B]}{[A]} = 10.7$

3.

	K_h	pH	%Hydrolysis
(i)	5×10^{-10}	8.7	0.01%
(ii)	5×10^{-10}	5.7	0.025%
(iii)	10.0	13.68	95%
(iv)	2.5×10^{-5}	11.60	0.625%
(v)	2.5×10^{-5}	7.0	0.5%
(vi)	1.25	9.35	52.8%

5. $CH_3COOH \rightleftharpoons CH_3COO^- + H^+$.

$$1.84 \times 10^{-5} = \frac{0.04}{0.06} \times [H^+].$$

$$[H^+] = \frac{3}{2} \times 1.84 \times 10^{-5} = 2.76 \times 10^{-5}\ M.$$

8. $$pOH = pK_b + \log \frac{[n_{salt}]}{[n_{acid}]}$$

Since, pH = 5 ; pOH = 9.

$$9 = 8.824 + \log \frac{[n_{salt}]}{0.2 mol}.$$

$$0.176 = \log \frac{[n_{salt}]}{0.2 mol}$$

$[n_{salt}] = 0.3$ mole.

DPP No. # 19

8. **(i)** The conc. of HCl is highest in this case.
(ii) This is actually a solution of weak acid HCN with salt NaCl (having spectator ions only)
(iii) $[H^+] = 10^{-10}$ M from Hendersen equation.

9. **(iii)**

	$NaOH + H_2SO_4 \longrightarrow$		$NaHSO_4 + H_2O$
initial m mole	10	5	0
reaction	5	0	5

	$NaOH + NaHSO_4 \longrightarrow$		$Na_2SO_4 + H_2O$
	5	5	0
	0	0	5

$$pH = 7 + \frac{1}{2}\left[2 + \log\frac{5}{200}\right] = 7 + \frac{1}{2}\left[2 + \log 5 - \log 200\right] = 7 + \frac{1}{2}[2 + 0.7 - 0.3 - 2] = \mathbf{7.2.}$$

DPP No. # 21

3. $Ag_2SO_4 \rightleftharpoons 2Ag^+ + SO_4^{-2}$

$2s' \quad (s' + 10^{-2}) \approx 10^{-2}$

$K_{sp} = (2s')^2 (10^{-2}) = (2 \times 2 \times 10^{-8})^2 (10^{-2}) = 16 \times 10^{-18}$.

DPP No. # 22

2. pH = 13 means $[H^+] = 10^{-13}$ mol L^{-1}
or $10^{-13} \times 6.023 \times 10^{23} / 1000$ H^+ ions/c.c $= 6.023 \times 10^7$

3. $K_W = 55.5 \times 3.6 \times 10^{-15} \times 0.1 = 2 \times 10^{-14}$
Hence temperature must be > 25°C.

4. $K_h = \dfrac{10^{-14}}{4 \times 10^{-13}} = 0.025$

	$BH^+ + H_2O \rightleftharpoons B + H_3O^+$		
t = 0	C		
t_{eq}	$C(1-\alpha)$	$C\alpha$	$C\alpha$

$$K_h = \frac{C\alpha^2}{(1-\alpha)} = 0.025 \Rightarrow \frac{0.01\,\alpha^2}{1-\alpha} = 0.025.$$

$\Rightarrow \alpha^2 + 2.5\alpha - 2.5 = 0 \Rightarrow \alpha = 0.76$

$[H^+] = 7.6 \times 10^{-3} \Rightarrow pH = -\log [H^+] = 2.1.$

5. $pH = P_{KIn} + \log_{10}\left[\dfrac{In^-}{HIn}\right]$

$pH = [6 - \log_{10} 5] + \log_{10}\left[\dfrac{1}{20}\right] = 4$

$pH = P_{KIn} + \log_{10}\left[\dfrac{In^-}{HIn}\right]$

$= P_{KIn} + \log_{10}\left[\dfrac{40}{1}\right]$

$= 6 - \log_{10} 5 + \log_{10} 40$

$= 6 - 0.7 + 1.6 = 6.9$

6. If 10^{-3} mole $Zn(OH)_2$ go into $Zn(OH)_4^{2-}$.

$Zn(OH)_2\,(s) + 2OH^-\,(aq) \rightleftharpoons Zn(OH)_4^{2-}\,(aq)$

$$10^{-2} = \frac{10^{-3}}{[OH^-]^2} \Rightarrow [OH^-] = 0.316\ M$$

7.* $pK_a\,(H_3O^+) = -1.74 = pK_b$ of OH^-

$pK_a + pK_b = 14$ only for conjugate acid base pair.

$\alpha = 1.8 \times 10^{-9}$ or 1.8×10^{-7} % for H_2O.

8.* (A) Correct statement

(B) Due to common ion effect on $H_2O \rightleftharpoons H^+ + OH^-$

(D) relative strength of strong acids can not be determined in water due to levelling effect.

9. I.P. $\geq K_{sp}$

$[Mg^{2+}]\,[OH^-] \geq 10^{-11}$

$[OH^-]^2 \geq 10^{-10}$

$[OH^-] \geq 10^{-5}$

$P^{OH} \leq 5$

$P^H \geq 9$

10. 25 ml of 0.02 N acetic acid $= \dfrac{0.02}{1000} \times 25 = 5 \times 10^{-4}$ g eq.

2.5 ml of 0.1 N NaOH $= \dfrac{0.1}{1000} \times 25 = 2.5 \times 10^{-4}$ g eq.

After neutralization, CH_3COOH left is $(5 - 2.5) \times 10^{-4}$ g eq. $= 2.5 \times 10^{-4}$ g eq.

$pH = pK_a = -\log (10^{-5})$; $= 5$

11. Blue litmus turns red by acidic solution

(i) $Al_2(SO_4)_3$
(iv) H_3BO_3
(v) H_3PO_3
(vi) HIO_3
(vii) H_2PtCl_{16}

] (All five acidic nature)

12. Na_2HPO_3 is the salt of H_3PO_3 which is dibasic in nature (as it contains two OH^- groups)

13. **(i)** $[H^+] = \sqrt{K_1C_0} = \sqrt{4\times10^{-7}\times0.1} = 2\times10^{-4}$ M.

(ii) $[H^+] = \sqrt{K_1K_2} = \sqrt{4\times10^{-7}\times4\times10^{-11}} = 4\times10^{-9}$ M

(iii) $[H^+] = \sqrt{K_1C_1+K_2C_2} = \sqrt{10^{-7}\times0.1+4\times10^{-7}\times0.2} = 3\times10^{-4}$ M

DPP No. # 23

1. Hydrolysis of cartion can form H^+. So Be^{+2}, $C_5H_6N^+$ forms acidic solution.

3. $BH^{2-} + H_2O \rightleftharpoons BH_2^- + OH^-$

$$K_b = \frac{K_w}{K_a(\text{of } BH_2^-)}$$

$$\text{i.e. } K_b = \frac{K_w}{K_2}$$

4. $[Ag^+]$ req for pptation of AgX $= \frac{K_{sp}}{[X^-]} = \frac{9\times10^{-14}}{10^{-6}} = 9\times10^{-8}$ M

$[Ag^+]$ req for pptation of $Ag_2Y = \sqrt{\frac{K_{sp}}{[y^-]}} = \sqrt{\frac{4.9\times10^{-21}}{10^{-6}}} = 7\times10^{-8}$ M

$[Ag^+]$ req for pptation of $Ag_3Z = \sqrt[3]{\frac{K_{sp}}{[z^-]}} = \sqrt[3]{\frac{5.12\times10^{-28}}{10^{-6}}} = 8\times10^{-8}$ M

clearly, $[Ag^+]$ req for pptation of Ag_2Y is minimum.
$\therefore$ Ag_2Y will be the first one to pricipitate out.

5. $\Delta T_f = i \times k_f \times m$

$0.2 = i \times 1.8 \times 0.1$

$\Rightarrow$ $i = 1.11$

$\Rightarrow$ $\alpha = 0.11$

$$k_a = \frac{c\alpha^2}{1-\alpha} = \frac{0.1\times(0.11)^2}{(1-0.11)}$$

$= 1.35\times10^{-3}$ **Ans.**

6. Let the solubility of AgCl, AgBr and Ag_2CrO_4 be xM, yM and zM, then we get

$K_{sp(AgCl)} = x^2 \Rightarrow x = \sqrt{1.8\times10^{-10}} \Rightarrow x = 10^{-5}\sqrt{1.8}$

Similarly, $y = 10^{-7}\sqrt{50}$

$K_{sp}\ Ag_2CrO_4 = 4z^3 = 2.4\times10^{12}$

$\Rightarrow$ $z = (60)^{1/3}\times10^{-4}$

$\therefore$ More (Ag^+) is needed to precipitate it.

7. In $AgNO_3$ solution, the solubility of AgCN will decrease as compared to pure water because of common ion effect of Ag^+ ion.
In NH_3 solution and buffer of pH = 5, the solubility of AgCN will increase due to complex formation in case of NH_3 solution and hydrolysis of CN^- ions in case of buffer of pH = 5.

8. In a given mixture, the ionisation of two acids can be written as: Let α, β be degree of ionisation at same concentration.

$$\underset{1-\alpha}{CH_3COOH} \rightleftharpoons \underset{\beta}{CH_3COO^-} + \underset{\alpha+\beta-x}{H^+} \qquad \underset{1-\beta}{C_2H_5COOH} \rightleftharpoons \underset{\beta}{C_2H_5COO^-} + \underset{\alpha+\beta-x}{H^+}$$

$$\therefore \quad K_{A.A} = \frac{[\alpha][\alpha+\beta-x].c}{[1-\alpha]} \qquad K_{P.A} = \frac{[\beta][\alpha+\beta-x].c}{[1-\beta]}$$

(where 'x' is equivalents of NaOH droped).

$$\therefore \quad \frac{K_{A.A}}{K_{P.A}} = \frac{\alpha}{1-\alpha} \times \frac{1-\beta}{\beta} \qquad \text{or} \qquad \frac{\alpha}{1-\alpha} = \frac{1.75}{1.3} \times \left[\frac{\beta}{1-\beta}\right]$$

Hence, A,C,D.

9. m. moles of HCl = 0.1 × 20 = 2
m. moles of CH_3COOH = 0.1 × 20 = 2
After titration of HCl by NaOH

$$[CH_3COOH] = \frac{2}{40} = \frac{1}{20}\,M$$

$$\therefore pH = \frac{1}{2}(pK_a - \log C) = \frac{1}{2}\left[5 - \log 2 - \log\left(\frac{1}{20}\right)\right] = \mathbf{3.}$$

10. When 10 ml of NaOH is added, it reacts with CH_3COOH to produce salt and water. The solution is then an acidic buffer. So, for acidic buffer,

$$pH = pK_a + \log \frac{[\text{Conjugate base}]}{[\text{Acid}]}$$

$$= 4.7 + \log \frac{10 \times 0.1}{60 \times 0.1 - 10 \times 0.1}$$

$$= 4.7 + \log \frac{1}{5} = \mathbf{4}$$

11. $C_6H_5NH_3^+Cl^-$, $FeCl_3$, $Al(NO_3)_3$.

DPP No. # 24

1. **(a)** In polymerisation of ethene gas forming polyethene and condensation of dew on leaves in winters, entropy of the system decreases.
(b) Δn_g is most – ve
(c) Polymerisation leads to more ordered structure.

3. For a reversible adiabatic process, $\Delta S_{sys} = \Delta S_{surr} = \Delta S_{univ} = 0$

4. $$\Delta S_{gas} = n\,C_{V,m} \ln \frac{T_2}{T_1} = 2 \times \frac{3}{2} R \ln \frac{573}{473} = 3R \ln \left(\frac{573}{473}\right).$$

5. $$\Delta S = mS \ln \frac{T_2}{T_1} = 2.5 \times 4.2 \ln \left(\frac{360}{300}\right) = 1.89\ J/K$$

6. $$\Delta S_{(system)} = \frac{1 \times -436.8}{368} = -1.19\ JK^{-1}$$

The ice-water bath absorbs the 436.8 J mol^{-1} at temperature 273 K.

$$\therefore \quad \Delta S_{surrounding} = \frac{1 \times 436.8}{273} = 1.6\ JK^{-1} \text{ and } \quad \Delta S_{(universe)} = -1.19 + 1.6 = 0.41\ JK^{-1}$$

7. (A) For isoentropic process $\Delta S_{system} = 0$

$$\therefore nC_{p,m} \ln \frac{T_2}{T_1} + nR \ln \frac{P_1}{P_2} = 0 \Rightarrow \ln (P_2) = \frac{5}{2} \times \ln \left(\frac{600}{300}\right)$$

$= 1.75$ atm.

8. **(a)** For isothermal free expansion of an ideal gas,
$\Delta T = 0$ Therefore, $\Delta H = \Delta E = 0$
Also, $W = 0$ (since $P_{ext.} = 0$)
Therefore, from first law, $q = 0$. Therefore, $\Delta S_{surr.} = 0$.
Since gas is expanding, $\Delta S_{sys.} > 0$.

9.* $H_2O(\ell, 1bar, 373K) \longrightarrow H_2O(g, 1bar, 373\ K)$
$\Delta S > 0$
$\Delta H > 0$
$\Delta G = 0$

10. $W = -P_{ext}(V_f - V_i) = -(1\ atm)(8-2)\ L$
$= -6\ L\ atm$
as $q = 0$ so

$$\Delta E = W = n\left(\frac{6}{2}R\right)\left(\frac{P_fV_f}{nR} - \frac{P_iV_i}{nR}\right) \qquad \text{Here } \Delta E = nC_v\Delta T$$

$3(8P_f - 12) = -6$

$$8P_f = 12 - \frac{6}{3} = 10 \qquad \Rightarrow \qquad P_f = \frac{5}{4}\ atm$$

so, $$\frac{T_f}{T_i} = \frac{\frac{5}{4}\times 3}{6\times 2} = \frac{10}{12}$$

so $$\Delta S = 3\ \frac{12}{300} \ln \left(\frac{10}{12}\right) + \frac{12}{300} \ln 8$$

$$= \frac{3\times 12}{300} \ln \left(\frac{5}{6}\times 2\right) \qquad = \frac{12}{100} \ln \left(\frac{5}{3}\right) \times 100\ J$$

$= 12(\ln 5 - \ln 3) = 12 \times 2.3 \times (0.7 - 0.48)$
$= 12 \times 2.3 \times 0.22 = 6.072\ J/K$
Ans. 6 J/K

11. **(a) (i)** $\Delta S_{vap.} = \frac{\Delta H_{vap.}}{T} = \frac{26\times 10^3}{308} = 84.41\ JK^{-1}\ mol^{-1}$.

(ii) $\Delta S_{cond.} = \frac{\Delta H_{cond}}{T} = -84.41\ JK^{-1}\ mol^{-1}$.

(b) Using $\Delta G = \Delta H - T\Delta S = -11.50$ KJ/mol.

12. **(a)** $T < \frac{\Delta H}{\Delta S} = \frac{-95.4\times 10^3}{-198.3} = 481.0$ K. (Since ΔS and ΔH both are negative)

(b) For $\Delta H_{min.}$, $\Delta G = 0$

$\therefore$ $\Delta H_{min} = T\Delta S = 36.06$ KJ.

13. Spontaneity of a reaction is decideded by

$$\Delta S_{total} = (\Delta S_{Sys} + \Delta S_{surr.}) > 0$$

$$\Delta S_{surr} = \frac{-1648\times 10^3\ J/mol}{298} = 5530\ JK^{-1}\ mol^{-1}$$

$\therefore$ $\Delta S_{total} = 4980.6\ JK^{-1}\ mol^{-1} > 0$ (Hence, spontaneous).

DPP No. # 25

2. $\Delta G = (\Delta H) - T(\Delta S)$
$\downarrow \quad \downarrow$
–ve –ve

since both are –ve, the reaction would have a –ve ΔG below a temperature of $\frac{33000}{58}$ K (= 569K)

3. It is because of the fact that for spontaneity, the value of $\Delta G = (\Delta H - T\Delta S)$ should be < 0. If ΔS is – ve, the value of $T\Delta S$ shall have to be less than ΔH or the value of ΔS has to be less than $\frac{\Delta H}{T}$ i.e., $\frac{x}{298}$.

4. (C) $0.42 = a(10)^3 \Rightarrow a = 0.42 \times 10^{-3}$

$$S_m = \int_0^{20} \frac{C_{p,m}}{T} dT$$

$$= \int_0^{20} aT^2 dT = \frac{a}{3}[20^3 - 0] = 1.12 \text{ J/K-mol.}$$

5. (B) $Cu_2O(s) + \frac{1}{2}O_2(g) \rightleftharpoons 2CuO(s)$

$\Delta G^0_{reaction} = [2 \times (-30.4)] - [-34.98] = -25.82$ kcal
and $-25.82 \times 10^3 = 2.303 \times 2 \times 298 \log K$
$\therefore \quad K \approx 10^{19}$, a very high value, hence reaction will be almost complete with a trace of Cu_2O.

6. $\Delta G = \Delta H - \Delta(TS)$
$= \Delta H - T\Delta S$ (isothermal)

$$= 0 - T\Delta S = -T\left(\int \frac{dq_{rev}}{T}\right)$$

$$= -\int dq_{rev} = -q_{rev} = W_{rev}$$

as process is isothermal so $\Delta E = 0 = q_{rev} + W_{rev}$

so $\Delta G = -nRT \ln\left(\frac{V_f}{V_i}\right)$

$= -RT \ln 2 = -8.314 \times 300 \times 0.693 \times 10^{-3}$ KJ mol^{-1} K^{-1}
$= 1.728$ KJ mol^{-1} K^{-1}

8. $0.42 = a(10)^3 \quad \Rightarrow \quad a = 0.42 \times 10^{-3}$

$$S_m = \int_0^{10} \frac{C_{p.m.}}{T} dT = \int_0^{10} aT^2 = \frac{a}{3}[10^3 - 0] = \frac{0.42}{3} = 0.14\,J/K - mol$$

9.* Adiabatic process. So, q = 0.
Expansion against vacuum. So, $P_{ext} = 0$. Therefore, W = 0.
So, from Ist law, $\Delta U = 0$. So, $\Delta T = 0$. So, $\Delta H = 0$.
$\Delta S_{sys} > 0$, since expansion of gas occurs.

10.* Boiling of a liquid at normal boiling point is a equilibrium process and on decreasing the pressure equilibrium will go forward and ΔG will be negative and vice versa.

11.* $\Delta S = nC_v \ln\left(\frac{T_f}{T_i}\right) + nR \ln\left(\frac{V_f}{V_i}\right)$

$\Delta H = nC_p\Delta T$
$\Delta E = nC_v\Delta T$
$\Delta G = \Delta H - \Delta(TS)$

13. $\Delta G^\circ = -2.303 \times 8.314 \times 300 \log [2 \times 10^{-7}]$
$= 38.48$ KJ/mol

$\Delta S^\circ = \dfrac{\Delta H^\circ - \Delta G^\circ}{T} = -33.6$ J mol^{-1} K^{-1}.

DPP No. # 26

1. Galvanic cells are electro chemical cells which convert chemical energy into electrical energy.

2. $E^\circ_{cell} = [E^\circ_A - E^\circ_C]_{OP} = 0.76 - 0.41 = 0.35$ V.

