DPP - Daily Practice Problems

Date : | **Start Time :** | **End Time :**

CHEMISTRY CC16

SYLLABUS : Solutions

Max. Marks : 120 **Marking Scheme :** + 4 for correct & (–1) for incorrect **Time : 60 min.**

INSTRUCTIONS : This Daily Practice Problem Sheet contains 30 MCQ's. For each question only one option is correct. Darken the correct circle/ bubble in the Response Grid provided on each page.

1. The solubility of a solid in a liquid is significantly affected by temperature changes.

$$\text{Solute} + \text{Solvent} \rightleftharpoons \text{Solution}.$$

The system being in a dynamic equilibrium must follow Le-chatelier's principle. Considering the Le-chatelier's principle which of the following is correct?

(a) $\Delta H_{sol} > 0$; solubility ↑ ; temperature ↓

(b) $\Delta H_{sol} < 0$; solubility ↓ ; temperature ↑

(c) $\Delta H_{sol} > 0$; solubility ↓ ; temperature ↑

(d) $\Delta H_{sol} < 0$; solubility ↑ ; temperature ↑

2. The vapour pressure of a solution of the liquids A ($p° = 80$ mm Hg and $x_A = 0.4$) and B ($p° = 120$ mm Hg and $x_B = 0.6$) is found to be 100 mm Hg. It shows that the solution exhibits

(a) positive deviation from ideal behaviour

(b) negative deviation from ideal behaviour

(c) ideal behaviour

(d) positive deviation for lower conc. and negative for higher conc.

RESPONSE GRID	1. ⓐⓑⓒⓓ	2. ⓐⓑⓒⓓ

3. Plot of $\frac{1}{x_A}$ Vs $\frac{1}{y_A}$ (x_A mole fraction of A in liquid state and y_A in vapour state) is linear whose slope and intercept respectively are given

(a) p^o_B / p^o_A , $\frac{p^o_B - p^o_A}{p^o_B}$

(b) $p^o_A - p^o_B$, $\frac{p^o_A - p^o_B}{p^o_B}$

(c) $p^o_B - p^o_A$, $\frac{p^o_B - p^o_A}{p^o_B}$

(d) p^o_B / p^o_A , $\frac{p^o_A - p^o_B}{p^o_B}$

4. Coolent used in car radiator is aqueous solution of ethylene glycol. In order to prevent the solution from freezing at –0.3 °C. How much ethylene glycol must be added to 5 kg of water ? ($K_f = 1.86$ K kg mol^{-1})

(a) 50 kg (b) 50 g

(c) 45 g (d) 40 g

5. A solution contains non-volatile solute of molecular mass M_2. Which of the following can be used to calculate the molecular mass of solute in terms of osmotic pressure ?

(a) $M_2 = \left(\frac{m_2}{\pi}\right)VRT$ (b) $M_2 = \left(\frac{m_2}{V}\right)\frac{RT}{\pi}$

(c) $M_2 = \left(\frac{m_2}{V}\right)\pi RT$ (d) $M_2 = \left(\frac{m_2}{V}\right)\frac{\pi}{RT}$

6. Henry's law constant of oxygen is 1.4×10^{-3} mol. lit^{-1}. atm^{-1} at 298 K. How much of oxygen is dissolved in 100 ml at 298 K when the partial pressure of oxygen is 0.5 atm?

(a) 1.4 g (b) 3.2 g

(c) 22.4 mg (d) 2.24 mg

7. What is the degree of dissociation of sodium chloride, if the molar mass determined by a cryoscopic method was found to be 31.80 g mol^{-1} [Atomic mass Na = 23 g mol^{-1} Cl = 35.5 g mol^{-1}] ?

(a) 0.58 (b) 0.73

(c) 0.83 (d) 0.92

8. A solution containing components A and B follows Raoult's law when

(a) A – B attraction force is greater than A – A and B – B

(b) A – B attraction force is less than A – A and B – B

(c) A – B attraction force remains same as A–A and B –B

(d) Volume of solution is different from sum of volume of solute and solvent

9. Two 1-litre flask A and B are connected to each other by a valve which is closed. Flask A has benzene in equilibrium with its vapours at 30°C. The flask B, is evacuated, and the valve is opened. Which of the following is true. If temperature is kept constant.'

(a) Some of the benzene molecules would move to flask B from flask A.

(b) Vapour pressure will be half the initial value.

(c) The vapour pressure remains unchanged

(d) Some more of the liquid benzene in flask A would evaporate.

