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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 $\dfrac{n'_A}{n'_B} = \dfrac{p_A^0}{p_B^0}$ (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^o_{water} (mm Hg)	$p^o_{substance}$ (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

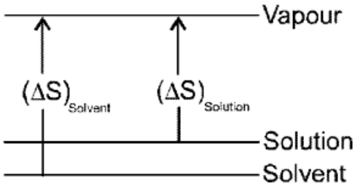
(A) 50%
(B) 75%
(C) 100%
(D) Zero

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.

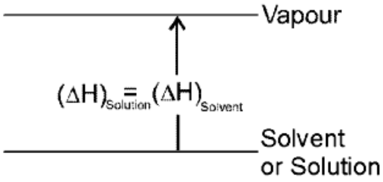
(A) 2.3
(B) 5.0
(C) 5.3
(D) cannot be calculated

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

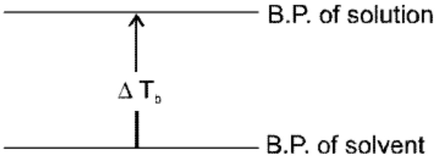
(A)



(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°C.K_f = 0.1°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.

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

And $\Delta T_f = K_f m$ 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)$_2$O$_2$(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$_5$N] 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$_4$H$_2$(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)$_5$NO]
(b) [Ni(DMG)$_2$]
(c) NH$_4$[Cr(SCN)$_4$(NO)$_2$] (NO is nitrosyl)
(d) [Pd(H$_2$O)$_2$I$_2$(ONO)$_2$]
(e) [Co(NH$_3$)$_4$Cl(NCS)]$^+$
(f) K$_4$[FeO$_4$]
(g) K$_2$[Co(N$_3$)$_4$]
(h) [Ni(PPh$_3$)$_2$Cl$_2$]
(i) [Cr(acac)$_3$]
(j) [Pt(C$_5$H$_5$N)$_4$][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.

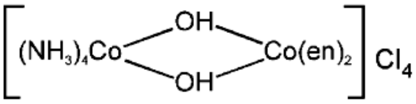
(D) Azide ion (N_3^-) has two N as donor atoms and behaves as a chelating ligand.

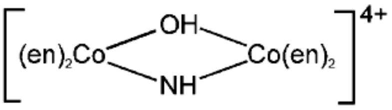
3. Write IUPAC names of the following

(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)	**List (II)**
(Equiv. conductance at infinite dilution)	(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 ?

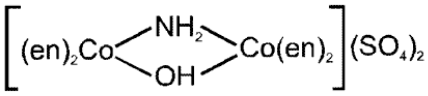
(A) $[Fe(CN)_6]^{3-}$
(B) $[Fe(CN)_6]^{4-}$
(C) $[Cr(NH_3)_6]^{3+}$
(D) $[Ni(en)_3]^{2+}$

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



$$\left[(en)_2Co\begin{matrix}NH_2\\OH\end{matrix}Co(en)_2\right](SO_4)_2$$

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) $[Pt(NH_3)_2\ Cl_2]$ 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 :

$[Co(NH_3)_3\ Cl_3]$, $[Co(NH_3)_6]\ Cl_3$ and $[Co(NH_3)_5\ Cl]Cl$.

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 $K_6[(CN)_5Co–O–O–Co(CN)_5]$ is oxidised by bromine into $K_5[(CN)_5Co–O–O–Co(CN)_5]$. 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(III) 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) $[Cr(H_2O)_5Cl]Cl_2$

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.

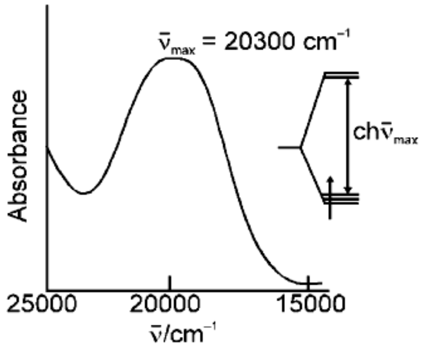
Comprehension # (Q.11 to Q.12)

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]

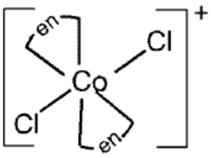
1. Which of the following is true :
(A) $[Zn(Cl)_2(NH_3)_2]$ will exist in cis and trans forms
(B) $[Pt(Br)(Cl)(NH_3)(Py)]$ is an optically active compound
(C) The brown ring complex $[Fe(H_2O)_5NO^+]^{2+}$ is paramagnetic
(D) All the above are true