3. $E^\circ_{cell} = [E^\circ_C - E^\circ_A]_{RP} = 1.25 + 1.25 = 2.50$ V.
$E^\circ_{cell} = [E^\circ_C - E^\circ_A]_{RP} = 1.25 - (-1.25) = 2.50$ V (Maximum value)

4. Electrode potential values depend on reference electrode chosen but not cell potential.

5. $Sn^{2+} \longrightarrow Sn^{+4} + 2e^-$ $\quad E^\circ = -0.15$ V
$Hg_2^{2+} \longrightarrow 2Hg^{2+} + 2e^-$ $\quad E^\circ = -0.92$ V
$Sn^{2+} \,]\, Hg_2^{2+}$

6. $E^\circ(Cr_2O_7^{2-} \rightarrow Cr^{3+}) = 1.33$V (A)
$E^\circ (Fe^{3+} \rightarrow Fe^{2+}) = 0.77$V (B)
When these two electrodes are connected, then the electrode with higher reduction potential act as cathode.
So (A) is cathode (B) is anode.
e^- flow from anode to cathode in external circuit.
$E^\circ_{cell} = 1.33 - 0.77 = 0.56$V
cathode (A) is a +ve electrode in electro chemicall cell.

7. Higher oxidation potential, higher reducing tendency.

8. $E^\circ_{H^+/H_2} = 0$ V.
Hydrogen gas will reduce those metals which have reduction potential greater than H_2 gas.

9. Cu will reduce to those metal which have higher reduction potential than Cu.
So, Ag^+ has higher potential.

10. As carbon can reduce XO and YO but not ZO, SRP of X and Y are more than carbon. Y can reduce XO,which means SRP of X is more than Y. Hence the order of SRP is
SRP of X > SRP of Y > SRP of C > SRP of Z.
More active metal has lesser SRP.
So the order of activity of metals is Z > Y > X **Ans.**

11. (A) It is a convention that SRP of standard hydrogen electrode is zero at all tempertures.
(B) is incorrect.
(C) the difference should be +ve quantity.
(D) $KMnO_4$ is stronger oxidising agent (SRP values).

12. Any temperature can be selected.

13. From given SRP values.

14. On increasing concentration of $[H^+]$ ions the solubility of basic hydroxide $Fe(OH)_2$, will increase.

DPP No. # 27

1. E° is intensive property.

2.

$Cu^{2+} + 2e^- \longrightarrow Cu$	$E^\circ = 0.337$ V	$\Delta G^\circ = -2F \times 0.337$.
$Cu^{2+} + e^- \longrightarrow Cu^+$	$E^\circ = 0.153$ V	$\Delta G^\circ = -1F \times 0.153$.
$Cu^{2+} + 2e^- \longrightarrow Cu$	$E^0_1 = 0.337$ V	$\Delta G^0_1 = -2F \times 0.337$.
$Cu^+ \longrightarrow Cu^{2+} + e^-$	$E^0_2 = 0.153$ V	$\Delta G^0_2 = 1\times F \times 0.153$.
$Cu^+ + e^- \longrightarrow Cu$	$E^0_3 = ?$	$\Delta G^0_3 =$

$\Delta G_3^0 = \Delta G_1^0 + \Delta G_2^0$.

$-F \times E_3^0 = -2F \times 0.337 + F \times 0.153$.

$E_3^0 = 2 \times 0.337 - 0.153 =$ **0.521 V.**

3. $Fe^{3+} + e^- \longrightarrow Fe^{2+}$ (1) $E^o_1 = 0.77V$ $\Delta G_1^o = -1 \times F \times 0.77$
$Fe^{3+} + 3e^- \longrightarrow Fe$ (2) $E^o_2 = -0.036V$ $\Delta G_2^o = 3 \times F \times 0.036$
$Fe \longrightarrow Fe^{2+} + 2e^-$ (3) $E_3^o = \Delta G_3^o = -2 \times F \times E_3^o$
(1) – (2) = 3
$\Delta G_1^o - \Delta G_2^o = \Delta G_3^o$
$\Rightarrow -F \times 0.77 - 3F - 0.036 = -2 \times F \times E_3^o$
$\Rightarrow (0.77 \times 0.108) = 2 \times E_3^o$
$\Rightarrow E_3^o \simeq 0.44V$ **Ans.**
Disproportionation reaction.
$3Fe^{2+} \longrightarrow Fe + 2Fe^{3+}$ (4)
$Fe^{2+} + 2e^- \longrightarrow Fe$
$E^o = -0.44V$ $\Delta G^o = -2 \times F \times (-0.44)$ (5)
$Fe^{2+} \longrightarrow Fe^{3+} + e^-$
$E^o = -0.77V$ $\Delta G^o = -1 \times F \times (-0.77)$ (6)
(5) + 2 × (6) = (4)
$\Rightarrow \Delta G^o_4 = -2 \times F \times (-0.44) + 2(-1 \times F \times (-0.77))$
$= +ve$
$\because \Delta G_4^o > 0$,
$\Rightarrow$ Reaction is not spontaneous.
Hence, Fe^{2+} is stable to disproportionation.

4. From the given data, we see that Fe^{3+} reduces to Fe^{2+} as $E^o_{(Fe^{3+}/Fe^{2+})}$ is positive and Fe oxidises to Fe^{2+} are $E^o_{(Fe^{2+}/Fe)}$ is negative.
So, Fe^{3+} decreases, Fe^{2+} increases.

5. Only for this reaction E^0 will come out to be positive, calculate using relation
$\Delta G^\circ = \Delta G_1^0 + \Delta G_2^0$ and $\Delta G^0 = -nFE^\circ_{cell}$

6. $AgCl(s) + \frac{1}{2}H_2(g) \rightleftharpoons Ag(s) + H^+ + Cl^-$.
$\Delta G^o = -nF\,E^o_{cell} = -21.52\ KJ = -1 \times F\,E^o_{cell}$.
$2AgCl(s) + H_2(g) \rightleftharpoons 2Ag(s) + 2H^+ + 2Cl^-$.
$\Delta G^o = -2 \times F \times E^o_{cell} = -21.52 \times 2 =$ **– 43.04 kJ.**

7. At anode : $Zn \longrightarrow Zn^{2+} + 2e^-$
At cathode : $Zn^{2+} + 2e \longrightarrow Zn$
As cell discharges, $[Zn^{2+}]$ increase in anode compartment and decrease in cathode compartment, finally becoming equal at equilibrium. Hence, they approach each other.

8. $T\ell^{3+} + 2e^- \longrightarrow T\ell^+$ $E_{Cell} = +1.2496$ V

$$E_{Cell} = 1.2496\ V = E^o_{Cell} - \frac{0.0591}{2}\log\frac{0.01}{0.1}$$

$E^o_{Cell} = 1.22$ V.

9. $$E_{cell} = E^o_{cell} - \frac{0.0591}{2}\log\frac{1}{[H^+]^2}.$$

$H_2 \longrightarrow 2H^+ + 2e^-$.

$$E_{cell} = -\frac{0.0591}{2}\log[H^+]^2.$$

Higher the $[H^+]$ conc ; less will be emf.

or $E_{cell} = 0 - \frac{0.0591}{2} \log \frac{(C)^2}{(\sqrt{KC})^2}$

$E_{cell} = 0 - \frac{0.0591}{2} \log \frac{(1)^2}{(0.1)^2}$

$= - \frac{0.0591}{2} \times 2 = - 0.0591.$

10. $E_{cell} = E^o_{cell} - \frac{0.0591}{2} \log \frac{[Zn^{2+}]}{[Ag^+]^2} . = 0.8 - (- 0.14) - \frac{0.0591}{2} \log \frac{1}{1^2}$ = **0.94 V.**

11. E_{cell} increases by increasing concentration of oxidised species at cathode and by increasing concentration of reduced species at anode.
Or by decreasing concentration of reduced species at cathode on decreasing concentration of oxidixed species at anode.

12. $\Delta G^o = (2 \times 0.34 + 2 \times 1.25)$
$- 2 \times E^o = (2 \times 0.34 + 2 \times 1.25)$
$E^o = - 1.59$ V non-spontanous $E^o = -$ ve

13. $E_{cell} = - 2.36 - \frac{0.0591}{2} \log \frac{1}{10^{-2}} = - 2.4191$ V.

DPP No. # 28

1. $E_{cell} = -0.0591 \log \frac{[H^+]anode}{[H^+]cathode}$

For (A) $E_{cell} = 0.0591$ V
(B) $E_{cell} = 0.273$ V

$$[H^+]_{Anode} = \sqrt{\frac{K_w}{K_b}.C} = \sqrt{\frac{10^{-14}}{18 \times 10^{-5}} \times 10^{-2}} = \sqrt{\frac{10}{1.8}} \times 10^{-6}$$

(C) $E_{cell} = - 0.0591 \log \frac{1}{2} = 0.0591 \log 2 = 0.0178$ V

(D) $E_{cell} = - 0.0591 \log \frac{1}{1} = 0.$

2. $E^o_{Ag^+/Ag} - E^o_{Cu^{2+}/Cu} = 0.46 V$

(+) $E^o_{Cu^{2+}/Cu} - E^o_{Zn^{2+}/Zn} = 1.1 V$

$E^o_{Ag^+/Ag} - E^o_{Zn^{2+}/Zn} = 1.56 V$

Zn/Zn^{2+} (0.1M) $||$ Ag^+ (1.0M) | Ag $E^o_{cell} = 1.56$

$E_{cell} = E^o_{cell} - \frac{0.059}{n} \log Q.$

Cell reaction :
$Zn \longrightarrow Zn^{2+} + 2e^-$
$+ (Ag^+ + e^- \longrightarrow Ag) \times 2$

$Zn + 2Ag^+ \longrightarrow Zn^{2+} + 2Ag$

$$Q = \frac{[Zn^{2+}]}{[Ag^+]^2} = \frac{(0.1)}{(1)^2} = 0.1$$

$\Rightarrow \quad E_{cell} = E^{o}_{cell} - \frac{0.059}{2} \log 0.1$

$= 1.56 - \frac{0.059}{2} \times -1$

$= 1.59V$ **Ans.**

3. $Ni\ (s) + Cl_2 \longrightarrow Ni^{2+}\ (aq) + 2Cl^{-}$.

$Q = \frac{[Ni^{2+}][Cl^{-}]^2}{P_{Cl_2}} = \frac{(0.19)(0.4)^2}{0.1} =$ **0.304.**

4. $pH_1 = pK_a + \log \frac{x}{y}$ ——(1)

$pH_2 = pK_a + \log \frac{y}{x}$ ——(2)

Oxidation : $H_2 \longrightarrow 2H^{+} + 2e^{-}$

$E_1 = E^{\circ}_{H_2/H^{+}} - \frac{0.0529}{2} \log [H^{+}]^2_1 = 0.0529\ pH_1$

$E_2 = 0.0529\ pH_2$

$\Rightarrow \quad E_1 + E_2 = 00529\ (2pK_a)$

$\Rightarrow \quad pK_a = \frac{E_1 + E_2}{0.118}$.

5. $H_2 \longrightarrow 2H^{+} + 2e^{-}$

$Hg_2Cl_2 + 2e^{-} \longrightarrow 2Hg + 2Cl^{-}$

$H_2 + Hg_2Cl_2 \longrightarrow 2H^{+} + 2Cl^{-} + 2Hg$

$E^{initial} = E^{\circ} + \frac{0.059}{2} \log \frac{1}{[H^{+}]^2[Cl^{-}]^2} = 0.6 \qquad E^{final} = E^{\circ} + \frac{0.059}{2} \log \frac{1}{(10^{-7})^2[Cl^{-}]^2} = 0.718$

subtracting we get $0.118 = 0.059 \log \frac{[H^{+}]}{10^{-7}} \Rightarrow \frac{[H^{+}]}{10^{-7}} = 100 \Rightarrow [H^{+}] = 10^{-5} \Rightarrow pH = 5.$

6. $[Ag(NH_3)_2]^{+} + e^{-} \longrightarrow Ag^{+} + 2\ NH_3 \qquad K_d = 10^{-13}$

$\Delta G^{\circ}_1 = RT \ln K_d$

$Ag^{+} + e^{-} \longrightarrow Ag \qquad \Delta G^{\circ}_3 = -1 \times F \times 0.8$

$[Ag(NH_3)_2]^{+} + e^{-} \longrightarrow Ag + 2NH_3 \qquad \Delta G^{\circ}_3 = \Delta G^{\circ}_1 + \Delta G^{\circ}_2$

$-1 \times F \times E^{\circ} = -RT \ln k_d - 1 \times F \times 0.8$

$E^{\circ} = -\frac{RT}{F} \ln k_d + 0.8 \quad \Rightarrow \quad \frac{8.314 \times 298}{96500} \times 2.303 \times (-13) + 0.8$

$E^{\circ} = 0.0313$ V.

7. $Zn(s) \longrightarrow Zn^{2+} + 2e^{-}$

$Cu^{2+} + 2e^{-} \longrightarrow Cu(s)$

$Zn(s) + Cu^{2+} \longrightarrow Zn^{2+} + Cu(s)$

$E_{cell} = E^{o}_{cell} - \frac{0.0591}{2} \log \frac{C_1}{C_2}$

Since slope is –ve i.e. $-\frac{0.0591}{2}$

$\therefore \quad$ Ans is (B).

8. For spontaneity, $E_{cell} > 0$

$E^o_{cell} = 0$ for concentration cell.

(A) Anode : $H_2 \longrightarrow Zn^+ + 2e^-$

Cathode : $Zn^+ + 2e^- \longrightarrow H_2$

H_2 / anode $\longrightarrow$ H_2 / cathode

$$E_{cell} = -\frac{0.0591}{2}\log\frac{H_2/\text{cathode}}{H_2/\text{anode}} = -\frac{0.0591}{2}\log\frac{P_2}{P_1}$$

= +ve

(B) Anode : $Zn\ (s) \longrightarrow Zn^{2+} + 2e^-$

Cathode : $Zn^{2+} + 2e^- \longrightarrow Zn\ (s)$

Zn^{2+} / cathode $\longrightarrow$ Zn^{2+} / anode

$$E_{cell} = -\frac{0.0591}{2}\log\frac{Zn^{2+}/\text{anode}}{Zn^{2+}/\text{cathode}} = -\frac{0.0591}{2}\log\frac{C_1}{C_2}$$

= +ve.

9. For urea

$\Delta T_f = k_f \times m$

or $k_f = \frac{\Delta T_f}{m} = \frac{1.86}{1} = 1.86$

Now for CH_3COOH

$\Delta T_f = i\, k_f\, m$

so $i = \frac{0.02046}{1.86 \times 0.01} = 1.1$

Now $i = 1 + \alpha$

so $\alpha = 1.1 - 1 = 0.1$

Now

CH_3COOH	$\rightleftharpoons$	CH_3COO^-	+	H^+
C		0		0
$C - C\alpha$		$C\alpha$		$C\alpha$

$[H^+] = C\alpha = 0.01 \times 0.1 = 0.001$

so pH = 3.

10. [Acetyl saliclic acid] $= \frac{0.36}{250} \times 2 \times 1000\ g\ L^{-1}$

$= \frac{0.36 \times 8}{180} = 0.016\ M$

By Ostwald's dilution law $[H_3O^+]$

$= \sqrt{K_a C} = \sqrt{6.25 \times 10^{-9} \times 0.016} = 10^{-5}\ M$

$pH = -\log [H_3O^+] = 5$

DPP No. # 29

2. $Sn \mid Sn^{2+}\ (1\ M) \mid\mid Pb^{2+}\ (10^{-3}\ M) \mid Pb.$

$E^0_{(Sn^{2+}/Sn)} = -0.14$ V. and $E^0_{(Pb^{2+}/Pb)} = -0.13$ V.

$E^o_{cell} = -0.13 + 0.14 = 0.01$ V.

$E_{cell} = 0.01 - \frac{0.0591}{2}\log\frac{1}{10^{-3}} =$ **-0.0785 V.**

3. $\log K_{eq.} = \frac{2 \times 0.777}{0.0591}$, $K_{eq.} = 2.18 \times 10^{26}$

4. $E_{cell} = 3.11 - \frac{0.0591}{2} \log K_{eq.}$ $\quad E_{cell} = 0.$

$\log K_{eq.} = \frac{3.11 \times 2}{0.0591}$

$K_{eq.} = 1.864 \times 10^{107}$

$\Delta G^{o} = -2.303\ RT \log 1.864 \times 10^{107} = -2.303 \times 8.314 \times 298 \log 1.86 \times 10^{107}$

5. $0 = E^{o}_{cell} - \frac{0.0591}{1} \log 0.531$

$E^{o}_{cell} = 0.0591 \log 0.531 = 0.0591 \log 5.31 \times 10^{-1}$

$E^{o}_{C} - E^{o}_{A} = -0.01624$

$E^{o}_{C} = -0.01624 + 0.799 = 0.7826$ V.

6. For the given options

(A) Sodium ion and azide ion

$Na^{+} + N_3^{-1} \longrightarrow Na + N_2$ $\quad E° = -2.71 + 3.09 < 1.7$ V

(B) Silver ion and perchlorate ion

$ClO_4^{-} + Ag \longrightarrow Ag^{+} + ClO_3^{-}$ $\quad E° = 1.23 - 0.80 < 1.7$ V

(C) Silver ion and azide ion

$Ag^{+} + N_3^{-} \longrightarrow Ag + N_2$ $\quad E° = 0.80 + 3.09 = 3.89 > 1.7$ V

So will lead to explosion

7. If Fe^{3+} is present, then

$Fe^{3+} + H_2O_2 \longrightarrow Fe^{2+} + O_2$ $\quad E° = 0.77 + 1.03 = 1.8$ V > 0 so spontaneous

$Fe^{2+} + H_2O_2 \longrightarrow Fe^{3+} + H_2O$ $\quad E° = 1.76 + 0.77 = 0.99 > 0$

Hence Fe^{2+} and Fe^{3+} both are capable of decomposing H_2O_2.

8. From SRP values it is clear that O_3 will oxidise H_2O_2 into O_2.

9. $NO_2^{-} + H_2O \rightleftharpoons HNO_2 + OH^{-}$

$c(1-h)$ $\quad ch \quad ch$ $\quad$ where h is degree of hydrolysis

$[OH^{-}] = ch$;

Also; $h = \sqrt{\frac{K_H}{c}} = \sqrt{\frac{K_w}{K_a.c}} = \sqrt{\frac{10^{-14}}{4 \times 10^{-4} \times 0.04}} =$ **2.5×10^{-5}**

$\therefore$ $[OH^{-}] = 0.04 \times 2.5 \times 10^{-5}$ $\quad$ or $\quad$ pOH = 6

$\therefore$ pH = 14 – pOH = **8**

10. (1) $pH = \frac{1}{2}(pK_w - pK_b - \log C)$; (2) $pH = \frac{1}{2}(pK_w + pK_{a_2} + \log C)$

(3) $Na_2S + 2HCl \longrightarrow 2NaCl + H_2S$

$\therefore$ $pH_{WA} = \frac{1}{2}(pK_{a_1} - \log C)$

(4)

	$NaOH + H_3PO_4 \longrightarrow$	$NaH_2PO_4 +$	H_2O	
i	5	2		
f	3	0	2	2
	$NaOH + NaH_2PO_4 \longrightarrow$	$Na_2HPO_4 +$	H_2O	
i	3	2		
f	1	0	2	2
	$NaOH + Na_2HPO_4 \longrightarrow$	$Na_3PO_4 +$	H_2O	
i	1	2		
f	0	1	1	1

$\therefore$ Buffer solution $\therefore$ $pH = pK_{a_3} + \log_{10} \frac{[PO_4^{3-}]}{[HPO_4^{2-}]}$

(5) $CH_3COONa + HCl \longrightarrow CH_3COOH + NaCl$

i	5	4		
f	1	0	4	4

$\therefore$ Acidic buffer $\therefore$ $pH = pK_a + \log_{10} \frac{[CH_3COO^-]}{[CH_3COOH]}$

(6) $pH = \frac{pK_{a_2} + pK_{a_1}}{2}$

(7) $HCl + NaHCO_3 \longrightarrow NaCl + H_2CO_3$

i	2	1		
f	1	0	1	1

For a mixture of WA + SA, major H^+ ions will come from HCl.

