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

Answer Key

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1.	(B)	**2.**	(C)	**3.**	(C)	**4*.**	(ABE)
5*.	(ABD)	**6*.**	(BCD)	**7*.**	(ACD)	**8.**	440 mm of Hg.
10.	[A – q, r] ; [B – s] ; [C – p] ; [D – q].						

Hints & Solutions

PHYSICAL / INORGANIC CHEMISTRY

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1. For gas,

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$$\frac{760 \times 91.9}{273} = \frac{P_2 \times 100}{288} \Rightarrow P_2 = 736.8 \text{ mm of Hg}$$

$$P_{total} = P_{2,gas} + \text{V.P.} \Rightarrow \text{V.P.} = 750 - 736.8 = 13.2 \text{ mm of Hg}$$

2. $P = X_A P_A^0 + X_B P_B^0 = (P_A^0 - P_B^0)X_A + P_B^0$

So $P_B^0 = 254$

$P_A^0 - P_B^0 = -119$ $\quad P_A^0 = 135$

3. For immiscible solution $= P_T = P_A^0 + P_B^0$

$= 400 + 200 = 600.$

4. For ideal solution, $\Delta V_{mix} = 0$, $\Delta H_{mix} = 0$, $\Delta S_{mix} = +$ ve, $\Delta G_{mix} = -$ ve,

5. $x_A P_A^\circ + x_B P_B^\circ = 700$ ...(i)

$x_A'' P_A^\circ + x_B'' P_B^\circ = 0.30\, P_A^\circ + 0.70\, P_B^\circ = 600$ ...(ii)

if moles of A & B initially are x & y then

$$x = 0.75 \times \frac{2}{3}(x+y) + 0.30 \times \frac{1}{3}(x+y)$$

& $x_A = \frac{x}{x+y}$ or $x_B = \frac{y}{x+y}$

Solving gives

$x_A = 0.6$, $x_B = 0.4$, $P_A^\circ = \frac{2500}{3}$ torr & $P_B^\circ = 500$ torr.

6. 1 mole glucose is present in 1000 ml solution

180 gm glucose is present in 1000 × 1.18 gm solution

180 gm glucose is present in 1180 – 180 gm solvent

$$\text{molality} = \frac{1}{1000} \times 1000 = 1$$

$$\%\ \text{w/v} = \frac{180}{1000} \times 100 = 18$$

$$\%\ \text{w/w} = \frac{180}{1180} \times 100 = 15.25$$

7. Only single solution have all these

means 100 ml solution have 5.85 gm NaCl = 0.1 mole

and 5.55 gm $CaCl_2$ = 0.05 mole

and 6 gm NaOH = 0.15 mole

$[Cl^-] = \frac{(0.1+0.05\times 2)\times 1000}{100} = 2\ M \quad \Rightarrow \quad [Na^+] = \frac{(0.1+0.15)\times 1000}{100} = 2.5\ M$

$[Ca^{2+}] = \frac{0.05}{100} \times 1000 = 0.5\ M \quad \Rightarrow \quad [OH^-] = 1.5\ M$

8. For vessel X

$400 \times 1.5 = P_X \times 4 \Rightarrow P_x = 150$ mm Hg

For vessel Y,

$208 \times 2.5 = 4 \times P_Y = 130$ mm of Hg

Total pressure $P_T = 150 + 130 + 160$

$= 440$ mm of Hg.

9. Millimoles of $Na_2SO_4 = 20 \times 0.5 = 10$

Millimoles of $H_2SO_4 = 50 \times 0.2 = 10$

Millimoles of $Al_2(SO_4)_3 = 30 \times 0.4 = 12$

$\Rightarrow$ Millimoles of $Na^+ = 20$

Millimoles of $H^+ = 20$

Millimoles of $Al^{3+} = 24$

Millimoles of $SO_4^{2-} = 10 + 10 + 36 = 56$

Total volume $= 20 + 50 + 30 = 100$ ml

$[Na^+] = \frac{20}{100} = 0.2\ M$

$[H^+] = \frac{20}{100} = 0.2\ M$

$[Al^{3+}] = \frac{24}{100} = 0.24\ M$

$[SO_4^{2-}] = \frac{56}{100} = 0.56\ M$

10. (a) $[Cl^-] = \frac{50\times 3+150\times 1\times 3}{200} = \frac{600}{200} = 3\ M$ & $[H^+] = \frac{50\times 3}{200} = 0.75\ M$

(b) Molality $= \frac{0.1}{0.9\times 18}\times 1000 = 6.17$ m

(c) Molality $= \frac{\frac{10}{60}}{90}\times 1000 = 1.85$ m

(d) Molarity of HCl $= \frac{\frac{10.95}{36.5}}{100} \times 1000 = 3\ M \Rightarrow [H^+] = [Cl^-] = 3M$