10. For a solution of two liquids A and B it was proved that $P_S = x_A(p°_A - p°_B) + p°_B$. The resulting solution will be

(a) Non -ideal (b) ideal

(c) semi-ideal (d) None of these

11. A 0.0020 m aqueous solution of an ionic compound $Co(NH_3)_5(NO_2)Cl$ freezes at –0.00732 °C. Number of moles of ions which 1 mol of ionic compound produces on being dissolved in water will be ($K_f = -1.86$°C/m)

(a) 3 (b) 4

(c) 1 (d) 2

12. A solution of urea (mol. mass 56 g mol^{-1}) boils at 100.18°C at the atmospheric pressure. If K_f and K_b for water are 1.86 and 0.512 K kg mol^{-1} respectively, the above solution will freeze at

(a) 0.654°C (b) –0.654°C

(c) 6.54°C (d) –6.54°C

RESPONSE GRID					
3. ⓐⓑⓒⓓ	**4.** ⓐⓑⓒⓓ	**5.** ⓐⓑⓒⓓ	**6.** ⓐⓑⓒⓓ	**7.** ⓐⓑⓒⓓ
8. ⓐⓑⓒⓓ	**9.** ⓐⓑⓒⓓ	**10.** ⓐⓑⓒⓓ	**11.** ⓐⓑⓒⓓ	**12.** ⓐⓑⓒⓓ

13. In mixture *A* and *B* components show -ve deviation as
(a) $\Delta V_{mix} > 0$
(b) $\Delta H_{mix} < 0$
(c) *A* – *B* interaction is weaker than *A* – *A* and *B* – *B* interaction
(d) *A* – *B* interaction is stronger than *A* – *A* and *B* – *B* interaction.

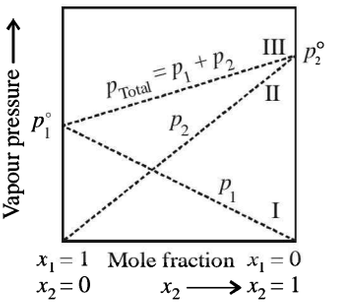
14. All form ideal solution except
(a) C_6H_6 and $C_6H_5CH_3$
(b) C_2H_6 and C_2H_5I
(c) C_6H_5Cl and C_6H_5Br
(d) C_2H_5I and C_2H_5OH.

15. A binary liquid solution is prepared by mixing *n*-heptane and ethanol. Which one of the following statements is correct regarding the behaviour of the solution?
(a) The solution is non-ideal, showing – ve deviation from Raoult's Law.
(b) The solution is non-ideal, showing + ve deviation from Raoult's Law.
(c) *n*-heptane shows + ve deviation while ethanol shows – ve deviation from Raoult's Law.
(d) The solution formed is an ideal solution.

16. We have three aqueous solutions of NaCl labelled as 'A', 'B' and 'C' with concentrations 0.1M, 0.01M and 0.001M, respectively. The value of van't Hoff factor for these solutions will be in the order _____.
(a) $i_A < i_B < i_C$ (b) $i_A > i_B > i_C$
(c) $i_A = i_B = i_C$ (d) $i_A < i_B > i_C$

17. During depression of freezing point in a solution the following are in equilibrium
(a) liquid solvent, solid solvent
(b) liquid solvent, solid solute
(c) liquid solute, solid solute
(d) liquid solute, solid solvent

18. A plot of p_1 or p_2 vs the mole fractions x_1 and x_2 is given as.



In this figure, lines I and II pass through the point for which.
(a) $x_1 \neq 1; x_2 = 1$ (b) $x_1 = x_2 \neq 1$
(c) $x_1 = 1; x_2 \neq 1$ (d) $x_1 = x_2 = 1$

19. Which of the following modes of expressing concentration is independent of temperature ?
(a) Molarity (b) Molality
(c) Formality (d) Normality

20. How many grams of concentrated nitric acid solution should be used to prepare 250 mL of 2.0M HNO_3 ? The concentrated acid is 70% HNO_3
(a) 90.0 g conc. HNO_3 (b) 70.0 g conc. HNO_3
(c) 54.0 g conc. HNO_3 (d) 45.0 g conc. HNO_3

21. Which among the following will show maximum osmotic pressure?
(a) 1 M NaCl (b) 1 M $MgCl_2$
(c) 1 M $(NH_4)_3PO_4$ (d) 1 M Na_2SO_4

22. The boiling point of 0.2 mol kg^{-1} solution of X in water is greater than equimolal solution of Y in water. Which one of the following statements is true in this case ?
(a) Molecular mass of X is greater than the molecular mass of Y.
(b) Molecular mass of X is less than the molecular mass of Y
(c) Y is undergoing dissociation in water while X undergoes no change.
(d) X is undergoing dissociation in water.