$\therefore$ $pH = -\log_{10}[H^+]_{HCl}$

(8) $pH = \frac{1}{2}(pK_w + pK_a - pK_b)$

(9) $NH_4OH + HCl \longrightarrow NH_4Cl + H_2O$

i	4	3		
f	1	0	3	3

$\therefore$ Basic buffer $\therefore$ $pOH = pK_b + \log_{10} \frac{[NH_4^+]}{[NH_4OH]}$

Clearly, pH of solutions 4, 5, 6, 8 and 9 is not affected by dilution.

DPP No. # 30

1. $pH = 14 \Rightarrow [OH^-] = 1\ M$

$[Al^{3+}] = \frac{Ksp}{[OH^-]^3} = 10^{-33}$

$Al^{3+} + 3e^- \longrightarrow Al$

$E_{cell} = E^\circ_{Al^{3+}/Al} - \frac{0.0591}{3} \log \frac{1}{[Al^{3+}]}$.

2. Cell reaction

Cathode : $H_2O(\ell) + \frac{1}{2}O_2(g) + 2e^- \longrightarrow 2OH^-(aq.)$

Anode : $H_2(g) \longrightarrow 2H^+(aq.) + 2e^-$

$H_2O(\ell) + \frac{1}{2}O_2(g) + H_2(g) \longrightarrow 2H^+(aq.) + 2OH^-(aq.)$

Also we have

$H_2(g) + \frac{1}{2}O_2(g) \longrightarrow H_2O(\ell)$ $\quad \Delta G^\circ_f = -257.2$ kJ/mole

$H_2O(\ell) \longrightarrow H^+(aq.) + OH^-(aq.)$ $\quad \Delta G^\circ = 80.35$ kJ/mole

Hence for cell reaction

$\Delta G^\circ = -96.50$ kJ/mole

So, $E^\circ = -\frac{\Delta G^\circ}{nF} = \frac{96500}{2 \times 96500} = 0.50$ V

3. $E_{cell} = E^{\circ}_{cell} \frac{-0.0591}{2} \log \frac{[H^+]^2}{[Ni^{2+}][H_2]}$

$\Rightarrow \quad E_{cell} - E^{\circ}_{cell} = \frac{-0.0591}{1} \log [H^+] = 0.0591 \times pH$

$\Rightarrow \quad pH = 1$

$H_2 \longrightarrow 2H^+ + 2e^-$

$Ni^{2+} + 2e^- \longrightarrow Ni(s)$

$H_2 + Ni^{2+} \longrightarrow 2H^+ + Ni(s).$

4. For the cell $Ag \mid Ag^+ \parallel I^- , AgI ; Ag$

LHS electrode $Ag \longrightarrow Ag^+ + e^-$

RHS electrode $AgI + e^- \longrightarrow Ag + I^-$

Cell reaction, $AgI \rightleftharpoons Ag^+ + I^-$

The equilibrium constant (K) = The solubility product K_s

$\Delta G = - nFE$

$\Delta G^{\circ} = - 2.303\ RT \log K$

$\log K = \frac{nFE}{2.303\ RT}$

5. $Zn \mid ZnCl_2\ (0.05M) \mid AgCl(s) \mid Ag\ E_{cell} = 1.015V$

$\left(\frac{dE_{cell}}{dT}\right) = -4.92 \times 10^{-4}\ \frac{V}{K}$

$\Delta G = -nFE_{cell} = -ve \qquad (as\ E_{cell} = +ve)$

$= -2 \times 96500 \times 1.015$

$= -195.895\ kJ.$

$\Delta S = nF \left(\frac{dE_{cell}}{dT}\right)$

$= 2 \times 96500 \times -4.92 \times 10^{-4}$

$= -94.956\ J/K.$

$\Rightarrow \quad \Delta G = \Delta H - T\Delta S.$

$= -198.895 + \frac{298}{1000} \times (-94.956)$

$= -224.19\ KJ.$

So, all are negative.

6. $E^{\circ}_{Cl^-/AgCl,Ag} = E^{\circ}_{Ag^+/Ag} + 0.0591 \log k_{sp}\ (AgCl)$

$= 0.8 + 0.0591 \log 1.56 \times 10^{-10}$

$= 0.8 + 0.0591\ (-10 + \log 1.56) = 0.2204\ V$

7. $Ag \longrightarrow Ag^+ + e^- \qquad E^{\circ} = -0.8\ V$

$AgBr + e^- \longrightarrow Ag + Br^- \qquad E^{\circ} = 0.073$

$AgBr \rightleftharpoons Ag^+ + Br^-$

$E^{\circ}_{cell} = 0.073 - 0.8 - 0.0591 \log [Ag^+]\ [Br^-]$

$0.8 - 0.073 = - 0.0591 \log K_{sp}\ (AgBr^-)$

$K_{sp} = 4.998 \approx 5 \times 10^{-13}$

$[Ag^+]\ [Br^-] = 5 \times 10^{-13}$

$[Br^-] = \frac{5 \times 10^{-13}}{0.1} = 5 \times 10^{-12}$

Solubility of AgBr = $[Br^-] = 5 \times 10^{-12} M$

8. $\Delta S^\circ = nF\left(\frac{dE^\circ}{dt}\right)_p$

$= 2 \times 96500 \times [-1.25 \times 10^{-3}] = 241.45\ Jk^{-1}$

$\Delta H^\circ = -nF\ E^\circ_{cell} + n\ F\ T\ \frac{dE^\circ_{cell}}{dT}$

$= -2 \times 96500 \times 1.36 + 2 \times 96500 \times 298 \times (-1.25 \times 10^{-3})$

$= -3.3437 \times 10^2$ KJ.

10. For same amount of gas at constant temperature, lesser is the volume, lower will be the entropy.

11. **S_2 :** Molar entropy of gas is much greater than that of solid and liquid.
S_3 : Entropy change is positive if Δn_g is positive.
S_4 : Molar entropy of a crystalline solid will be zero at absolute zero temperature.

DPP No. # 31

1. **(a)** Solution contains Sn^{2+}, Cl^-, H_2O.
Anode is tin anode.

$E^o_{Sn^{2+}/Sn} = -0.14V$; $E^o_{O_2/H_2O} = 1.23V$; $E^o_{Cl_2/Cl^-} = 1.36V$.

From the SRP values, it is clear that the reaction for which SRP is least will take place at anode $E^o_{Sn^{2+}/Sn}$ is least.

So, $Sn \longrightarrow Sn^{2+} + 2e^-$ **Ans.**

(b) The solution contains Ni^{2+}, SO_4^{2-}, H_2O

$E^o_{Ni^{2+}/Ni} = 0.23V$ $\quad E^o_{S_2O_8^{2-}/SO_4^{2-}} = 2.05V$

$E^o_{O_2/H_2O} = 1.23V$ $\quad E^o_{Au^{3+}/Au} = 1.4V$ $\quad E^o_{Cu^{2+}/Cu} = 0.34V$

If Nickel electrode is used, then Nickel will get oxidised as its SRP is least. So Nickel is not anode. If gold electrode is used, then water will get oxidised as SRP of gold is more than SRP of water. So gold is the anode.
If copper electrode is used, then copper will get oxidised as SRP of Cu is less than that of water.

2. **(a)** K_2SO_4(aq.) contains K^+, SO_4^{2-}, H_2O
At anode ; water gets oxidized

$2H_2O \longrightarrow O_2 + 4n^+ + 4e^-$

as H^+ are produced, region around anode has lesser pH.
At cathode, water get reduced.

$2H_2O + 2e^- \longrightarrow H_2 + 2OH^-$

as OH^- are produced, region around cathode has higher pH.
Cathode is negatively charged.
(b) In $CuCl_2$ solution,
At anode

Either $2Cl^- \longrightarrow Cl_2 + 2e^-$

5. $H_2O \xrightarrow{2e^-} H_2 + \frac{1}{2}O_2$

$2 \times 96500\ C \rightarrow 22.4 \times 1000\ cm^3\ H_2$

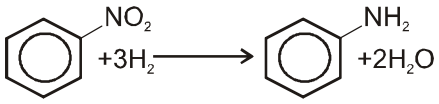
$\frac{2 \times 96500 \times 224}{22.4 \times 1000}\ C \leftarrow \quad \therefore\ 224\ cm^3\ H_2$

$= 1930$ C.

6. Gold chloride $AuCl_3$

$$m = \frac{M}{96500 \times n} \times I \times t$$

$$I = \frac{2 \times 96500 \times 3}{197 \times 20 \times 60} = 2.448A.$$

9. 

$\frac{6.15}{123}$ = 0.05 mole of mitro benzene

V.F = 6

electricity of charge required if efficiency is 100%

= 0.05 × 6 = 0.3 F

But efficiency is 40%

charge required = $\frac{0.3}{0.4}$ = 0.75.

11. XSO_4 (aq.)

Y_2SO_4 (aq.)

$$\frac{\text{Mol.mass X}}{\text{Mol.mass Y}} = \frac{2}{1} \Rightarrow \text{eq. wt. of X} = \frac{\text{mol. mass X}}{2} \Rightarrow \text{eq. wt. of Y} = \frac{\text{mol. mass Y}}{2}$$

$$\frac{\text{mass of Y}}{\text{mass of X}} = \frac{\text{eq.wt. of Y}}{\text{eq.wt. of X}} = \frac{\text{mol.mass Y}}{\text{mol.mass X}} \times \frac{2}{1} = 1:1.$$

DPP No. # 32

1. Remains colourless since solution is almost neutral & Hph shows pink colour only in basic medium.

Cathode : $2H_2O + 2e \longrightarrow H_2 + 2OH^-$.

Anode : $2H_2O \longrightarrow O_2 + 4H^+ + 4e^-$.

both OH^- equivalent = H^+ equivalent.

2. $NaCl O_3 + H_2O \longrightarrow NaClO_4 + H_2$

At cathode : $2H^+ + 2e^- \longrightarrow H_2$

For 1 mole of $NaClO_4$ and H_2 we require 2 F of charge

For 0.5 mole of $NaClO_4$ we require 1 F of charge

$\therefore$ Electricity required = 1×100/60 = 1.67F.

4. The number of Faradays = $\frac{600 \times 0.2}{96500}$ = 1.243×10^{-3}.

At the cathode, reaction is

$$H_2O + e^- \longrightarrow \frac{1}{2} H_2 + OH^-$$

1.243×10^{-3} mol of OH^- are produced.

The concentration = $1.243 \times 10^{-3} / 0.05 = 0.02486$ Molar.

5. th × Area × density = $\frac{108 \times 0.2 \times 0.8 \times 3600}{96500}$;

$$th = \frac{108 \times 0.2 \times 0.8 \times 3600}{96500 \times 100 \times 10} \text{ cm} = 6.4 \times 10^{-4} \text{ cm}$$

6. Anode : $2Cl^- \longrightarrow Cl_2(g) + 2e^-$ $\quad E^\circ = -1.36$ V

Cathods : $2H_2O + 2e^- \longrightarrow H_2(g) + 2OH^-$ $\quad E^\circ = -0.83$ V

pH = 12.24 $\Rightarrow [OH^-] = 0.0174M$

Moles of $OH^- = 0.3 \times 0.0174 = 5.213 \times 10^{-3}$ moles

= Moles of e^-

Total charge = $5.213 \times 10^{-3} \times 96500 = 503.1$ C.

$$It = 503.1 \quad \Rightarrow \quad I = \frac{503.1}{360} = 1.4 \text{ A.}$$

7. The reduction potential of $Cu^{2+} > Zn^{2+} > Mn^{2+}$.

8. Since, no. of Faraday used

= No of equivalent deposited = (n-factor) × mole deposited

$$\therefore \text{ mole deposited } = \frac{\text{no. of Faraday used}}{\text{n-factor}} = \frac{i \times t}{96500} \times \frac{1}{n} = \frac{1 \times 96.5 \times 60}{96500 \times 2} = 30 \times 10^{-3} = 0.03.$$

9. If time for the deposition of Zn be t

$\therefore \quad t = 106.5 - 96.5 = 10$ minute.

$$\therefore \text{ mole deposited } = \frac{1 \times 10 \times 60}{96500} \times \frac{1}{2} = 0.0031.$$

10. No.of equivalent of O_2 evolved = no.of Faraday used

$$= \frac{\left(\frac{50}{100}\right) i.t}{96500} = \frac{0.5 i.t}{96500} \quad \therefore \quad \text{mole of } O_2 = \frac{0.5 \times 1 \times 96.5 \times 60}{96500} \times \frac{1}{4} = \frac{0.03}{4}$$

$$\therefore \quad \text{volume at NTP } = \frac{0.03}{4} \times 22.4 = 0.168 \text{ L} = 168 \text{ mL.}$$

DPP No. # 33

1. Weak electrolyte is weakly ionizing substance, dilution promotes ionization thus conductivity.
For strong electrolyte, as concentration increases interionic attraction increases and conduction decreases.

2. Normality of resulting solution = $\frac{0.1V}{2V} = 0.05$ N

$$\wedge_{eq.} = \frac{K \times 1000}{N} = \frac{0.0055 \times 1000}{0.05} = 110$$

3. $R_A = \frac{1}{0.01} = 100$

$R_B = \frac{1}{0.005} = 200$

$$\frac{1}{Req} = \frac{1}{R_A} + \frac{1}{R_B}$$

$Sep = S_A + S_B = 0.01 + 0.005 = 0.0155$

6. $\kappa_{electrolyte} = \kappa_{solution} - \kappa_{solvent}$

$= 3.4 \times 10^{-6} - 2.02 \times 10^{-6} = 1.38 \times 10^{-6}$ Scm^{-1}

$$\text{Solubility} = \frac{\kappa_{electrolyte} \times 1000}{\lambda_m^\circ}$$

$$= \frac{1.38 \times 10^{-6} \times 1000}{138} = 10^{-5} \text{ M.}$$

7. $\Lambda^\circ_{eq}\, Ba(OH)_2 = \lambda^\circ\, Ba^{2+} + \lambda^\circ eq,\, OH^-$
$\lambda^\circ eq\, BaCl_2 = \lambda^\circ eq\, Ba^{2+} + \lambda^\circ eq, Cl^-$
$\lambda^\circ eq\, NH_4Cl = \lambda^\circ eq\, NH^+_4 + \lambda^\circ eq, Cl^-$
$\lambda^\circ eq,\, NH_4OH = \lambda^\circ eq, NH_4^+ + \lambda^\circ eq, OH^-$
I + III + II
$\lambda^\circ eq, NH_4OH = (228.8 + 129.8) - 120.3 = 238.33\ cm^2 eq^{-1}$

$$\lambda eq,\, NH_4OH = \frac{4.766\times10^{-14}\times1000}{0.2} = 2.383$$

$$\alpha = \frac{\lambda eq, NH_4OH}{\lambda^\circ eq, NH_4OH} = 10^{-2}$$

$NH_4OH \rightleftharpoons NH_4^+ + OH^-$
$c(1-\alpha) \qquad c\alpha \quad c\alpha$
$[OH^-] = 0.2 \times 10^{-12} = 2 \times 10^{-3}$
$pOH = 3 - \log 2 \Rightarrow \quad pH = 14 - (3 - \log 2) = 11.3$

8. $$R = \frac{1}{\kappa}\,\frac{\ell}{A} \quad \Rightarrow \quad \kappa = \frac{1}{250}\times\frac{7}{7} = 0.004\ \Omega^{-1}\ cm^{-1}$$

$$\Lambda_{eq} = \frac{0.004}{0.1}\times 1000\ \Omega^{-1}\ cm^2\ eq^{-1} = 40\ \Omega^{-1}\ cm^2\ eq^{-1}\ .$$

9. Number of moles of Cu^{2+} discharged from anode = number of moles of Cu^{2+} deposited at cathode.

DPP No. # 34

1. In solution A : $Cu^{2+} + 2e^- \longrightarrow Cu$; $2H_2O \longrightarrow O_2 + 4H^+ + 4e^-$ (pH decreases)

In solution B : $2Br^- \longrightarrow Br_2 + 2e^-$; $2H_2O + 2e^- \longrightarrow H_2 + 2OH^-$ (pH increases)

2. (D) Ni $(dmg)_2$ complex is square planar and dimagnetic.
Pt (II) – $5d^8$ configuration. Complex is square planar and therefore, dimagnetic.
So, $\mu = 0$

4. On increasing dilution, conductivity (k) of solution decreases but molar conductivity (λ_m) increases.

5. emf of cell is intensive function so do not depend stoichometic coefficient. In complex formation concentration of cation of decreases, emf and connectivity get change.

7. $\Lambda^\infty_m\,(Cu_2[Fe(CN)_6]) = 2\,\lambda^\infty_m(Cu^{2+}) + \lambda^\infty_m(Fe(CN)_6^{4-})$
$= 2\,\Lambda^\infty_m(CuSO_4) + \Lambda^\infty_m(K_4Fe(CN)_6) - 2\Lambda^\infty_m(K_2SO_4)$
$= 640\ S\ cm^2\ mol^{-1}$

$$\Lambda^\infty_m = \frac{\kappa\times100}{s}$$

$$s = \frac{\kappa\times1000}{\Lambda^\infty_m} = \frac{1.28\times10^{-5}\times1000}{640} = 2\times10^{-5}$$

8. $\lambda^\infty_{K^+} = 96.50$

$$\therefore \quad \text{Ionic mobility } \mu^\infty_{K^+} = \frac{\lambda^\infty_{K^+}}{F} = \frac{96.50}{96500} = 10^{-3}\ cm^2\ sec^{-1}\ volt^{-1}$$

$$\text{Potential gradient applied} = \frac{6.0}{10} = 0.6\ volt\ cm^{-1}$$

$$\text{Ionic mobility } (\mu) = \left(\frac{\text{speed of ion}}{\text{potential gradient}}\right)$$

So speed of $(K^+) = (10^{-3}\times0.6) = 6\times10^{-4}$ cm/sec.
$\therefore$ Distance travelled in 2 hours 46 minutes and 60 seconds
d = 6 cm.

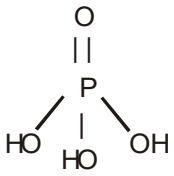
DPP No. # 35

1. $(NH_4)_2Cr_2O_7 \xrightarrow{\Delta} N_2 + Cr_2O_3 + 4H_2O$

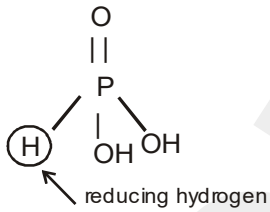
4. (C) oxygen gas is produced.