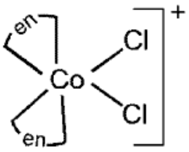
2. Which of the following is true about the complex $[PtCl_2(NH_3)(OH_2)]$; [Atomic no. of Pt = 78]
(i) It will have two geometrical isomeric forms, cis and trans
(ii) The hybridisation state of Pt(II) is sp^3
(iii) It is a square planar complex
(iv) It is a diamagnetic complex
(v) It can show hydrate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

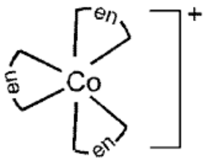
3. The octahedral complex $[Rh(NO_2)(SCN)(en)_2]^+$ can exist in a total number of isomeric forms including stereoisomers :
(A) 2 (B) 4 (C) 8 (D) 12

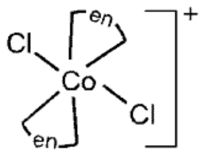
4. Total number of geometrical isomers of Ma_3b_3 type of octahedral complex are
(A) Two (B) four (C) Six (D) Zero

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 ethylenediamine (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 $109^{\circ}.28'$.
(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
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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
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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 °C is 4×10^{-14}. What is pH of pure water at this temperature.

$[\text{Take} : \log 2 = 0.3]$

(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 °C (B) 30 °C (C) 40 °C (D) 50 °C

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

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

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

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

4. **(a)** At – 50°C 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
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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 cm³ 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 $\frac{[HPO_4^{2-}]}{[H_2PO_4^-]}$ 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 ; $K_a(HAc) = 2 \times 10^{-5}$.
(ii) 0.008 M NH_4Cl ; $K_b(NH_3) = 2 \times 10^{-5}$.
(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 25°C, 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 1/4th and 3/4th 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^-

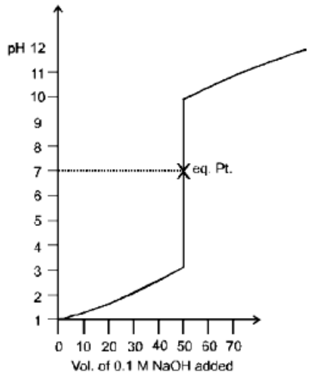
9. **Comprehension # (Q.(i) to Q.(iii))**

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 1518ºC 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.

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

(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) = 5×10^{-10}

(A) 0.01 M Ag NO_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 27ºC 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 300ºC 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 27ºC to 87ºC ? 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 0ºC :

(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 27ºC is subjected to a reversible isoentropic compression until final temperature reached to 327ºC. 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) $\Delta G = -ve$ (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 $\Delta H = -113$ KJ/mol and $\Delta S = -145\ JK^{-1}\ mol^{-1}$.

12. **(a)** For the reaction, $N_2(g) + 3H_2(g) \longrightarrow 2NH_3\ (g)$; $\Delta H = -95.4$ 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 : $\Delta_rH° = -1648$ 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 **<u>not correct?</u>**

(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^-

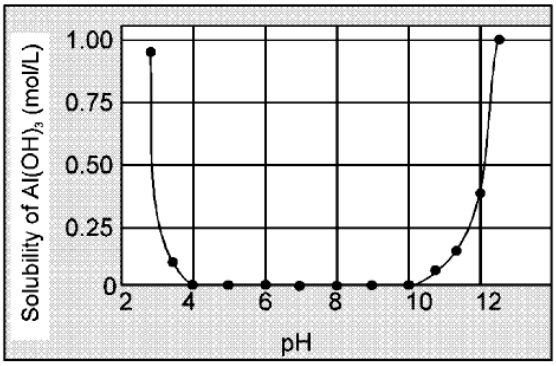
Comprehension # (Q.14 to Q.15)

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.

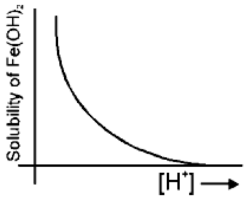


Other examples of amphoteric hydroxides include $Zn(OH)_2$, $Cr(OH)_3$, $Sn(OH)_2$ and $Pb(OH)_2$, which react with excess OH^- ions to form the soluble complex ions $Zn(OH)_4^{2-}$ (zincate ion), $Cr(OH)_4^-$ (chromite ion), $Sn(OH)_3^-$ (stannite ion), and $Pb(OH)_3^-$ (plumbite ion), respectively. 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.

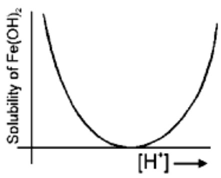
14. Which of the following curves best represents the variation of solubility of ferrous hydroxide $Fe(OH)_2$ with the concentration of $[H^+]$ ions in the solution :

(A)

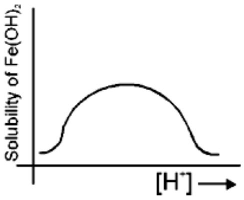
(B)



(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