Solution and Colligative properties

SET Self Evaluation Test - 4

1. The $2N$ aqueous solution of H_2SO_4 contains

(a) 49 gm of H_2SO_4 per litre of solution

(b) 4.9 gm of H_2SO_4 per litre of solution

(c) 98 gm of H_2SO_4 per litre of solution

(d) 9.8 gm of H_2SO_4 per litre of solution

2. The amount of $KMnO_4$ required to prepare 100 *ml* of $0.1N$ solution in alkaline medium is **[CPMT 1986]**

(a) 1.58 gm (b) 3.16 gm

(c) 0.52 gm (d) 0.31 gm

3. What weight of hydrated oxalic acid should be added for complete neutralisation of $100ml$ of $0.2\,N-NaOH$ solution ? **[MP PMT 1997]**

(a) $0.45\,g$ (b) $0.90\,g$

(c) $1.08\,g$ (d) $1.26\,g$

4. A $500\,g$ tooth paste sample has $0.2g$ fluoride concentration. What is the concentration of F in terms of *ppm* level **[AIIMS 1992]**

(a) 250 (b) 200

(c) 400 (d) 1000

5. To $5.85\,gm$ of $NaCl$ one kg of water is added to prepare of solution. What is the strength of $NaCl$ in this solution (mol. wt. of $NaCl = 58.5$) **[CPMT 1990; DPMT 1987]**

(a) 0.1 Normal (b) 0.1 Molal

(c) 0.1 Molar (d) 0.1 Formal

6. The degree of dissociation of $Ca(NO_3)_2$ in a dilute aqueous solution containing 14*g* of the salt per 200*g* of water 100^oC is 70 percent. If the vapour pressure of water at 100^oC is 760 *cm*. Calculate the vapour pressure of the solution **[UPSEAT 2000]**

(a) 746.3 *mm* of *Hg* (b) 757.5 *mm* of *Hg*

(c) 740.9 *mm* of *Hg* (d) 750 *mm* of *Hg*

7. The vapour pressure of pure benzene at a certain temperature is 200 *mm Hg*. At the same temperature the vapour pressure of a solution containing 2*g* of non-volatile non-electrolyte solid in 78*g* of benzene is 195 *mm Hg*. What is the molecular weight of solid **[UPSEAT 2001]**

(a) 50 (b) 70

(c) 85 (d) 80

8. Which one of the following non-ideal solutions shows the negative deviation

(a) $CH_3COCH_3 + CS_2$ (b) $C_6H_6 + CH_3COCH_3$

(c) $CCl_4 + CHCl_3$ (d) $CH_3COCH_3 + CHCl_3$

9. The O.P. of equimolar solution of Urea, $BaCl_2$ and $AlCl_3$, will be in the order **[DCE 2000]**

(a) $AlCl_3 > BaCl_2 >$ Urea

(b) $BaCl_2 > AlCl_3 >$ Urea

(c) Urea $> BaCl_2 > AlCl_3$

(d) $BaCl_2 >$ Urea $> AlCl_3$

10. The osmotic pressure of a 5% solution of cane sugar at 150^oC is (mol. wt. of cane sugar = 342) **[CPMT 1986; Manipal MEE 1995]**

(a) 4 atm (b) 3.4 atm

(c) 5.07 atm (d) 2.45 atm

11. Which one of the following pairs of solutions can we expect to be isotonic at the same temperature **[NCERT 1**

(a) $0.1M$ urea and $0.1M$ $NaCl$

(b) $0.1M$ urea and $0.2M$ $MgCl_2$

(c) $0.1M$ $NaCl$ and $0.1M$ Na_2SO_4

(d) $0.1M$ $Ca(NO_3)_2$ and $0.1M$ Na_2SO_4

12. Which of the following would have the highest osmotic pressure (assume that all salts are 90% dissociated) **[NCERT 1982]**

(a) Decimolar aluminium sulphate

(b) Decimolar barium chloride

(c) Decimolar sodium sulphate

(d) A solution obtained by mixing equal of (b) and (c) and filtering

13. Which solution will have the highest boiling point **[NCERT 1981]**

(a) 1% solution of glucose in water

(b) 1% solution of sodium chloride in water

(c) 1% solution of zinc sulphate in water

(d) 1% solution of urea in water

14. The boiling point of a solution of 0.11 *gm* of a substance in 15 *gm* of ether was found to be $0.1^{o}C$ higher than that of the pure ether. The molecular weight of the substance will be $(K_b = 2.16)$ **[MP PET 2002]**

(a) 148 (b) 158

(c) 168 (d) 178

15. The boiling point of benzene is 353.23 *K*. When 1.80 *gm* of a nonvolatile solute was dissolved in 90 *gm* of benzene, the boiling point is raised to 354.11 *K*. the molar mass of the solute is

[K_b for benzene = 2.53 *K* mol^{-1}] **[DPMT 2004]**

(a) $5.8\ g\,mol^{-1}$

(b) $0.58\ g\,mol^{-1}$

(c) $58\ g\,mol^{-1}$

(d) $0.88\ g\,mol^{-1}$

16. The boiling point of 0.1 molal aqueous solution of urea is $100.18^{o}C$ at 1 atm. The molal elevation constant of water is

(a) 1.8 (b) 0.18

(c) 18 (d) 18.6

17. The freezing point of a solution containing 4.8 *g* of a compound in 60 *g* of benzene is 4.48. What is the molar mass of the compound $(K_f = 5.1 km^{-1})$, (freezing point of benzene = $5.5^{o}C$)