5. **(a)** $Ca_3P_2 + 6HCl \longrightarrow 3CaCl_2 + 2PH_3$ **(b)** $CaO + H_2O \longrightarrow Ca(OH)_2$

6.



(H_3PO_4)



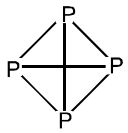
(H_3PO_3)

Strength of phosphorus oxy acid depends upon the number of OH groups per P = O group. It is the P = O group which induces polarisation and helps in the release of proton from-OH group. $H_3PO_3 > H_3P_4$

8. (A) Burns only in pure dioxygen gas.
(D) Avalability of electrons for metallic bonding ↓.

10. Both statement are correct but not correct explanation
NO solid is dimerised so diamagnetic O=N – N=O (s) but gasesous form is paramagnetic.

15. **(i)**



Six P–P single bonds are present.

(ii) $P_4 + 3NaOH + 3H_2O \longrightarrow PH_3 + 3NaH_2PO_2$

DPP No. # 36

2. (i) Graphite like layered structure.
(ii) $Sb + 5HNO_3 \longrightarrow H_3SbO_4 + 5NO_2 + H_2O$
(iii) $2Pb(NO_3)_2 \xrightarrow{673K} 2PbO + 4NO_2 + O_2$

4. Down the group $\Delta_{dissociation}H(E – H)$ bond decreases.

6. S_1 - N_2H_4 is formed in aqueous dilute solution in presence of glue or gelatin.
S_2 - PH_3 solution in water explodes forming red phosphrous and H_2.
S_3 - $Ba(N_3)_2 \xrightarrow{\Delta} Ba + 3N_2\uparrow$
S_4 - $H_4P_2O_6$ = P – P bond, H_3PO_2 = P – H bond.

7. ClO_2 does not dimerise because odd electron is present in 'd' orbital and is declocalised not localised as in NO_2.

11. (A) $3H_3PO_2 \xrightarrow{415K} 2H_3PO_3 + PH_3\uparrow$

$4H_3PO_3 \xrightarrow{435K} 3H_3PO_4 + PH_3$

(B) $PCl_3 + 3H_2O \xrightarrow{\text{Hydrolysis}} H_3PO_3 + 3HCl$

$4H_3PO_3 \xrightarrow{435K} 3H_3PO_4 + PH_3\uparrow$

(C) $2NO_2 + H_2O \longrightarrow HNO_2 + HNO_3$

(D) $4HNO_3 + P_4O_{10} \longrightarrow 4HPO_3 + 2N_2O_5$

* PH_3 and HNO_2 act as reducing agents.

12. $E = 0.76 + \frac{0.0591}{2}\log\frac{10}{1}$

& $E = 0.76 + \frac{0.0591}{2}\log\frac{1}{10}$

13. $Fe(C_{12}H_8N_2)_3^{3+} + e^- \rightleftharpoons Fe(C_{12}H_8N_2)_3^{2+}$

range = $1.14 \pm \frac{0.0591}{1}$

14. $2CH_3COONa \xrightarrow{\text{Electrolysis}} \underset{\text{at anode}}{C_2H_6 + 2CO_2} + \underset{\text{Cathode}}{H_2}$

Electric supplied = $\frac{0.965 \times 60 \times 60}{96500} = 3.6 \times 10^{-3}$ F

$V_{H_2} = \frac{3.6 \times 10^{-3}}{2} \times \frac{0.0821 \times 298}{1} = 0.44$ lit

$V_{total} = V_{C_2H_6} + V_{CO_2} + V_{H_2} = 4 \times 0.44 = 1.76$ lit.

DPP No. # 37

1. **(a)** $PbO_2 + 2HNO_3 \longrightarrow Pb(NO_3)_2 + 1/2\ O_2 + H_2O$

$2MnO_2 + 2H_2SO_4 \longrightarrow 2MnSO_4 + H_2O + O_2$

$2\ KMNO_4 + 16HCl \longrightarrow 2KCl + 2MnCl_2 + 8H_2O + 5Cl_2$

2. (A) and (B). Source NCERT

3. **(b)** $H_2S + H_2SO_4 \longrightarrow 2H_2O + SO_2 + S$

4. **(a)** $3S + H_2SO_4 \longrightarrow 3SO_2 + 2H_2O$

5. $2Na_2S(aq) + 3SO_2(g) \longrightarrow S\downarrow + Na_2S_2O_3(aq)$

7. **(b)** (A), (B) (C) can be explained on the basis of decrease in bond (H-E) dissociation enthalpy
(D) Hydrogen bonding, and van der Waal's force of attraction.

8. **(a)** S_1 (NCERT), S_3 β-Sulphur is stable above 369K.

(b) (D) $PbS_2O_3 + H_2O \xrightarrow{\Delta} PbS\downarrow$ (black) $+ H_2SO_4$

9. Kept in plastic or wax-lined glass containers containing urea or phosphoric acid.

10. **(a)** on the basis of atomicity, oxygen diatomic where as sulphur is polyatomic.

(b) $Na_2S_2O_3 + 2H^+ \longrightarrow 2Na^+ + H_2SO_3 + S\downarrow$ (colloidal sulphur)
(c) S_2 (in vapour state) has two unpaired electrons, like O_2.

11. (A) $H_2O = 273$ K, $H_2Te = 222$ K; $\Delta_{diss}H$ (H—E()/kJ mol^{-1}
$H_2O = 463$ and $H_2TE = 238$;

(B) $SO_3 = 44.8$ºC and $SO_2 = -10.07$ºC, $\overset{+4}{SO_2}$, $\overset{+6}{SO_3}$

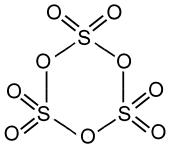
SO_3 more acidic than SO_2
(C) $H_2SO_4 = 338$ºC; $H_2O_2 = 144$ºC
(D) $NH_3 = 238.5$°C, $PH_3 = 185.5$°C; ↓ down the group thermal stability ↓ acidic character ↑ Reducing character.

DPP No. # 38

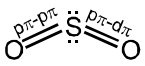
1. $NH_4ClO_4 + HNO_3 \longrightarrow HClO_4 + NH_4NO_3$

$2NH_4NO_3 \xrightarrow{\Delta} 2N_2O + 4H_2O$

3. During oxidation of H_2O_2, O–O bond is not broken.

4. **(a)** 

Hence, Ans.(D)

(b) 

6. **S_1 :** It is correct statement. Dark coloured bottle prevents the auto oxidation of H_2O_2 by light. Urea and sodium stannate act as negative catalyst for the decomposition of H_2O_2.

S_2 : $2KMnO_4 + 5H_2O_2 + 3H_2SO_4 \longrightarrow 2MnSO_4 + K_2SO_4 + 5O_2 + 8H_2O$.

S_3 : H_2O_2 , boiling point 152ºC.

S_4 : $H_2O_2 \longrightarrow H^+ + HO_2^-$, $K_{20ºC} = 1.5 \times 10^{-12}$.

7. **O_2 :** KK, $\sigma 2s^2$, $\sigma^* 2s^2$, $\sigma 2px^2$, $\pi 2py^2$, $\pi 2pz^2$, $\pi^* 2py^1$, $\pi^* 2pz^1$

8. $2Hg + O_3 \longrightarrow Hg_2O + O_2$

Hg_2O dissolves in Hg and thus its mobility decreases.

10. **(i)** Phosphorous acid (H_3PO_3) Dibasic $\therefore$ x = 2

Tetrathionic acid ($H_2S_4O_6$) Dibasic $\therefore$ y = 2

Pyrophosphoric acid ($H_4P_2O_7$) tetrabasic $\therefore$ z = 4

(iii) P_4O_6, SiO_2, CO_2, NO_2 are acidic oxides, CO and NO are neutral oxides and PbO_2 and SnO_2 are amphoteric oxides.

DPP No. # 39

1. **(a)** $Cl_2O_7 + H_2O \longrightarrow 2HClO_4$; $Cl_2O_3 + H_2O \longrightarrow 2HClO_2$

$2ClO_2 + H_2O \longrightarrow HClO_2 + HClO_3$

$Cl_2O_5 + 2H_2O \longrightarrow 2HClO_3$

2. **(b)** In H_2SO_4, intense H-bonding makes it less volatile than HCl. HCl is more volatile as there is no H-bonding. So H_2SO_4 displaces HCl from its salt.

(c) $I_2 + HNO_3 \longrightarrow 2HIO_3 + 4H_2O + 10\ NO_2$

3. (A) $KI + I_2 \longrightarrow KI_3$

I_2 is non-polar covalent compound. So soluble in (C) & (D)

5. Statement-1 : $SiO_2 + HF \longrightarrow SiF_4 + 2H_2O$; $SiF_4 + 2HF \longrightarrow H_2SiF_4$

Statement-2 : True.

Statement-3 : $3KClO_3 + 3H_2SO_4 \longrightarrow 3KHSO_4 + HClO_4 + 2ClO_2 + H_2O$

Statement-4 : $6\ NaOH + 3Cl_2 \longrightarrow 5NaCl + NaClO_3 + 3H_2O$

6. Statement-3 : $4I^- + 4H^+ + O_2 \longrightarrow 2I_2 + 2H_2O$

7. Statement-1 : HI > HBr due to low bond dissociation enthalpy.

Statement-2 : Due to small size

Statement-3 : $F_2 > O_3$ oxidising agent. Highest SRP of fluorine

Statement-4 : Fluorine does not have empty d-orbital.

8. **(a)** $3Br_2 + 3Na_2CO_3 \longrightarrow 5\,NaBr + NaBrO_3 + 3CO_2$

$NaBr + H_2SO_4 \longrightarrow Na_2SO_4 + SO_2 + Br_2 + H_2O$

9. **(b)** Bond energy of F_2 is less than Cl_2 because lp–lp repultion.

(c) $H_2O + Cl_2 \longrightarrow 2HCl + [O]$

$SO_2 + 2H_2O \longrightarrow H_2SO_4 + 2\,[H]$

(d) $I_2 + 2Na_2S_2O_3 \longrightarrow 2NaI + (\text{colourless}) + Na_2S_4O_6$

DPP No. # 40

1. **(b)** $2F_2 + 2NaOH\ (dil) \longrightarrow OF_2\ (s) + 2NaF + H_2O$

2. $2AgClO_3 + Cl_2 \longrightarrow 2AgCl\downarrow + 3ClO_2.$

4. **(a)** S_1 and S_2 are correct statements.

S_3 : $2XeF_2(s) + H_2O(\ell) \longrightarrow 2Xe(g) + 4HF(aq) + O_2(g)$

$6XeF_4 + 12H_2O \longrightarrow 4Xe + XeO_3 + 24HF + 3O_2$

$XeF_6 + 3H_2O \longrightarrow XeO_3 + 6HF$ } Complete hydrolysis

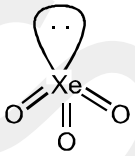
S_4 : $XeF_2 + PF_5 \longrightarrow [XeF]^+\,[PF_6]^-$

$XeF_4 + SbF_5 \longrightarrow [XeF_3]^+\,[SbF_6]^-$

$XeF_6 + MF \longrightarrow M^+[XeF_7]^-$

M = Na, K, Rb or Cs

(b) **S_1 :** Statement is correct



S_2 : Statement is false

$2e^- + 2H^+ + XeF_2 \longrightarrow Xe + 2HF$

SRP = +2.64V.

S_3: Statement is false as He atoms being smaller do not trapp in the cavities formed by water molecules (ice).

S_4 : Statement is false $2F_2 + 2NaOH \longrightarrow OF_2(g) + 2NaF + H_2O$

5. **(a)** $Fe + 2HCl \longrightarrow FeCl_2 + H_2$

Liberation of hydrogen prevents the formation of ferric chloride.

(b) $XeF_6 + H_2O \longrightarrow XeOF_4 + 2HF$

$2XeF_6 + SiO_2\ (\text{from glass}) \longrightarrow 2XeOF_4 + SiF_4$

10. (A) $XeF_4 + 6H_2O \longrightarrow 2Xe + XeO_3 + 3/2O_2 + 12HF$

(B) $2[HXeO_4]^- + 2OH^- \longrightarrow [XeO_6]^{4-} + Xe + O_2 + 2H_2O$

(C) $3H_2O + 3F_2 \longrightarrow 6HF^- + O_3$

$2H_2O + 2F_2 \longrightarrow 4HF + O_2$

(D) $2NOCl + O_2 \longrightarrow 2NO_2 + Cl_2$

12. $\underset{(+6)}{H_2SO_5}$ and $\underset{(+2)}{Na_2S_2O_3}$

DPP No. # 41

2. **(a)** For triclinic $a \neq b \neq c$ & $\alpha \neq \beta \neq \gamma \neq 90°$

3. **(b)** $a \neq b \neq c$ & $\alpha = \beta = \gamma = 90°$ the crystal system is orthorhombic

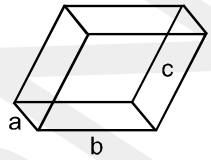
6. **(a)** $P = 8 \times \frac{1}{8} = 1$; $Q = 1 = 1$; $R = 12 \times \frac{1}{4} = 3$; formula = PQR_3

(b) Au $= 8 \times \frac{1}{8} = 1$ $Cu = 6 \times \frac{1}{2} = 3$ formula $AuCu_3$

7. $A = 7 \times \frac{1}{8} = \frac{7}{8}$; $B = 6 \times \frac{1}{2} = 3$

Formula = $A_{7/8}\ B_3$ or A_7B_{24}

10. **(a)** In triclinic unit sell.



$a \neq b \neq c$
$\alpha \neq \beta \neq \gamma$

(b). In simple cubic contribution of one corner = $\frac{1}{8}$

total corner = 8

effective no. of atom per unit cell = $\frac{1}{8} \times 8 = 1$

No. of bondy center in simple cubic = 1
No. of atom in body center = 1
AB

DPP No. # 42

3. $d = \frac{ZM}{a^3N_A}$ $\frac{d_1}{d_2} = \frac{4}{(3.5)^3} \times \frac{(3)^3}{2} = 1.26$

7. $\frac{r_{tetrahedral}}{r_{octahedral}} = \frac{0.225R}{0.414R} = 0.543.$

11. 8, 4, 100%.
It has fluorite (CaF_2) structure.

12. $d = \frac{ZM}{a^3N_A}$ $3.9 = \frac{4 \times 84}{a^3 \times 6.023 \times 10^{23}}$ or $a^3 = 174.9 \times 10^{-24}$

$a = 5.6 \times 10^{-8}$ cm or 5.6 Å

$2r = \frac{a}{\sqrt{2}} = \frac{5.6}{\sqrt{2}} = 3.95$ Å

13. (A) $2r = \frac{\sqrt{3}\,a}{2} = \frac{\sqrt{3} \times 5.2}{2} = 4.5$ Å

(B) Distance = a = 5.2 Å
(C) 8
(D) 6

(E) $d = \frac{2 \times 39}{(5.2 \times 10^{-8})^3 \times 6.02 \times 10^{23}} = 0.92$ g/ml

14. In bcc unit cell there are 8 atoms at the corners of the cube and one atom at the body centre
∴ No of atoms per unit = 8 × 1/8 + 1 = 2
No of atoms is 4.0 g of potassium = $4/39 \times 6.023 \times 10^{23}$
∴ No of unit cells in 4.0 g potassium = $4/39 \times 6.023 \times 10^{23}/ 2 = 3.09 \times 10^{22}$

DPP No. # 43

1. $2.75 = \dfrac{Z \times 118}{(6.54 \times 10^{-8})^3 \times 6.023 \times 10^{23}}$ $\Rightarrow$ Z = 4 (fcc with NaCl type structure)

2. $r_+ + r_- = \dfrac{\sqrt{3}\,a}{2} = \dfrac{\sqrt{3} \times 4.3}{2} = 3.72$ Å

4. $2r = \dfrac{\sqrt{3}\,a}{2} \Rightarrow a = \dfrac{2(2r)}{\sqrt{3}} = \dfrac{2 \times 1.73}{1.73} = 2$Å $= 200$ pm

6. $\dfrac{1 \times \frac{4}{3}\pi r^3}{a^3} = \dfrac{\frac{4}{3}\pi r^3}{(2r)^3} = \dfrac{\pi}{6}$

7. $d = \dfrac{ZM}{a^3 N_A} = \dfrac{4 \times 21.76}{6.8 \times 10^{-8} \times 4.4 \times 10^{-8} \times 7.2 \times 10^{-8} \times 6.023 \times 10^{23}} = 0.6708$ g cm^{-2}

9. $\dfrac{1 \times \frac{4}{3}\pi r^3}{a^3} \times 100 = \dfrac{\frac{4}{3}\pi r^3}{8R^3} \times 100 = 52.38\%$

10. $r_{octahedral} = 0.414\ R$

for FCC $4R = \sqrt{2}\,a$

$R = \dfrac{\sqrt{2}\,a}{4}$ $\Rightarrow$ $r = \dfrac{0.414\sqrt{2}\,a}{4} = \dfrac{0.414\sqrt{2} \times 3.61}{4} = 0.53$ Å

11. **(i)** K_3CrO_8 is a tetraperoxo species $K_3[Cr(O_2)_4]$.

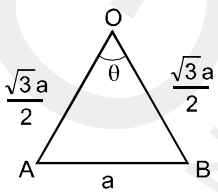
(ii) Bond order = $\frac{1}{2}$ [bonding electrons – antibonding electrons]

DPP No. # 44

2. volume of 4 atoms = a^3
$= (4 \times 10^{-8})^3$ cm^3

volume of N_A atoms $= \dfrac{(4 \times 10^{-8})}{4} \times 6.023 \times 10^{23} = 9.6$ ml

3.



$\cos\theta = \dfrac{\frac{3a^2}{4} + \frac{3a^2}{4} - a^2}{2\left(\frac{\sqrt{3}\,a}{2}\right)\left(\frac{\sqrt{3}\,a}{2}\right)} = \dfrac{1}{3} = 70°32'$

5. mass of one unit cell = d × V = $8.5 \times (3 \times 10^{-8})^3 = 8.5 \times 27 \times 10^{-24}$ gm

no. of cells in 50 g = $\dfrac{50}{8.5 \times 27 \times 10^{-24}} = 2.178 \times 10^{23}$

7. (a) $a\sqrt{3} = 4r$ where a = edge length

$$r = \frac{a\sqrt{3}}{4} = \frac{2.93 \times \sqrt{3}}{4} = 1.268 \text{ Å}$$

(b) Distance between the centres of neighbouring spheres = 2r = 2 × 1.268 = 2.537 Å
(c) No. of atoms per unit cell = 8 × 1/8 + 1 = 2.
(d) Volume occupied by an atom of iron = $4/3\ \pi r^3$.

8. (a) $2r = \frac{a}{\sqrt{2}} = \frac{4.07}{\sqrt{2}} = 2.878$ Å (b) a = 4.07 Å

(c) 12 (d) 6

(e) $d = \frac{4 \times 197}{(4.07 \times 10^{-8})^3 \times 6.023 \times 10^{23}} = 19.4$ g/ml . (f) 0.74

11 **(a)** $xVO + yFe_2O_3 \longrightarrow FeO + V_2O_5$

$3H_2O + 2VO \longrightarrow V_2O_5 + 6H^+ + 6e^-$
v.f.=3

$2e^- + 2H^+ + Fe_2O_3 \longrightarrow 2FeO + H_2O$
v.f.=3

So, x = 2 and y = 3.

(b) m-eq. of H_2O_2 = m-eq. of $KMnO_4$

$20 \times N = 0.05 \times 5 \times 80$

$\Rightarrow$ N = 1

$$N = \frac{\text{volume strength of } H_2O_2}{5.6}$$

$\Rightarrow$ volume strength of $H_2O_2 = 5.6$

DPP No. # 45

1. **(a)** HCP = AB AB AB .....pattern repeat
For calculating voids between two layers A and B.
Total tetrahedral voids = 12 (represented by dots) out of which 8 are completely inside but rest are shared by other unit cells.
Total octahedral voids = 6 (represented by cross). All are completely inside.
(b) According to figure, it shows a simple cubic lattice. Now observe the center atom , its has 6 nearest neighbours

2. **(a)** When all particle along one body diagonal are removed, these 2 X particles from corner are removed, one Y particle removed & 2 Z particle removed.

Hence new arrangement, X particle = $\frac{1}{8} \times 6 + \frac{1}{2} \times 6 = \frac{15}{4}$; Y particle = 3 ; Z particle = 6

Hence formula = $X_{15/4}Y_3Z_6 = X_{5/4}YZ_2 = X_5Y_4Z_8$

(b) In new arrangement, A particles = $\left(\frac{1}{8} \times 8 + \frac{1}{2} \times 6\right) - \left(\frac{1}{8} \times 4 + \frac{1}{2} \times 2\right) = \frac{5}{2}$

& B particles = $\left(\frac{1}{4} \times 12 + 1\right) - \left(1 + \frac{1}{4} \times 2\right) = \frac{5}{2}$

So, formula is AB

3.* In flourite structure, cations form the lattice & anions occupy each of tetrahedral voids.

4. $4\, d_{C-C} \sin(54°44') = \sqrt{2}\, a \quad \Rightarrow \quad r = \frac{d_{C-C}}{2} = 0.78$

5. $d = \frac{8 \times 12}{N_A \times a^3} = 3.37$ gm/cc.

6. Total number of unit cells $= \frac{1.2 \times N_A}{12 \times 8} = 7.5 \times 10^{21}$.

7. **(a)** In zinc blende S^{2-} from FCC while alternate tetrahedral voids are occupied by Zn^{2+}.

(b) S^{2-} ion : number of tetrahedral void

1 : 2

8. We have theoretical density $= \frac{zM}{NV} = \frac{zM}{N(a^3)}$

For a b.c.c lattice: z = 2 and given that $a = 3.50 \times 10^{-10}$ and $M = 7 \times 10^{-3}$ kg / mole

$$d_{cal} = \frac{2 \times (7 \times 10^{-3})}{6.022 \times 10^{23} \times (3.50 \times 10^{-10})^3} = 5.42 \times 10^2 \text{ kg m}^{-3}$$

$\therefore$ percentage occupancy $= \frac{\rho_{exp}}{\rho_{cal}} = \frac{5.30 \times 10^2}{5.42 \times 10^2} \times 100 = 97.78\ \%$.

9. Let there be 80 O^{2-} in the crystal.

$\therefore$ Octahedral voids = 80 ; Tetrahedral voids = 160

A^{2+} ions $= \frac{1}{8} \times 60 = 20$

B^{3+} ions $= \frac{1}{2} \times 80 = 40$

$A^{2+} : B^{3+} : O^{2-} = 20 : 40 : 80 = 1 : 2 : 4$

$\therefore$ Formula is AB_2O_4.

11. In a face -centred cubic cell,

radius $= \frac{\sqrt{2}a}{4}$

$\therefore$ the closest distance between two atoms = diameter $= 2 \times \frac{\sqrt{2}a}{4} = \frac{a}{\sqrt{2}}$

$= \frac{4.070}{\sqrt{2}}$ Å $= 2.878$ Å .

Number of atoms in a face-centred unit cell $= 8\left(\frac{1}{8}\right) + 6\left(\frac{1}{2}\right) = 4$

Mass of 4 atom per unit cell = 4 × 197 amu

$= 4 \times 197 \times (1.66 \times 10^{-24})$g

$= 1.308 \times 10^{-21}$g

Volume of the unit cell $= a^3$

$= (4.07 \times 10^{-8})^3$cc.

$\therefore$ density of gold $= \frac{1.308 \times 10^{-21}}{(4.07 \times 10^{-8})^3} = 19.40$ g /cc.

12. (i) $2r = \frac{a}{\sqrt{2}} = \frac{4.07}{\sqrt{2}} = 2.878$ Å (ii) 12 (iii) $19.4 = \frac{4 \times m}{(4.07 \times 10^{-8})^3 \times 6.023 \times 10^{23}}$ or M = 197 (iv) 0.74

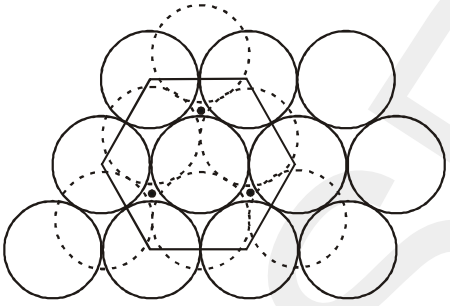
DPP No. # 46

1. $d = \frac{Z \times M}{N_A a^3} = \frac{4 \times 240}{6.02 \times 10^{23} \times 8^3 \times 10^{-24}} = 3.12$

3. $d^8 \rightarrow Ni^{2+}$, $d^7 \rightarrow Ni^{3+}$.
Total charge of nickel.
$(0.96 \times 2) + (0.04 \times 3) = 2.04$.
No. of O^{2-} ion $= \frac{2.04}{2} = 1.02$.
Formula of solid $= NiO_{1.02} = Ni_{0.98}O$.

5.* In schottky defect equal no. of cation and anion removes and formula would remain same.
If Na^+ would present in tetrahedral void then as NaCl formula must remain same.
Due to F-centre colour of compound changes
$a = 2(r^+ + r^-) = 2 \times$ inter ionic distance = 8.4 Å

6.*



hcp = AB AB AB .....pattern repeat
For calculating voids between two layers A and B.
Octahedral voids = 3 = represented by (•).
So total octahedral voids = 6 = All are completely inside.

14. **(i)** Distance between two octahedral void $= \frac{a}{\sqrt{2}} = 8.51$

$a = 8.51 \times 1.41 = 12$Å

Distance between two tetrahedral void = a/2 = 6Å

(ii) ZnS → Zinc blende structure, C.N. = 4
KCl → Rock salt, CN = 6
K_2O → Antifluorite structure, CN of $K^+ = 4$
CsBr → CN = 8
NaBr → Rock salt, CN = 6
CaF_2 → Fluorite structure, CN of $F^- = 4$ CN of $Ca^{2+} = 8$.

DPP No. # 47

1. Rate = $k[NO]^2[H_2]$

$\frac{\text{conc.}}{\text{time}} = k(\text{conc.})^3 \quad \Rightarrow \quad k = \frac{1}{\text{time}(\text{conc.})^2}$

$k = \frac{1}{\frac{\text{moles}^2}{L^2}(\text{min})} = \frac{L^2}{\text{moles}^2 - \text{min}}$

2. $A + 2B \xrightarrow{K} 3C$ (elementary reaction)

$$\text{Rate} = -\frac{d[A]}{dt} = -\frac{1}{2}\frac{d[B]}{dt} = \frac{1}{3}\frac{d[C]}{dt} = k[A][B]^2$$

3. $$\text{Rate} = -\frac{1}{2}\frac{d[A]}{dt} = \frac{d[B]}{dt} = \frac{1}{3}\frac{d[C]}{dt}$$

$$\frac{k_1}{2}[A]^2 = K_2[A]^2 = \frac{k_3}{3}[A]^2$$

$$\Rightarrow \quad \frac{k_1}{2} = k_2 = \frac{k_3}{3}$$

4. Unit of k for first order reaction is s^{-1}.

5. $\text{Rate} = k[A]^{1/2}[B]^2$

$r_1 = k[a]^{1/2}[b]^2$; $\quad r_2 = k[4a]^{1/2}[2b]^2$

$$\Rightarrow \quad \frac{r_1}{r_2} = \frac{1}{2\times 4} = \frac{1}{8}$$

$$\Rightarrow \quad r_2 = 8 \times r_1$$

6. $A \longrightarrow B$

$$\text{rate} = -\frac{d[A]}{dt} = \frac{d[B]}{dt} = k[A]^2$$

$$\frac{\left(\frac{d[B]}{dt}\right)_1}{\left(\frac{d[B]}{dt}\right)_2} = \frac{k(a)^2}{k(2a)^2} = \frac{1}{4}$$

7. From the unit of K, it is evident that it is a second order reaction.

$$-\frac{1}{2}\frac{d[NO_2]}{dt} = \frac{d[O_2]}{dt} \quad \Rightarrow \quad \therefore \quad -\frac{d[NO_2]}{dt} = 2 \times \frac{d[O_2]}{dt} = 2 \times 1.5 \times 10^{-4} = 3 \times 10^{-4}$$

$3 \times 10^{-4} = K[NO_2]^2 = 3 \times 10^{-3}[NO_2]^2 \quad \Rightarrow \quad \therefore \quad [NO_2] = 0.316.$

8. $a - 2r = 53.6$ pm

also $\quad 4r = \sqrt{3}a \quad \Rightarrow \quad a - \frac{\sqrt{3}}{2}a = 53.6$

$$\Rightarrow \quad a = \frac{53.6\times 2}{2-\sqrt{3}} = 400 \text{ pm}$$

$$\text{Density } (\rho) = \frac{2\times 23}{6.023\times 10^{23}\times 4^3\times 10^{-24}} = 1.19 \text{ g/cc}$$

9. $$2.32 = \frac{2\times M}{6\times 10^{23}(1.22)^3\times 10^{-21}}$$

$\Rightarrow M = 1264 \Rightarrow x \approx 47.$

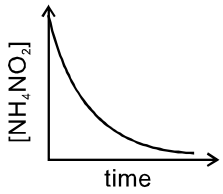
10. Given $a - 2r = 60.3$ and for bcc, $4r = \sqrt{3}a$

$$\Rightarrow \quad a - \frac{\sqrt{3}}{2}a = 60.3 \Rightarrow a = 450 \text{ pm}$$

$$\text{Density } (\rho) = \frac{2\times 48}{6.023\times 10^{23}\times (4.5)^3\times 10^{-24}} = 1.75 \text{ g/cc.}$$

DPP No. # 48

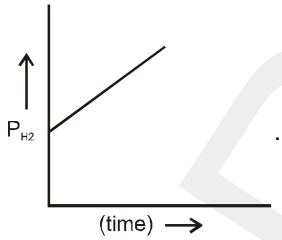
1. $C_t = C_o e^{-kt}$ (For Ist order) $\quad NH_4NO_2\,(aq) \longrightarrow N_2(g) + 2H_2O\,(\ell)$ (Ist order)



2. $2HI(g) \longrightarrow H_2(g) + I_2(g)$ (zero order)

t = 0	a	b	0	$b \propto P_{H_2}$, initial
t = t	a – 2x	b + x		$P_{H_2} \propto (b + x)$

$\Rightarrow \quad P_{H_2} = P_{H_2}$, initial + kt (zero order reaction)

So, graph is  .

3. $\because \quad C_t = \dfrac{C_0}{2^n}$

For 75% completion, no. of half lives taken = 2 half life $= \dfrac{100}{2} = 50$ min

For 87.5% completion, no. of half lives taken = 3.

$\therefore$ Time taken = 3 × 50 = 150 min.

4. For zero order, rate $= K = \dfrac{-(0.08 - 0.1)}{10} = \dfrac{0.02}{10}$ M min^{-1}

half life $= \dfrac{C_O}{2K} = \dfrac{0.1 \times 10}{2 \times 0.02} = 25$ min $\quad \Rightarrow \quad$ completion time $= \dfrac{C_O}{K} = \dfrac{0.1 \times 10}{0.02} = 50$ min.

5.

	A	$\longrightarrow$	B
t = 0	a		0
t = t	a – x		x

At intersection, a – x = x

$\Rightarrow \quad x = \dfrac{a}{2}$

so, this time represents half life.

6.

	A	$\longrightarrow$	Products
t = 0	a		0
t = t	a – x		x

$\dfrac{a-x}{a}$ = fraction of A $\Rightarrow \quad (a - x) = a - kt \quad \Rightarrow \quad \dfrac{a-x}{a} = -kt$

So, it is zero order.

7. $A \longrightarrow B + C$

rate constant $= 0.001\ Ms^{-1}$

$[C_O]_A = 1\ M$

From unit of rate constant, we can conclude that rate is of zero order.

Decrease in concentration of A in 10 min $= 0.001 \times 10 \times 60 = 0.6\ M$

$[C_O]_A$ t = 10 min $= 1 - 0.6 = 0.4\ M$

$[C_B]$ t = 10 min = 0.6 M.

9. (A) $\text{Rate (nj)} = -\frac{dC_A}{dt} = K C_A^a$

$\therefore \quad \log\left[-\frac{dC_A}{dt}\right] = \log K + a \log C_A$

$\therefore \quad \log K = 0.6$

$K = 3.98\ \text{time}^{-1}$ and $a = \tan 45^\circ = 1$.

10. Rate for the reaction at 20 second $= \frac{0.35}{50} = 7 \times 10^{-3}\ Ms^{-1}$

	A $\longrightarrow$	B
t = 0	0.4	0
t = 60	0.05	0.35

11.

	2A +	B $\longrightarrow$	C
t = 0	2a	a	0
t = t	2a – 2x	a – x	x

$\frac{d[C]}{dt} = k\,(2\,(a-x)\,(a-x)^{-1}) = 2k$

$\Rightarrow \quad \int d[c] = \int k\,dt \quad \Rightarrow \quad [C] = 2\,kt$

unit of $k = Ms^{-1}$

[A] = 2 (a – x) and [C] = x

[B] = (a – x).

DPP No. # 49

1. $\frac{1}{C_t} = \frac{1}{C_0} + Kt.$

$\frac{1}{0.04} = \frac{1}{0.02} + 0.002 \times t.$

$\Rightarrow \quad 25 = 5 + 0.002 \times t \quad \Rightarrow \quad t = \frac{20}{2\times10^{-3}} = 10{,}000\ \text{sec.}$

2.

Initial pressure	65	105	y	185
Half life	290	x	670	820

Initial pressure of gas α Initial moles of gas in above question.

Half life α Initial pressure

So, it must be zero order reaction

$t_{1/2} = \frac{C_O}{2k} = \frac{P_O}{2k} \qquad 290 = \frac{65}{2k} \quad \Rightarrow \quad k = \frac{65}{2\times290} = 0.112\ \text{mm of Hg/sec}$

$x = \frac{105\times2\times290}{2\times65} = 468\ \text{sec} \qquad 670 = \frac{y\times2\times290}{2\times64} \quad \Rightarrow \quad y = 150\ \text{mm of Hg}$

3. $\frac{dx}{dt} = k\,[C]^{3/2}$ For n^{th} order

$$(n-1)\ kt = \left[\frac{1}{[C_t]^{n-1}} - \frac{1}{[C_O]^{n-1}}\right] \quad \Rightarrow \quad \frac{k}{2}\,t = \left[\frac{1}{[C_t]^{\frac{1}{2}}} - \frac{1}{[C_O]^{\frac{1}{2}}}\right]$$

$$t = \frac{2}{k}\left[[C_t]^{-\frac{1}{2}} - [C_O]^{-\frac{1}{2}}\right] \qquad t \propto [C_t]^{-\frac{1}{2}}$$

So, For $C_t^{-\frac{1}{2}}$ Vs t will give linear plot.

4. For zero order, $\frac{C_0 - C_t}{t} = k \quad \Rightarrow \quad \frac{0.01 - 0.001}{100} = k \neq 9$

For first order, $k = \frac{2.303}{t}\log\frac{C_0}{C_t} = \frac{2.303}{100}\log\frac{0.01}{0.001} = 2.303 \times 10^{-2} \neq 9.$

For second order, $\frac{1}{t}\left[\frac{1}{C_t} - \frac{1}{C_0}\right] = k \quad \Rightarrow \quad k = \frac{1}{100}[1000 - 100] = 9$

so, reaction is 2nd order. Unit of rate constant is $M^{-1}s^{-1}$.

5. $t_{1/2} \propto \frac{1}{a^{n-1}}$ [Here $a \propto P$] $\quad \frac{880}{410} = \left[\frac{364}{170}\right]^{n-1} \quad \therefore\ n = 2.$

6. In 1st order Rxn, decrease in % of concentration same in same interval of Time

$$\left[\frac{(0.12 - 0.06)}{0.12} \times 100\right] = 50\%$$

$$\frac{(0.06 - 0.03)}{0.06} \times 100 = 50\%$$

so reaction must be of first order.

7. $A \rightarrow$ product

$$a \xrightarrow{30\,min} \frac{a}{2} \xrightarrow{60\,min} \frac{a}{4} \xrightarrow{90\,min} \frac{a}{8}$$

So, Order is 1.

8. $Kt = \ln\left(\frac{C_0}{C_t}\right)$

$K \times 30 = \ln\left(\frac{C_0}{C_1}\right)$ ....(1)

$K \times 40 = \ln\left(\frac{C_0}{C_2}\right)$ .....(2)

$$\frac{3}{4} = \frac{\ln\left(\frac{C_0}{C_1}\right)}{\ln\left(\frac{C_0}{C_2}\right)} \Rightarrow 3\ln\left(\frac{C_0}{C_2}\right) = 4\ln\left(\frac{C_0}{C_1}\right) \Rightarrow \left(\frac{C_0}{C_2}\right)^3 = \left(\frac{C_0}{C_1}\right)^4 \Rightarrow C_O = \frac{C_1^4}{C_2^3}$$

9. Rate $= K C_t = K C_o\ e^{-}\ kt$

$= 2.303 \times 1 \times e^{-2.303 \times 1}\ M\ min^{-1} = 2.303 \times e^{-\text{ in } 10} = \frac{2.303}{10} = 0.2303$

10. For Ist order reaction,

$[A]_t = [A]_0\, e^{-Kt}$

$-\frac{d[A]}{dt} = K\,[A]_t = [A]_0\, K\, e^{-Kt}$

$Kt = 2.303 \log [A]_0 - 2.303 \log [A]_t \quad \Rightarrow \quad \log [A]_t = \log [A]_0 - \frac{Kt}{2.303}$.

DPP No. # 50

1.

	aA	$\longrightarrow$	(b – 1)B	+ C
t=0	a′			$a' \propto P_0$
t=10min	a′ – x	$\frac{(b-1)}{a'}x$	$\frac{x}{a}\left[(a'-x)+\frac{(b-1)x}{a}+\frac{x}{a}\right] \propto P_0 + P_0\frac{50\left(\frac{b}{a}-1\right)}{100}$	

$$\left[a'-x+\frac{b}{a}x\right] \propto P_0\left[1+\frac{1}{2}\left(\frac{b}{a}-1\right)\right]$$

$$\left[a'+x\left(\frac{b}{a}-1\right)\right] \propto P_0 + \frac{P_0}{2}\left(\frac{b}{a}-1\right)$$

$\Rightarrow x \propto \frac{P_0}{2}. \quad \Rightarrow \quad x \propto \frac{a'}{2}$

$\Rightarrow$ half life = 10 minute.