(a) 100 (b) 200

(c) 300 (d) 400

18. When 0.01 mole of sugar is dissolved in $100\,g$ of a solvent, the depression in freezing point is 0.40^{o}. When 0.03 mole of glucose is dissolved in $50\,g$ of the same solvent, the depression in freezing point will be

(a) 0.60^{o} (b) 0.80^{o}

(c) 1.60^{o} (d) 2.40^{o}

19. The freezing point of equimolal aqueous solution will be highest for **[IIT 1990; DCE 2001]**

(a) $C_6H_5NH_3^+Cl^-$ (aniline hydrochloride)

(b) $Ca(NO_3)_2$

(c) $La(NO_3)_3$

(d) $C_6H_{12}O_6$ (glucose)

20. The Van't Hoff factor of the compound $K_3Fe(CN)_6$ is

(a) 1 (b) 2

(c) 3 (d) 4

Answers and Solutions

(SET -4)

1. (c) Wt. of H_2SO_4 per litre $= N \times$ eq. mass $= 2 \times 49 = 98g$.

2. (a) In alkaline medium $KMnO_4$ act as oxidant as follows.

$$2KMnO_4 + 2KOH \rightarrow 2K_2MnO_4 + H_2O + (O)$$

Hence its $eq.wt. = m.wt. = 158$

Now, Normality $= \frac{\text{Mass}}{\text{Eq. mass}} \times \frac{1}{V_{(L)}}$

$$\text{mass} = 0.1 \times 158 \times \frac{100}{1000} g = 1.58 \ g.$$

3. (d) For complete neutralization equivalent of oxalic acid = equivalent of $NaOH$ =

$$\frac{w}{eq.wt} = \frac{NV}{1000} \quad \therefore \ \frac{w}{63} = \frac{0.2 \times 100}{1000} \Rightarrow w = 1.26 \ gm \ .$$

4. (c) F^- ions in $PPm = \frac{0.2}{500} \times 10^6 = 400$

5. (b) 5.85 g $NaCl$ = 0.1 mol as it present in 1 kg of water ; molality $= \frac{wt.}{m\,wt. \times l} = \frac{5.85}{58.5 \times 1} =$ 0.1$molal$

6. (a)

7. (d) $\frac{P^o - P_s}{P^o} = \frac{n}{n+N}; \frac{P^o - P_s}{P^o} = \frac{w \times M}{m \times W} = 80$

8. (d) $CH_3COCH_3 + CHCl_3$ is non ideal solution which shown negative deviation.

9. (a) The particle come of $AlCl_3$ solution will be maximum due to ionisation less in $BaCl_2$ and minimum in urea

$$AlCl_3 \rightarrow Al^{3+} + 3Cl^- = 4$$

$$BaCl_2 \rightarrow Ba^{2+} + 2Cl^- = 3$$

More the number of particles in solution more is the osmotic pressure a colligative properties.

10. (c) $\pi = \frac{5 \times 0.0821 \times 1000 \times 423}{342 \times 100} = 5.07 \ atm$.

11. (d) Osmotic pressure is a coligative properties equimolar solution of $Ca(NO_3)_2$ and Na_2SO_4 will produce same number of solute particles.

$$CaNO_3 \rightleftharpoons Ca^{2+} + 2NO_3^-$$

$$Na_2(SO_4) \rightleftharpoons 2Na^+ + SO_4^{2-}$$

12. (a) $Al_2(SO_4)_3$ Deci-molar gives maximum ion. Hence, its osmotic pressure is maximum. ***

13. (b) $NaCl$ and $ZnSO_4$ gives 2 ions but $NaCl$ is more ionic than $ZnSO_4$.

14. (b) $m = \frac{K_b \times w \times 1000}{\Delta T_b \times W}$

$K_b = 2.16, \ w = 0.11, \ W = 15g, \ \Delta T_b = 0.1$

$$m = \frac{2.16 \times 0.11 \times 1000}{0.1 \times 15} = 158.40 \simeq 158 \ .$$

15. (c) The elevation (ΔT_b) in the boiling point

$$= 354.11K - 353.23K = 0.88K$$

Substituting these values in expression

$$M_{\text{Solute}} = \frac{K_b \times 1000 \times w}{\Delta T_b \times W}$$

Where, $w =$ weight of solute, $W =$ weight of solvent

$$M_{\text{solute}} = \frac{2.53 \times 1.8 \times 1000}{0.88 \times 90} = 58 \ gm\,mol^{-1}$$

Hence, molar mass of the solute $= 58 \ gm\,mol^{-1}$

16. (a) $K_b = \frac{0.18}{0.1} = 1.8$

17. (d) $m = \frac{K_f \times 1000 \times w}{W \times \Delta T_f} = \frac{5.1 \times 1000 \times 4.8}{60 \times 1.02} = 400$.

18. (d) $\Delta T_f = mk_f$

$$0.40 = \frac{0.01 \times 1000}{100} \times k_f \Rightarrow k_f = 4$$

again $\Delta T_f = mk_f$

$$= \frac{0.03 \times 1000}{50} \times 4$$

$$= 2.4$$

19. (d) $La(NO_3)_3$ will furnish four ions and thus will develop more lowering in freezing point whereas glucose gives only one particle and thus minimum lowering in freezing point.

20. (d) $K_3[Fe(CN)_6] \rightarrow 3K^+ + [Fe(CN)_6]^{3-}$.