2. (C) $t_1 = \frac{(t_{1/2})_1}{0.693} \ln\left(\frac{1}{1-(1/4)}\right)$

$t_2 = \frac{(t_{1/2})_2}{0.693} \ln\left(\frac{1}{1-3/4}\right)$

$\frac{t_1}{t_2} = \frac{8}{1} \times \frac{\ln(4/3)}{\ln(4)} =$ **1 : 0.62.**

3. For I[st] order reaction

$k_1 = \frac{\ell n2}{t_{1/2}} = \frac{0.693}{40}$ second^{-1}

For zero order reaction

$k_0 = \frac{C_0}{2\,t_{1/2}} = \frac{1.386}{2 \times 20}$

$\Rightarrow \frac{k_1}{k_0} = \frac{0.693}{1.386} = 0.5$

4. $t = \frac{2.303}{k} \log\left(\frac{100}{0.1}\right) = \frac{2.303}{k} \times 3$

$t = \frac{2.303 \times 3}{\frac{0.693}{t_{1/2}}} = \frac{2.303 \times 3 \times t_{1/2}}{0.693}$ $\quad \left(t_{1/2} = \frac{0.693}{k}\right)$

$\Rightarrow \quad \frac{t_{99.9\%}}{t_{1/2}} = \frac{2.303 \times 3}{0.693} = 10$

5. $nA \longrightarrow B$

a

a–x $\quad \frac{x}{n} \quad t_{½} = 24$ min

at t = 48 $\quad a–x = \frac{x}{n}$

$$a = \frac{(1+n)x}{n} ; \frac{na}{1+n} = x$$

$$\frac{\ell n 2}{24} = \frac{1}{48} \quad \ell n \frac{a}{a - \frac{na}{(1+n)}}$$

$$4 = \frac{a(1+n)}{a} \qquad \Rightarrow \qquad n = 3.$$

6. We know, $k = \frac{2.303}{t} \log \frac{a}{(a-x)}$

99.9% completion

a = 100

a – x = (100 – 99.90) = .10

Then $t = \frac{2.303}{k} \log \left(\frac{100}{.10}\right)$

$t = 2.303 \times 3 \times \left[\frac{1}{k}\right]$; $t = 6.9 \times t_{av}$

7. $nA \longrightarrow B + C$

$\frac{-d[A]}{dt} \alpha [A]$ (I^{st} order)

$[A]_t \alpha t$ (zero order)

$\frac{1}{[A]_t} \alpha t$ (2^{nd} order)

8.

	A	+	B	→	C	+	D
t = 0	1		1		0		0
t = t	1 – x		1 – x		x		x

$r = k[A]^{1/2} [B]^{1/2}$

$\Rightarrow \quad \frac{dx}{dt} = k (1 - x)^{1/2} (1 - x)^{1/2}$.

or $\frac{dx}{dt} = k (1 - x)$.

$\Rightarrow \quad t = \frac{1}{k} \ln \left(\frac{1}{1-x}\right)$; $t = \frac{2.303}{2.303 \times 10^{-2}} \log \left(\frac{1}{0.1}\right) = 100$ sec.

9. $(CH_3)_2 O (g) \longrightarrow CH_4(g) + H_2 (g) + CO(g)$

t=0	a	0	0	0	$a \alpha P_o = 312$ mm
t=400 sec	a–x	x	x	x	$a+2x \alpha p_{400} = 412$mn
t=1200 sec	a – y	y	y	y	$a+2y \alpha p_{1200} = 560$ mm
t= ∞	0	a	a	a	$3a \alpha P_\infty = 935$ mm

$Kt = \ln \left(\frac{C_o}{C_t}\right) = \ln \left(\frac{a}{a-x}\right) \qquad \Rightarrow \qquad Kt = \ln \left(\frac{p_\infty - p_o}{p_\infty - p_t}\right)$

(t = 400sec) $K_1 = \frac{1}{400} \ln \left(\frac{935 - 312}{935 - 412}\right) = \frac{1}{400} \ln \left(\frac{623}{523}\right) \text{sec}^{-1} = 0.175 \times \frac{1}{400}$

(t = 1200sec) $K_2 = \frac{1}{1200} \ln \left(\frac{935 - 312}{935 - 560}\right) = \frac{1}{1200} \ln \left(\frac{623}{375}\right) \text{sec}^{-1} = 0.5076 \times \frac{1}{1200}$

$t_{1/2} = \frac{\ln 2}{\frac{k_1 + k_2}{2}} = \frac{2 \ln 2}{(k_1 + k_2)} = \frac{1584 + 1638}{2} = 1611$ sec.

10.

$[A]_0$,M	$[B]_0$, M	duration of experiment (hr)	final conc. $[A]_f$	Rate
0.1000	1.0	0.5	0.0975	5×10^{-3} M hr^{-1}
0.1000	2.0	0.5	0.0900	20×10^{-3} M hr^{-1}
0.0500	1.0	2.0	0.0450	2.5×10^{-3} M hr^{-1}

$A + B \longrightarrow C$

$$\text{Rate} = -\frac{d[A]}{dt} = -\frac{d[B]}{dt} = \frac{d[C]}{dt}$$

$\text{Rate} = K[A]^a [B]^b$

$R_1 = K [0.1]^a [1]^b = 5 \times 10^{-3}$ M hr^{-1}

$R_2 = K [0.1]^a [2]^b = 20 \times 10^{-3}$ M hr^{-1}

$$\frac{R_1}{R_2} = \left[\frac{1}{2}\right]^b = \frac{1}{4} \Rightarrow b = 2$$

$R_3 = K [0.05]^a [1]^2 = 2.5 \times 10^{-3}$ M hr^{-1}

$R_1 = K [0.1]^a [1]^2 = 5 \times 10^{-3}$ M hr^{-1}

$$\frac{R_3}{R_1} = \left[\frac{1}{2}\right]^a = \frac{1}{2} \Rightarrow a = 1$$

$R_1 = K [0.1] [1]^2 = 5 \times 10^{-3}$ M hr^{-1}

$$K = \frac{5\times10^{-3}}{0.1} = 5 \times 10^{-2} \text{ M}^{-2} \text{ hr}^{-1}$$

11. $[NOBr]_t = 4.00 \times 10^{-3} - 1.50 \times 10^{-3} = 2.50 \times 10^{-3}$

$$k = \frac{1}{2t}\left[\frac{1}{[NOBr]_t} - \frac{1}{[NOBr]_0}\right]$$ (due to cofficients of the reactant = 2)

$$0.810 = \frac{1}{2t}\left[\frac{1}{2.50\times10^{-3}} - \frac{1}{4.00\times10^{-3}}\right]$$

$$t = \frac{1}{2\times0.810}\left[\frac{(4.00-2.50)\times10^{-3}}{2.50\times10^{-3}\times4.00\times10^{-3}}\right]$$

t = **92.6 s.**

12.

	A		+	C	
t=0	a	0		0	$a \propto P_0$
t=t	a-x	x		x	$(a-x) \propto P_t$

$$Kt = \ln\left(\frac{a}{a-x}\right) \Rightarrow k = \frac{1}{t}\ln\left(\frac{P_0}{P_t}\right)$$

13.

	A		+	C			
t=0	a	0		0	$a \propto P_0$		
t=t	a-x	x		x	$(a+x) \propto P_t$	$\Rightarrow$	$x \propto (P_t - P_0)$

$$Kt = \ln\left(\frac{a}{a-x}\right) \Rightarrow k = \frac{1}{t}\ln\left(\frac{P_0}{P_0-(P_t-P_0)}\right) \Rightarrow k = \frac{1}{t}\ln\left(\frac{P_0}{2P_0-P_t}\right)$$

14.

	A		+	C			
t=0	a	0		0			
t=t	a-x	x		x	$2x \propto P_t$	$\Rightarrow$	$x \propto \frac{P_t}{2}$
$t=\infty$	0	a		a	$2a \propto P_\infty$	$\Rightarrow$	$a \propto \frac{P_\infty}{2}$

$$Kt = \ln\left(\frac{a}{a-x}\right) \Rightarrow k = \frac{1}{t}\ln\left(\frac{P_\infty}{P_\infty-P_t}\right)$$

DPP No. # 51

1. $k\,t = \ln\left(\frac{C_O}{C_t}\right)$

	$2\,N_2O_5$	$\longrightarrow$	$2N_2O_4$	+	O_2
t=0	200 cm^3		0		0
t=t	20 cm^3		180cm^3		90 cm^3
t= ∞	0		200cm^3		100 cm^3

Initial volume of N_2O_5 = 200 cm^3.
because Max. volume of O_2 = 100 cm^3.

$\therefore \quad K \times 500 = \ln\left(\frac{200}{20}\right) \quad \Rightarrow \quad k = \frac{\ln 10}{500} = \frac{2.303}{500}$.

2.

	A(g)	+	2B(g)	→	C(g)
t = 0	0.4 atm		1 atm		0 atm
t = t	(0.4 –0.3)atm		(1 – 0.6)atm		0.3 atm

Since reaction is elementary.
So, Rate of reaction w.r.t. A & B will be of order equal to stoichiometric coefficient
Rate = K [A] $[B]^2$
$Rate_{(Initial)}$ = K [0.4] $[1]^2$
$Rate_{(aftar\ t = t)}$ = K [0.1][0.4]^2

$$\frac{R_{(t=t)}}{R_{(t=o)}} = \frac{K[0.1]\,[0.4]^2}{K[0.4]\,[1]} = \frac{1}{25}$$

3. We know
Rate = k [conc.]
Given Rxn catalysed by HA and HB
Rate constant $k_A = k_1\,[H^+]_A$
$k_B = k_1\,[H^+]_B$
Then relative strength of acids A and B is

$$\frac{k_A}{k_B} = \frac{[H^+]_A}{[H^+]_B} \qquad \frac{2}{1} = \frac{[H^+]_A}{[H^+]_B} = \text{strength of } \frac{[Acid\,A]}{[Acid\,B]}$$

4.

	A(g)	$\longrightarrow$	2B(g)	+ C(g)
Let initial pressure	P_0		0	0
After 10 min.	$(P_0 - x)$		2x	x
After long time $(t \to \infty)$	0		$2P_0$	P_0

as per given $(P_0 - x) + 2x + x +$ vaour pressure of H_2O = 188
$P_0 + 2x = 160$ and $3P_0 + 28 = 388$
so, $P_0 = 120$ and x = 20 torr

$$k = \frac{1}{t}\ln\left(\frac{P_0}{P_0 - x}\right)$$

$$\Rightarrow \quad \frac{1}{10}\ln\left(\frac{120}{100}\right) = \frac{1}{10} \times (\ln 4 + \ln 3 - \ln 10)$$

$= 0.02\ min^{-1} = 1.2\ hr^{-1}$

5. $Kt = \ln\left(\frac{r_\infty - r_0}{r_\infty - r_t}\right)$

$$K = \frac{1}{84}\ln\left(\frac{-10-50}{-10-20}\right) = \frac{1}{84}\ln(2)$$

Solution is optically inactive i.e. optical rotation is zero.

$$\left(\frac{1}{84}\ln 2\right) t = \ln\left(\frac{-10-50}{-10-0}\right) \quad \Rightarrow \quad t = 84\,\frac{\ln 6}{\ln 2} = \mathbf{218}$$

6. $A \rightarrow$ Products.

$t_{1/2} = [\text{conc.}]^{1-n}$ $n \rightarrow$ order of reaction.

$$\frac{100}{50} = \left(\frac{0.1}{0.025}\right)^{1-n}$$

$2 = 2 - 2n$

$\Rightarrow$ $2n = 1.$

$\Rightarrow$ $n = \frac{1}{2}.$

order of reaction is $\frac{1}{2}$.

$$\frac{100}{t_{1/2}} = \left(\frac{0.1}{1}\right)^{1/2}$$

$\Rightarrow$ $t_{1/2} = 100\sqrt{10}$ min for $[A_0] = 1M.$

7. Slope $= \frac{(1-1.75)}{25-0} = -0.03$

$k = -2.303$ (slope) min^{-1}

$= -2.303\ (-0.03)\ \text{min}^{-1} = 0.06909\ \text{min}^{-1} = 4.14\ \text{hr}^{-1} \approx 4\ \text{hr}^{-1}$

8.

	A	$\longrightarrow$ B	+	C	
t=0	a	0		0	$a \propto V_0$
t=t	a-x	x		x	$(a-x) \propto V_t$

$$Kt = \ln\left(\frac{a}{a-x}\right) \quad \Rightarrow \quad k = \frac{1}{t}\ln\left(\frac{V_0}{V_t}\right)$$

9.

	A(soln.)	$\longrightarrow$ B(soln.)	+ C(soln.)
t=0	a	0	0
t=t	a-x	x	x
$t=\infty$	0	a	a

Let n-factor of A, B & C are n_1, n_2 & n_3 & that of reagent is n & molarity of reagent is M

At t= 0,

meq. of A = meq. of reagent

$n_1 \times a = M \times n \times V_0$ ..... (i)

At t= t,

meq. of reagent = meq. of A + meq of B + meq of C

$MV_t\, n = (a-x)n_1 + xn_2 + xn_3$ ..... (ii)

At $t= \infty$,

meq. of reagent = meq of B + meq of C

$MV_\infty\, n = an_2 + an_3$ ..... (iii)

From (iii) & (i)

$$(n_2 + n_3) = \frac{MV_\infty\, n}{a} \quad \& \quad n_1 = \frac{MV_0\, n}{a}$$

$$\Rightarrow \quad MV_t\, n = (a-x)\ \frac{MV_0\, n}{a} + x\ \frac{MV_\infty\, n}{a} \quad \Rightarrow \quad \frac{a}{a-x} = \left(\frac{V_\infty - V_0}{V_\infty - V_t}\right)$$

$$Kt = \ln\ \frac{a}{a-x} \quad \Rightarrow \quad K = \frac{1}{t}\ \ln\left(\frac{V_\infty - V_0}{V_\infty - V_t}\right)$$

10. Same as of question 9.

11.

	A(soln.) $\longrightarrow$	B(soln.) +	C(soln.)
t=0	a	0	0
t=t	a-x	x	x
t= ∞	0	a	a

Let α, β & γ are specific rotation of A, B & C respectively.

At t=0, $r_0 = a\alpha$ ..... (i)

At t=t, $r_t = (a-x)\alpha + x\beta + x\gamma$ ..... (ii)

At t= ∞, $r_\infty = a\beta + a\gamma$ ..... (iii)

From (i) & (iii)

$$\alpha = \frac{r_0}{a} \text{ \& } (\beta + \gamma) = \frac{r_\infty}{a}$$

Putting in (ii)

$$r_t = (a - x)\frac{r_0}{a} + \frac{r_\infty}{a}x \Rightarrow \frac{a}{a-x} = \frac{r_\infty - r_0}{r_\infty - r_t} \Rightarrow Kt = \ln\frac{a}{a-x} \Rightarrow k = \frac{1}{t}\ln\left(\frac{r_\infty - r_0}{r_\infty - r_t}\right)$$

12. rate $= K[NO]^a[H_2]^b$

$$\frac{r_1}{r_2} = \frac{1.5}{0.25} = \left(\frac{359}{152}\right)^a \Rightarrow \frac{6}{1} = (2.36)^a \Rightarrow a = 2$$

$$\frac{r_3}{r_4} = \frac{1.6}{0.79} = \left(\frac{289}{147}\right)^b \Rightarrow 2 = (1.966)^b \Rightarrow b = 1$$

order of the reaction = 1 + 2 = **3**

13.

	$2N_2O_5(g) \longrightarrow$	$4NO_2(g)$ +	$O_2(g)$	
t = 0	a	0	0	
t = t	a – x	2x	$\frac{x}{2}$	$\left(a + \frac{3x}{2}\right) \propto P_t$
t= ∞	0	2a	$\frac{a}{2}$	$\frac{5a}{2} \propto P_\infty$

$$kt = \ln\left(\frac{a}{a-x}\right)$$

$$a \propto \frac{2}{5}P_\infty \quad \& \quad x \propto \frac{2}{3}\left(P_t - \frac{2}{3}P_\infty\right)$$

$$k = \frac{1}{t}\ln\left(\frac{\frac{2}{5}P_\infty}{\frac{2}{5}P_\infty - \frac{2}{3}\left(P_t - \frac{2}{5}P_\infty\right)}\right) = \frac{1}{t}\ln\left(\frac{3P_\infty}{5(P_\infty - P_t)}\right)$$

DPP No. # 52

1. $$\frac{k_t}{k_0} = (TC)^{t-0/10}$$

Taking log gives $\log_e k_t - \log_e k_0 = \frac{t}{10}\log_e(TC) \Rightarrow \ln k_t = \ln k_0 + \left(\frac{\ln(TC)}{10}\right)t$

Comparison indicates $\frac{\ln(TC)}{10} = 0.0693 \Rightarrow \ln(TC) = 0.693 \Rightarrow TC = 2$

2. $k_1 = Ae^{-Ea/RT_1}$ & $k_2 = Ae^{-Ea'/RT_1}$

$k'_1 = Ae^{-Ea/RT_2}$ & $k'_2 = Ae^{-Ea'/RT_2}$

$$\Rightarrow \quad \frac{k'_1}{k_1} = e^{\frac{Ea}{R}\left(\frac{1}{T_1}-\frac{1}{T_2}\right)} \qquad \& \qquad \frac{k'_2}{k_2} = e^{\frac{E'a}{R}\left(\frac{1}{T_1}-\frac{1}{T_2}\right)}$$

Since Ea > E'a $\Rightarrow \quad \frac{k'_1}{k_1} > \frac{k'_2}{k_2}$

3. As temperature increases, K_A & K_B tends to A.
So, they are equal in magnitude.

4. According to Arrhenius equation

$$k = A \cdot e^{-E_a/RT}$$

At temp., T the equation will be

$$k' = A \cdot e^{-E_{a'}/RT}$$

Given E_a' = 4.15 kJ mol^{-1}

..... in the presence of a catalyst

$$\therefore \quad \frac{k'}{k} = e^{(E_a - E_a')/RT}$$

Given k' = (1 + 1.718) k = 2.718k = ek

Hence $e = e^{(E_a - E_a')/RT}$

or $E_a - E_a' = RT$

or Ea = E_a' + RT = 4.15 + 8.3 × 500 × 10^{-3} = **8.3 kJ mol^{-1}.**

5. Fraction of molecules which cross over the barrier

$$= e^{-\frac{Ea}{RT}} = e^{-\frac{18428}{8\times 1000}} = e^{-2.303} = e^{-\ln 10} = \frac{1}{10}$$

6. $$\log k = -\frac{E_a}{2.303\,R}\,\frac{1}{T} + \text{constant}$$

$$= -\frac{E_a}{2.303\,R} \times 10^{-3} \times \frac{10^3}{T} + \text{constant}$$

thus, slope of graph will be $-\frac{E_a \times 10^{-3}}{2.303\,R} = -\frac{4}{0.4}$

$\Rightarrow \quad E_a = 2.303 \times 1.98 \times 10^4 = 45600$ cal

7.

	4A(g)	$\longrightarrow$	B(g) +	2C(g)
t = 0	800		–	–
t = 10 minutes,	800 – 4p		p	2p
	800 – p = 650		∴ p = 150	Pressure of A = 200, so

$\therefore \quad 2 \times t_{1/2} = 10$ minutes $\Rightarrow \quad t_{1/2} = 5$ minutes

8. As only A is optically active. So conc. of A at t = 20 min $\propto$ 40°
While concentration of A at t = 50 min $\propto$ 10°
so $t_{1/2}$ = 15 min.
So volume consumed of H_2O_2 at t = 15 min = $t_{1/2}$, is according to 50% production of B.
at t = 60 min. production of B = 94.75% (four half lives)

So volume consumed = (40 ml) + $\left(\frac{40}{2}\right)$ ml + $\left(\frac{40}{4}\right)$ ml + $\left(\frac{40}{8}\right)$ ml = 75 ml ans.

9. S_1 $k = Ae^{-Ea/RT}$

S_2 rate $= k_n[C]^n \Rightarrow$ $\ln$ rate $= \ln k_n + n \ln C$

S_3 $A \rightarrow$ product

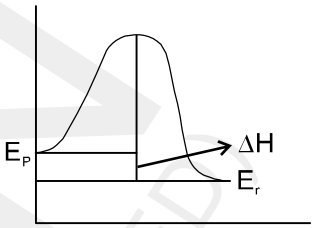
$$a \xrightarrow{\frac{1}{2}hr} \frac{a}{2} \xrightarrow{\frac{1}{2}hr} \frac{a}{4} \xrightarrow{\frac{1}{2}hr} \frac{a}{8} \Rightarrow I^{st} \text{ order reaction.}$$

10. $K_f = A_f\, e^{-Ea_f/RT}$; $K_b = A_b\, e^{-Ea_b/RT}$.

$$K_c = \frac{K_f}{K_b} = \frac{A_f}{A_b}\, e^{-(Ea_f - Ea_b)/RT}.$$

$$K_C = \frac{4\times10^{-4}}{2\times10^{-3}}\, e^{-(167000 - 180000)/8.314 \times 300.}$$

$K_C = 2 \times 10^{-1} \times 183 = 36.6.$



DPP No. # 53

1. $A \underset{K_2}{\overset{K_1}{\rightleftharpoons}} R + B$ $\quad R + C \xrightarrow{K_3}$ product.

$A \xrightarrow{K_1} R + B$; $\quad R + B \xrightarrow{K_2} A$; $\quad R + C \xrightarrow{K_3}$ Product.

$$\frac{d[A]}{dt} = -k_1[A] + K_2[R][B] \qquad \text{..... (i)}$$

$$\frac{d[R]}{dt} = K_1[A] - K_2[R][B] - K_3[R][C] \qquad \text{..... (ii)}$$

At steady state $\frac{d[R]}{dt} = 0$

$$[R] = \frac{K_1[A]}{K_2[B] + K_3[C]}$$

$$\frac{d[A]}{dt} = -K_1[A] + \frac{K_2[B]\ K_1[A]}{K_2[B] + K_3[C]} = \frac{-K_1[A]\{K_2[B] + K_3[C]\} + K_2[B]K_1[A]}{K_2[B] + K_3[C]}$$

$$\frac{d[A]}{at} = \frac{-K_1[A]K_3[C]}{K_2[B] + K_3[C]}$$

$$\Rightarrow \quad \frac{d[a-x]}{dt} = \frac{-K_1[A]K_3[C]}{K_2[B] + K_3[C]} \quad \Rightarrow \quad \frac{dx}{dt} = \frac{K_1[A]K_3[C]}{K_2[B] + K_3[C]} = \frac{K_1[A]}{1 + \frac{K_2[B]}{K_3[C]}}$$

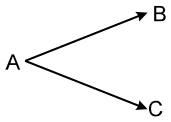
2. $2A \xrightarrow{k_1} B + 3C$, $\quad$ rate $= -\frac{1}{2}\frac{d[A]}{dt} = \frac{1}{3}\frac{d[C]}{dt} = k_1[A]^2$

$B + 3C \xrightarrow{k_{-1}} 3D$, $\quad$ rate $= -\frac{1}{3}\frac{d[C]}{dt} = k_{-1}[B][C]^3$

$2C \xrightarrow{k_2} 3D$, $\quad$ rate $= -\frac{1}{2}\frac{d[C]}{dt} = k_2[C]^2$

$$\frac{d[C]}{dt} = 3k_1[A]^2 - 3k_{-1}[B][C]^3 - 2k_2[C]^2$$

3.



$$\frac{[B]}{[C]} = \frac{k_1}{k_2} = \frac{0.4}{0.6} = \frac{2}{3}$$

$$\Rightarrow \quad k_2 = \frac{3}{2} k_1$$

$$\Rightarrow \quad k_{eff.} = k_1 + k_2$$

$$\frac{\ln 2}{(t_{1/2})_{overall}} = k_1 + \frac{3}{2} k_1 = \frac{5}{2} k_1$$

$$\Rightarrow \quad \frac{\ln 2}{12} = \frac{5}{2} \frac{\ln 2}{(t_{1/2})_{A \to B}}$$

$$\Rightarrow \quad (t_{1/2})_{A \to B} = 30 \text{ hrs.}$$

4. $[B] + [C] = 2$ M

$$\frac{[B]}{[C]} = \frac{2k_1}{3k_2} = \frac{4}{9}$$

$$\Rightarrow \quad \frac{4}{9}[C] + [C] = 2M \qquad \Rightarrow \quad \frac{13}{9}[C] = 2 \qquad \Rightarrow \quad [C] = \frac{18}{13} M$$

$$\therefore \quad [B] = 2 - [C] = 2 - \frac{18}{13} = \frac{8}{13} M.$$

5. $$\frac{d}{dt}[CH_3Br] = \frac{k_1[CH_4][Br_2]}{1 + k_2[HBr]/[Br_2]}$$

At initial stages ($[HBr] \approx 0$)

$$\frac{d}{dt}[CH_3Br] = K_1 [CH_4] [Br_2] \longrightarrow \text{2nd order}$$

At final stages ($[Br_2] \approx 0$)

$$\frac{d}{dt}[CH_3Br] = \frac{K_1[CH_4][Br_2]^2}{[Br_2] + K_2[HBr]} = \frac{K_1[CH_4][Br_2]^2}{K_2[HBr]} \longrightarrow \text{2nd order}$$

6. $k_1 = k_2$ (Since [C] = [D] at all the times)

$$\Rightarrow \quad \frac{2}{3}\text{rd of A has reacted for [A] = [C] = [D]}$$

$$\therefore \quad k_1 + k_2 = \frac{1}{t} \ln \frac{[A]_0}{\frac{1}{3}[A]_0}$$

$$\Rightarrow \quad t = \frac{1}{k_1 + k_2} \ln 3 = \frac{1}{2k_1} \ln 3 = \frac{1}{2k_2} \ln 3$$

7. Using the r.d.s. approximation method

$$\frac{d[Cl_2CO]}{dt} = k_3 [ClCO]^1 [Cl_2]^1$$

but $K_1 = \frac{[Cl]^2\,[M]}{[Cl_2]\,[M]}$ and $K_2 = \frac{[ClCO]\,[M]}{[Cl]\,[CO]\,[M]}$

$\Rightarrow$ $[ClCO] = K_2\,[Cl]\,[CO]$ and $[Cl] = \sqrt{K_1}\ \sqrt{[Cl_2]}$

$\therefore$ $\frac{d\,[Cl_2CO]}{dt} = k_3\,K_2\,[Cl]\,[CO]\,[Cl_2]$

$= k_3K_2\ \sqrt{K_1}\ \sqrt{[Cl_2]}\,[CO]\,[Cl_2]$

$= k_3K_2\ \sqrt{K_1}\,[Cl_2]^{3/2}\,[CO]$

comparision with the rate law given shows that

$k = k_3K_2\sqrt{K_1}$

8. $\frac{dC_D}{dt} = K_1C_A + K_3C_B - K_2\,C_D - K_4C_D$.

9. $A + B \longrightarrow$ Products

rate $= K\,[A]\,[B]^2$

$r_0 = K\,[1]\,[1]^2 = 10^{-2}$ $\Rightarrow K = 10^{-2}\ M^{-2}\ S^{-1}$ $\Rightarrow$ $r = 10^{-2}\left[\frac{1}{2}\right]\left[\frac{1}{2}\right]^2 = \mathbf{1.25 \times 10^{-3}\ Ms^{-1}}$

10. 50% completion in 50 minutes.

73% competion in 100 minutes.

Checking for zero order :

$t_{1/2} = \frac{C_0}{2K}$.

53 min. $= \frac{200}{2K}$ $\Rightarrow$ $K = \frac{100}{53}\ min^{-1}$.

$C_t = C_0 - 2\,K\,t.$

$C_t = 200 - \frac{200}{53} \times 100 =$ – ve.

So, it is not zero order.

For Ist order :

$t_{1/2} = \frac{\ln 2}{K}$ $\Rightarrow$ $K = \frac{\ln 2}{53} = \frac{0.693}{53}$.

$Kt = \ln\left(\frac{a_0}{a}\right) \Rightarrow \frac{\ln 2}{53} \times 100 = \ln\left(\frac{a_0}{a}\right)$.

$\frac{a_0}{a} = 3.6972.$ $\Rightarrow$ $a = \frac{200}{3.6972} = 54.1$ mm of Hg.

Competion of reaction $= \frac{a_0 - a}{a_0} \times 100 = 73\%$.

So, it is Ist order.

(b) In Ist order reaction, % completion is independent an initial concentration so, 73% completion takes place.

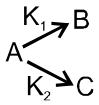
DPP No. # 54

1. We have,

$$\frac{[B]_t}{[C]_t} = \frac{4k_1}{3k_2} = \frac{16}{9} \qquad \text{so,} \qquad \frac{k_1}{k_2} = \frac{4}{3}$$

Now, $k = k_1 + k_2 = [2 \times 10^{-3} + \frac{3}{4} \times 2 \times 10^{-3}]\ \text{sec}^{-1}$

$$= \frac{7}{2} \times 10^{-3}\ \text{sec}^{-1} = \frac{7 \times 10^{-3} \times 60}{2}\ \text{min}^{-1} \qquad \text{so, } T_{1/2} = \frac{\ell n\, 2}{7 \times 30 \times 10^{-3}}\ \text{min} = \frac{693}{7 \times 30} = 3.3\ \text{min.}$$

2. 

$$\frac{[B]}{[C]} = \frac{K_1}{K_2} = \frac{2}{3}$$

$K_1 = 4 \times 10^{-4}$

$K_2 = \frac{3}{2} \times 4 \times 10^{-4} = 6 \times 10^{-4}\ \text{sec}^{-1}.$

3. $t_{1/2} = \frac{0.693}{K_1 + K_2} = \frac{0.693}{10^{-3}} = 693\ \text{sec.}$

4. $t = \frac{1}{K_1 + K_2} = 10^3$

5. $t = \frac{2.303}{K} \log\left(\frac{C_0}{C_0 - X}\right) \Rightarrow 2303 = \left(\frac{2.303}{10^{-3}}\right) \log\left(\frac{C_0}{C_0 - 5}\right)$

$\log \frac{C_0}{C_0 - 5} = 1 \Rightarrow \frac{C_0}{C_0 - 5} = 10 \Rightarrow 9C_0 = 50,\ C_0 = 50/9.$

6. Rate $= K\,[C]$
$= 10^{-3} \times [C_0 - x]$
$= 10^{-3} \times [50/9 - 5]$
$= 10^{-3} \times \frac{5}{9} = 5.55 \times 10^{-4}$

7. $K = \left(\frac{1}{C_t} - \frac{1}{C_0}\right) \times \frac{1}{t} = \frac{2-1}{5} = \frac{4-1}{15} = \frac{8-1}{35} = \frac{1}{5} = \text{constant}$

8. % of reaction molecules which are able to cross potential barriee $= e^{-Ea/RT} \times 100$

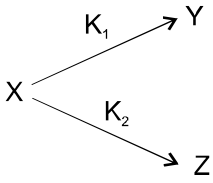
$\Rightarrow e^{-Ea/RT} \times 100 = 1.5 \times 10^{-4}$
$\Rightarrow e^{-Ea/RT} \times 100 = 1.5 \times 10^{-6}$
$\Rightarrow e^{-Ea/2 \times 300} = 1.5 \times 10^{-6} \Rightarrow E_a\ (\text{cal}) = 8014.5\ \text{cal.}$

$K = Ae^{-Eq/RT}$

$$\frac{dK}{dT} = Ae^{-Eq/RT}\left(\frac{-Ea}{R} \times \frac{-1}{T^2}\right)$$

$$\frac{dK}{dT} = K\frac{Ea}{RT^2} \Rightarrow 0.2 = K\frac{Ea}{2 \times (325)^2}$$

$$\Rightarrow K = \frac{0.2 \times 2 \times (325)^2}{Ea\,(\text{cal})} = 5.25\ S^{-1}$$

9. 

& $\frac{k_1}{k_2} = \frac{1}{2}$

$[X]_t = a e^{-(k_1+k_2)t}$

$[Y]_t = \frac{k_1 a}{k_1+k_2}\left(1-e^{-(k_1+k_2)t}\right)$ & $[Z]_t = \frac{k_2 a}{k_1+k_2}\left(1-e^{-(k_1+k_2)t}\right)$

At t = 30 min.,

$[X]_t = [Z]_t$

$a e^{-(k_1+k_2)\times 30} = \frac{k_2 a}{k_1+k_2}\left(1-e^{-(k_1+k_2)\times 30}\right)$

$\Rightarrow$ on solving, $(k_1 + k_2) = \frac{1}{30} \ln \frac{5}{2}$ ..... (i)

10. (A) $\alpha = \frac{x}{a} = \frac{C_{A_0} - C_{A_t}}{C_{A_0}} = 1 - \frac{C_{A_t}}{C_{A_0}}$

$\therefore C_{A_t} = C_{A_0} e^{-Kt} \Rightarrow \alpha = 1 - \frac{C_{A_0} e^{-Kt}}{C_{A_0}} = 1 - e^{-Kt}$

(B) $\frac{1}{C_{A_t}} - \frac{1}{C_{A_0}} = Kt \Rightarrow C_{A_t} = \frac{C_{A_0}}{C_{A_0}Kt+1} \Rightarrow \alpha = \frac{\frac{C_{A_0}}{C_{A_0}Kt+1}}{C_{A_0}} = \frac{C_{A_0}Kt}{C_{A_0}Kt+1}$

(C) $\alpha = 1 - \frac{C_{A_t}}{C_{A_0}}$ $\therefore C_{A_t} = C_{A_0} - Kt$

$\alpha = 1 - \frac{C_{A_0} - Kt}{C_{A_0}} = \frac{Kt}{C_{A_0}}$

(D) $\alpha = 1 - \frac{C_{A_t}}{C_{A_0}}$

DPP No. # 55

1. **(a)** (A) Cryolite is Na_3AlF_6; (B) Carnallite is $MgCl_2.KCl.6H_2O$.
(C) Malachite is $CuCO_3 . Cu(OH)_2$; (D) Cassiterite is SnO_2

(b) Bauxite - $A\ell_2O_3 . 2H_2O$ - $A\ell$ is extracted by Hall's process
Carnallite - $MgC\ell_2 . KC\ell . 6H_2O$
Malachite - $CuCO_3 . Cu(OH)_2$
Galena - PbS

2. **(a)** $CuCO_3Cu(OH)_2 \xrightarrow{\Delta} CuO + CO_2 + H_2O$; $CuO + C \longrightarrow Cu + CO$

3. **(a)** Calamine is $ZnCO_3$.
(b) Haematite is Fe_2O_3 which has magnetic property.

4. **(a)** Froth floatation process is used for the concentration of the sulphide ores of zinc, copper, lead, etc.
(b) Conversion of carbonate ore in to oxide on heating in absence of air is called calcination.

6. **(a)** Extraction of silver is not a high temperature operation like most metals and is done by the cyanide process in water solution.

(b) $CaCO_3 \longrightarrow CaO + CO_2$; $CaO + SiO_2 \longrightarrow CaSiO_3$

7. **(a)** $CaCO_3 \xrightarrow{\Delta} CaO + CO_2$

8. (A) $N_2 = \sigma 1s^2\ \sigma^* 1s^2\ \sigma 2s^2\ \sigma^* 2s^2\ \pi 2p_x^2 = \pi\ 2p_y^2\ \sigma\ 2p_z^2$

B.O. $= \frac{10-4}{2} = 3$; n = 0 (D)

$N_2^+ = \sigma 1s^2\ \sigma^* 1s^2\ \sigma 2s^2\ \sigma^* 2s^2\ \pi 2p_x^2 = \pi\ 2p_y^2\ \sigma\ 2p_z^1$

B.O. $= \frac{9-4}{2} = 2.5$; n = 1 (P)

(B) $O_2^+ = \sigma 1s^2\ \sigma^* 1s^2\ \sigma 2s^2\ \sigma^* 2s^2\ \sigma\ 2p_z^2\ \pi 2p_x^2 = \pi\ 2p_y^2\ \pi^* 2p_x^1 = \pi^*\ 2p_y^0$

B.O. $= \frac{10-5}{2} = 2.5$; n = 1 (P)

$O_2^{2+} = \sigma 1s^2\ \sigma^* 1s^2\ \sigma 2s^2\ \sigma^* 2s^2\ \sigma\ 2p_z^2\ \pi 2p_x^2 = \pi\ 2p_y^2\ \pi^* 2p_x^0 = \pi^*\ 2p_y^0$

B.O. $= \frac{10-4}{2} = 3$; n = 0 (D)

(C) $B_2 = \sigma 1s^2\ \sigma^* 1s^2\ \sigma 2s^2\ \sigma^* 2s^2\ \pi 2p_x^1 = \pi\ 2p_y^1$

B.O. $= \frac{6-4}{2} = 1$; n = 2 (P)

$B_2^+ = \sigma 1s^2\ \sigma^* 1s^2\ \sigma 2s^2\ \sigma^* 2s^2\ \pi 2p_x^2 = \pi\ 2p_y^1\ \sigma\ 2p_z^0$

B.O. $= \frac{5-4}{2} = 1/2$; n = 1 (P)

(D) $NO^- = \sigma 1s^2\ \sigma^* 1s^2\ \sigma 2s^2\ \sigma^* 2s^2\ \sigma\ 2p_z^2\ \pi 2p_x^2 = \pi\ 2p_y^2\ \pi^* 2p_x^1 = \pi^*\ 2p_y^1$

B.O. $= \frac{10-6}{2} = 1.0$; n = 2 (P)

$NO = \sigma 1s^2\ \sigma^* 1s^2\ \sigma 2s^2\ \sigma^* 2s^2\ \sigma\ 2p_z^2\ \pi 2p_x^2 = \pi\ 2p_y^2\ \pi^* 2p_x^1 = \pi^*\ 2p_y^0$

B.O. $= \frac{10-5}{2} = 2.5$; n = 1 (P).

DPP No. # 56

1. Aluminium is extractecd by Hall-Heroult process (electrolytic reduction).

2. Serpeck's method is

$Al_2O_3.2H_2O + 3C + N_2 \xrightarrow{1800^oC} 2AlN + 3CO + 2H_2O$

$2AlN + 3H_2O \longrightarrow Al(OH)_3 \downarrow + NH_3$

$2Al(OH)_3 \xrightarrow{1473K} Al_2O_3 + 3H_2O$

4. $PbS + O_2 \longrightarrow PbO + SO_2$

$PbS + 2O_2 \longrightarrow PbSO_4$

6. Carbon monoxide is better reducing agent than carbon below 983 K.

8. SRP zinc = – 0.76 ; SRP iron = – 0.44 ; SRP copper = + 0.34 (highest)
Hence only copper deposits, others do not.

9. Increasing voltage would cause deposition of Fe^{+2} and Zn^{+2} also to occur.

10. Water (pure) is a poor electrical conductor.

12. (A) $CuFeS_2$; $Cu_2S + 2\ Cu_2O \longrightarrow 6\ Cu + SO_2$; $Cu_2O + C \longrightarrow 2\ Cu + CO$

(B) PbS ; $PbS + 2PbO \longrightarrow 3Pb + SO_2$; $PbO + C \longrightarrow Pb + CO$; $PbO + CO \rightarrow Pb + CO_2$

(C) Ag_2S; Cyanide process, leaching with alkali metal cyanide followed by displacement with zinc dust.

(D) $CuCO_3.Cu(OH)_2$; Calcination $\longrightarrow CuO + C \longrightarrow Cu + CO$

DPP No. # 57

2. (D) Al_2O_3 is a poor conductor of electricity and having very high melting point. so to increase the conductivity Na_3AlF_6 is added and to decreases the melting point Na_3AlF_6 and CaF_2, are added so that melting point of electrolyte comes to around 930°C.

5. In the Bayer's process pure aluminium oxide is obtained from the bauxite ore. A low melting metal like tin can be refined by liquation method. Electrolysis is used in the refining of gold.

7. (A) In steel making. pure O_2 is purged into molten iron, where all impurities like C,S, Si, Mn converted into oxides then forming as slag, which is removed after wards.

8. (a) $\rightarrow$ van – Arkel method for Zr – Hg
$\rightarrow$ Based on volatile nature of halides of methods.

9. for $C(s) + \frac{1}{2}O_2(g) \longrightarrow CO(g)$ ΔS = +ve

10. ΔG = – 439 –(–941) = + 502 KJ/mol^{-1} so reaction will non-spontaneous

12. Force of attraction = $\frac{KZe \times 2e}{r_1^2} = \frac{2KZe^2}{r_1^2}$; Force of repulsion = $\frac{mv^2}{r_1} = \frac{2m_e \times v^2}{r_1}$

$\therefore \quad \frac{2KZe^2}{r_1^2} = \frac{2m_e \times v^2}{r_1}$

or $r_1 = \frac{KZe^2}{m_e v^2} = \frac{KZe^2}{m_e \times v^2} = \frac{KZe^2}{m_e \times \frac{n^2h^2}{4\pi m^2 r_1^2}}$ $\left[\because mvr = \frac{nh}{2\pi} \text{ or } v = \frac{nh}{2\pi mr}\right]$

or $r_1 = \frac{KZe^2 \times 4\pi^2 \times 4m_e^2 \times r_1^2}{m_e \times n^2h^2}$ or $r_1 = \frac{n^2h^2}{4\pi^2 m_e KZe^2 \times 4} = \frac{r}{4}$

or $\frac{r_1}{r} = \frac{1}{4}$

13. $v_1 = \frac{nh}{2\pi mr} = \frac{nh}{2\pi \times 2m_e \times r_1} = \frac{nh}{2\pi \times 2m_e \times \frac{r}{4}} = 2 \times \frac{nh}{2\pi m_e r} = 2 \times v$ or $\frac{V_1}{v} = 2.$

14. $TE = -\frac{1}{2}KE = -\frac{1}{2}mv^2 = -\frac{1}{2} \times 2m_e \times \frac{n^2h^2}{\pi^2 \times m_e^2 \times r^2} = -\frac{1}{2} \times 2m_e \times \frac{n^2h^2}{\pi^2 \times m_e^2 \times \frac{n^4h^4}{4^2\pi^4 m_e^2 K^2 Z^2 e^4}}$

$TE = -\frac{16 \times \pi^2 \times K^2 \times e^4 \times z^2 \times m_e}{n^2h^2}$

$TE = \left[-\frac{2 \times \pi^2 \times K^2 \times e^4 \times z^2 \times m_e}{n^2h^2}\right] \times 8$

$E_1 = E \times 8$ or $\frac{E_1}{E} = 8.$

DPP No. # 58

1. **(a)** $CaCO_3 \xrightarrow{\Delta} CaO + CO_2$

(b) Matte mostly contains Cu_2S and a little FeS.

2. **(a)** $Ag + 2CN^- \longrightarrow [Ag(CN)_2]^-$; $2[Ag(CN)_2]^- + Zn \longrightarrow [Zn(CN)_4]^{2-} + 2Ag\downarrow$

(b) Highest temperature 2170 K is found in the lower most part of the blast furnance, where carbon burns to form CO_2. $C + O_2 \longrightarrow CO_2$

3. **(a)** Cathode : $Al^{3+}(melt) + 3e^- \longrightarrow Al$

Anode : $C + O^{2-}(melt) \longrightarrow CO + 2e^-$; $C + 2O^{2-}(melt) \longrightarrow CO_2 + 4e^-$

(b) Mg being strong reducing agent cannot be obtained by any chemical reduction method.

4. **(a)** $O^{2-}(melt) \longrightarrow \frac{1}{2}O_2(g) + 2e^-(melt)$

(b) Zinc blende or sphalerite is ZnS.

5. **(a)** (A) $Al_2O_3(s) + 2NaOH(aq) + 2H_2O(\ell) \xrightarrow{\Delta} 2NaAlO_2(aq) + 3H_2O(\ell)$

(B) $Ag_2S(s) + 4CN^-(aq) \longrightarrow [Ag(CN)_2]^-(aq) + S^{2-}(aq)$

(C) $MgCl_2$ (anhydrous) – No leaching is required.

(D) $Cu_2O(s) + 4H_2SO_4 + O_2 \longrightarrow 4CuSO_4 + 4H_2O$

(b) It is extracted by the electrolysis of aluminia mixed with molten cryolite.

6. $MgCl_2 \rightleftharpoons Mg^{2+} + 2Cl^-$

At cathode : $Mg^{2+} + 2e^- \longrightarrow Mg$

At anode : $2Cl^- \longrightarrow Cl_2 + 2e^-$

$4Ag + 8CN^- + 2H_2O + O_2 \longrightarrow 4[Ag(CN)_2]^- + 4OH^-$

$2[Ag(CN)_2]^- + Zn \longrightarrow 2Ag\downarrow + [Zn(CN)_4]^{2-}$

7. All are correctly matched.

8. $Ag_2S + 4KCN \underset{O_2}{\rightleftharpoons} 2K[Ag(CN)_2] + K_2S$

$4K_2S + 5O_2 + 2H_2O \longrightarrow 2K_2SO_4 + 4KOH + 2S\downarrow$

9. Statement-1 : Haematite : Fe_2O_3, limonite : $Fe_2O_3.3H_2O$ and magnetite : Fe_3O_4.

Statement-2 : $Fe_2O_3 + CO \xrightarrow{\Delta} 2Fe_3O_4 + CO_2$; $Fe_3O_4 + CO \xrightarrow{\Delta} 3Fe + 4CO_2$

10. Haematite : Fe_2O_3 ; Limonite : $Fe_2O_3.3H_2O$; Magnetite : Fe_3O_4
Magnesite : $MgCO_3$; Cuprite : Cu_2O ; Argentite : Ag_2S
Bauxite : $Al_2O_3.2H_2O$; Sphalerite: ZnS ; Zincite : ZnO

11. $Al_2O_3 + 2NaOH + 2H_2O \xrightarrow{\Delta} 2NaAlO_2 + 3H_2O$; $Ag_2S + 2CN^- \longrightarrow [Ag(CN)_2]^- + S^{2-}$

$Au + 2CN^- + 2H_2O + O_2 \longrightarrow [Au(CN)_2]^- + 4OH^-$; $CuFeS_2 \longrightarrow$ No leaching

$PbS \longrightarrow$ No leaching ; $MgCl_2 \longrightarrow$ No leaching ; $FeCO_3 \longrightarrow$ No leaching

$2Cu_2O(s) + 4H_2SO_4(aq) + O_2(g) \longrightarrow 4CuSO_4(aq) + 4H_2O(\ell)$; $HgS \longrightarrow$ No leaching

12. Cryolite is $3NaF.AlF_3$ or $Na_3[AlF_6]$. It gives that coordination number of aluminium is six. It can expand its covalency by using empty d-orbitals.

DPP No. # 59

1. **(a)** $Ag/Au + 8CN^-(aq) + 2H_2O(aq) + O_2(g) \longrightarrow [Ag/Au(CN)_2]^-(aq) + 4OH^-(aq)$.

(b) $2Cu_2O$ (cuprite) $+ 4H_2SO_4(aq) + O_2(g) \longrightarrow 4CuSO_4(aq) + 4H_2O(\ell)$

$CuSO_4(aq) + Fe(s) \longrightarrow FeSO_4(aq) + Cu(s)\downarrow$

3 **(a)** (B) is correct statement.

(b) (A) Bauxite is leached with NaOH (concentrated) to form soluble $Na[Al(OH)_4]$ complex and insoluble impurities are filtered off.

(B) Carbonate and hydroxide ores are heated in absence of air below their melting point to convert in to their oxides in reverberatory furnace. This is called calcination. So magnesite, $MgCO_3$ is subjected to calcination.

(C) This method is commonly used for the concentration of the low grade sulphide ores like galena, PbS (ore of Pb) ; copper iron pyrites $Cu_2S.Fe_2S_3$ or $CuFeS_2$ (ore of copper) ; zinc blende, ZnS (ore of zinc) etc., and is based on the fact that gangue and ore particles have different degree of wettability with water and pine oil; the gangue particles are preferentially wetted by water while the ore particles are wetted by oil.

(D)Chromite ore ($FeO.Cr_2O_3$) having magnetic properties is separated from non–magnetic silicious impurities by magnetic separator.

4. **(a)** (i) Extraction of tin (carbon reduction) :

$SnO_2 + C \rightarrow SnO + CO\uparrow$

(ii) Extraction of zinc (carbon reduction) :

$ZnO + C \xrightarrow{\text{coke, 673}} Zn + CO$

(iii) Extraction of lead (self reduction) :

$PbS + 2O_2 \longrightarrow PbSO_4$; $PbS + 3O_2 \longrightarrow 2PbO + 2SO_2$

$PbS + 2PbO \longrightarrow 3Pb + SO_2$; $PbS + PbSO_4 \longrightarrow 2Pb + 2SO_2$

(iv) Extraction of copper (self reduction) :

$2CuFeS_2 + 4O_2 \longrightarrow Cu_2S + 2FeO + 3SO_2$

$Cu_2S + FeO + SiO_2 \longrightarrow FeSiO_3$ (fusible slag) $+ Cu_2S$ (matte)

$2Cu_2S + 3O_2 \longrightarrow 2Cu_2O + 2SO_2$; $2Cu_2O + Cu_2S \longrightarrow 6Cu + SO_2$

(v) Extraction of aluminium (electrolytic reduction, Hall-Heroult process) :

The purified Al_2O_3 is mixed with Na_3AlF_6 (cryolite) or CaF_2 (fluorspar)) which lowers the melting point of the mixture and brings conductivity. The fused matrix is electrolysed.

Cathode : $Al^{3+}(melt) + 3e^- \longrightarrow Al(l)$

Anode : $C(s) + O^{2-}(melt) \longrightarrow CO(g) + 2e^-$

$C(s) + 2O^{2-}(melt) \longrightarrow CO_2(g) + 4e^-$

(vi) Extraction of lead (leaching and displacement method) :

$4Au/Ag(s) + 8CN^-(aq) + 2H_2O(aq) + O_2(g) \longrightarrow 4[Au/Ag(CN)_2]^-(aq) + 4OH-(aq)$

$2[Au/Ag(CN)_2]^-(aq) + Zn(s) \longrightarrow 2Au/Ag(s) + [Zn(CN)_4]^{2-}(aq)$

(b) Ge, Si and Ga used as semi-conductors are refined by the zone refining method.

5. $3PbS + O_2(air) \longrightarrow PbS + 2PbO$

6. $\overset{2-}{PbS} + 2PbO \xrightarrow[\text{absence of air}]{\Delta} 3Pb(\ell) + \overset{+4}{SO_2}\uparrow$

7. $FeSiO_3$ is obtained as slag in the extraction of copper from copper pyrites.

8. Statement-1 : $MgCl_2$ (sea water) $+ Ca(OH)_2 \longrightarrow Mg(OH)_2 + CaCl_2$

$Mg(OH)_2 + 2HCl \longrightarrow MgCl_2 + 2H_2O$

On crystallisation hydrated $MgCl_2$ is obtained.

Statement-2 : $MgCl_2.6H_2O \xrightarrow[\text{dry HCl}]{\Delta} MgCl_2 + 6H_2O$.

9. Carnallite is $KCl.MgCl_2.6H_2O$.

10. At 500 – 800 K (lower temperature range in the blast furnace)

$3\,Fe_2O_3 + CO \longrightarrow 2\,Fe_3O_4 + CO_2$

$Fe_3O_4 + CO \longrightarrow 3Fe + 4\,CO_2$

$Fe_2O_3 + CO \longrightarrow 2FeO + CO_2$

At 900 – 1500 K (higher temperature range in the blast furnace):

$C + CO_2 \longrightarrow 2\,CO$; $FeO + CO \longrightarrow Fe + CO_2$

11. $2HgS + 3\,O_2 \longrightarrow 2HgO + 2SO_2$; $2HgO + HgS \longrightarrow 3Hg + SO_2$

$Cu_2S + 3O_2 \longrightarrow 3Cu_2O + 2\,SO_2$; $2Cu_2O + Cu_2S \longrightarrow 6Cu + SO_2$

$2PbS + 3O_2 \longrightarrow 2PbO + 2\,SO_2$; $2PbO + PbS \longrightarrow 3Pb + SO_2$

12. Copper pyrites ($CuFeS_2$) contains copper and iron.

DPP No. # 62

1. $BeCl_2$ is hydrolysed due to high polarising power and presence of vacant p-orbitals in Be-atom. (Be = $1s^2, 2s^2 2p_x^1\ 2p_y^0 2p_z^0$)

4. $M + (x + y)\,NH_3 \longrightarrow [M(NH_3)_x]^+ + [e(NH_3)_y]^-$

The electrical conductivity is due to the solvated ions and blue colour is due to solvated electrons.

5. As metallic character i.e. electropositive character of cations increases thermal stability of their sulphates increases and thus the correct order is $SrSO_4 > CaSO_4 > MgSO_4 > BeSO_4$.

7. $\underset{\text{'A'}}{3M} + N_2 \rightarrow \underset{\text{'B'}}{M_3N_2}$

$\underset{\text{'B'}}{M_3N_2} + 6H_2O \rightarrow \underset{\text{'C'}}{3M(OH)_2} + \underset{\text{'D'}}{2NH_3}$

$\underset{\text{'C'}}{M(OH)_2} + CO_2 \rightarrow \underset{\text{'D'}}{MCO_3} + H_2O$

M may be either Ca or Ba. It is not magnesium because $Mg(OH)_2$ has very low solubility in water.

9. The increasing thermal stability is

$BeCO_3 < MgCO_3 < CaCO_3 < K_2CO_3$

(IV) (II) (III) (I)

Increasing size of cation decreases its polarization ability towards carbonate, making the compound more stable.

11. Basic strength of the oxides increase in the order $Li_2O < Na_2O < K_2O < Rb_2O < Cs_2O$. The increase in basic strength is due to the decrease in I.E. down the group.

The melting point of the halides decrease in the order NaF < NaCl < NaBr < NaI, because of the decrease in lattice energies, as the size of the halide ion increases.

12. $Li + N_2 \longrightarrow \underset{\text{A = Lithium Nitride}}{Li_3N} \xrightarrow{H_2O} \underset{\text{B}}{LiOH} + \underset{\text{C}}{NH_3}$

DPP No. # 63

1. When sodium and potassium react with water, the heat evolved causes them to melt, giving a larger area of contact with water, lithium on the other hand, does not melt under these condition and thus reacts more slowly.

	Li	Na	K
Melting point (ºC)	180	98	64.

2. As the size of cation decreases, the extent of polarisation increases so covalent character ↑ and stability ↓

4. (4) Reducing nature increases down the group as their stability decreases down the group

CsH > RbH > KH > NaH > LiH

5. Both statements are correct but S_2 is not correct explanation of S_1 .
Statement -1 : The reason for this is that their lattice energies change is more than the hydration energies on descending the group.

Statement -2 : Hydration energy $\propto \frac{1}{\text{size of cation}}$.

6. The atom becomes larger on descending the group, so the bonds are weaker (metallic bond), the cohesive force/energy decreases and accordingly melting point also decreases.

7. (A) Due to the formation of metal ion clusters (B) $M + (x + y)\ NH_3 \longrightarrow M^+(NH_3)_x + e^-(NH_3)_y$
(C) due to the formation of metal clusters. (D) $M(NH_3)_6 \longrightarrow$ true statement

8. (i) $E^\theta\ Li^+/Li = -3.04$; $Na^+ / Na = -2.71$ which is least among the alkali metals.
(ii) Hydration enthalpy / KJ mol^{-1}
Li = – 506 ; Na = – 406 ; Cs has the least $\Delta H_{hyd} = -276$

9. (A) Bigger anion is stabilised by bigger cation through lattice energy effect.
(B) Because of their high reactivity towards air and water.
(C) True Statement
(D) In concentrated solution, unpaired electrons with opposite spins paired up – forming the solution diamagnetic.

10. Solubility of alkaline earth metal hydroxide increases as the solubility product increases.

	$Be(OH)_2$ < – – – – – – – <	$Ba(OH)_2$
K_{SP}	1.6×10^{-26}	5.4×10^{-3}

DPP No. # 64

1. Aluminium becomes passive due to formation of Al_2O_3.

2. BF_3 undergoes only partial hydrolysis, due to reaction of produced HF with H_3BO_3.

6. $[CO_4]^{-4}$ & $PbBr_4$ does not exist.

9. 'A' and 'B' are correct on the basis of structure of $Al_2(CH_3)_6$

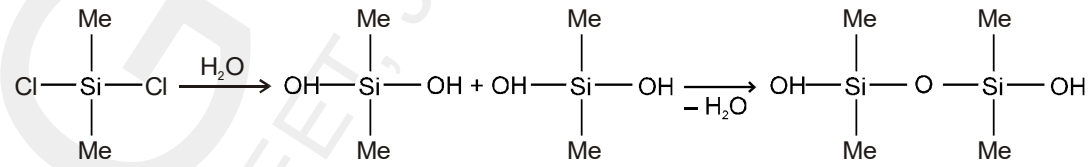
10. The more stable oxidation state of thallium is +1 on account of inert pair effect.

11. The stable oxidation state of germanium is +3 ; so it has tendency to oxidise to +3 from +2.

12. The stable oxidation state of lead is +2 on account of inert pair effect ; so it has tendency to reduce to +2 from +4.

DPP No. # 65

4.



In this manner several molecules may combine to form a long chain polymer whose both the ends will be occupied by –OH groups. Such compounds are generally represented from the following formula.