RESPONSE GRID					
	13. ⓐⓑⓒⓓ	**14.** ⓐⓑⓒⓓ	**15.** ⓐⓑⓒⓓ	**16.** ⓐⓑⓒⓓ	**17.** ⓐⓑⓒⓓ
	18. ⓐⓑⓒⓓ	**19.** ⓐⓑⓒⓓ	**20.** ⓐⓑⓒⓓ	**21.** ⓐⓑⓒⓓ	**22.** ⓐⓑⓒⓓ

23. Which of the following 0.10 m aqueous solutions will have the lowest freezing point ?

(a) $Al_2(SO_4)_3$ (b) $C_6H_{12}O_6$

(c) KCl (d) $C_{12}H_{22}O_{11}$

24. If sodium sulphate is considered to be completely dissociated into cations and anions in aqueous solution, the change in freezing point of water (ΔT_f), when 0.01 mol of sodium sulphate is dissolved in 1 kg of water, is (K_f= 1.86 K kg mol^{-1})

(a) 0.372 K (b) 0.0558 K

(c) 0.0744 K (d) 0.0186 K

25. Which one of the following salts will have the same value of van't Hoff factor (i) as that of $K_4[Fe(CN)_6]$.

(a) $Al_2(SO_4)_3$ (b) NaCl

(c) $Al(NO_3)_3$ (d) Na_2SO_4.

26. Mole fraction of the solute in a 1.00 molal aqueous solution is :

(a) 0.1770 (b) 0.0177

(c) 0.0344 (d) 1.7700

27. 25.3 g of sodium carbonate, Na_2CO_3 is dissolved in enough water to make 250 mL of solution. If sodium carbonate dissociates completely, molar concentration of sodium ions, Na^+ and carbonate ions, CO_3^{2-} are respectively (Molar mass of Na_2CO_3 = 106 g mol^{-1})

(a) 0.955 M and 1.910 M

(b) 1.910 M and 0.955 M

(c) 1.90 M and 1.910 M

(d) 0.477 M and 0.477 M

28. Azeotropic mixture of HCl and H_2O has

(a) 48% HCl (b) 22.2% HCl

(c) 36% HCl (d) 20.2% HCl

29. Freezing point of an aqueous solution is – 0.186°C. If the values of K_b and K_f of water are respectively 0.52 K kg mol^{-1} and 1.86 K kg mol^{-1}, then the elevation of boiling point of the solution in K is

(a) 0.52 (b) 1.04

(c) 1.34 (d) 0.052

30. Which of the following statements, regarding the mole fraction (x) of a component in solution, is incorrect?

(a) $0 \le x \le 1$

(b) $x \le 1$

(c) x is always non-negative

(d) $-2 \le x \le 2$

RESPONSE GRID					
	23. ⓐⓑⓒⓓ	**24.** ⓐⓑⓒⓓ	**25.** ⓐⓑⓒⓓ	**26.** ⓐⓑⓒⓓ	**27.** ⓐⓑⓒⓓ
	28. ⓐⓑⓒⓓ	**29.** ⓐⓑⓒⓓ	**30.** ⓐⓑⓒⓓ		

DAILY PRACTICE PROBLEM DPP CHAPTERWISE 16 - CHEMISTRY			
Total Questions	30	Total Marks	120
Attempted		Correct	
Incorrect		Net Score	
Cut-off Score	35	Qualifying Score	50
Success Gap = Net Score – Qualifying Score			
Net Score = (Correct × 4) – (Incorrect × 1)			

1. **(b)** According to Le-chateliers principle, for an exothermic reaction ($\Delta H < 0$) increase in temperature decreases the solubility.

2. **(b)** $P_{total} = p^o_A \times x_A + p^o_B \times x_B$
$= 80.0 \times 0.4 + 120.0 \times 0.6 = 104$ mm Hg
The observed P_{total} is 100 mm Hg which is less than 104 mm Hg. Hence the solution shows negative deviation.

3. **(c)** $p_A = p^o_A \times x_A = \text{Total pressure} \times y_A$

$p_B = p^o_B \times x_B = \text{Total pressure} \times y_B$
Where x and y represent mole fraction in liquid and vapour phase respectively.

$$\therefore \frac{p^o_B x_B}{p^o_A x_A} = \frac{y_B}{y_A},$$

$$\frac{p^o_B (1 - x_A)}{p^o_A x_A} = \frac{1 - y_A}{y_A}$$

$$\frac{1}{x_A} - 1 = \frac{p^o_A}{p^o_B}\left(\frac{1}{y_A} - 1\right)$$

$$= \frac{p^o_A}{p^o_B}\frac{1}{y_A} - \frac{p^o_A}{p^o_B}$$

$$\text{or, } \frac{1}{x_A} = \frac{p^o_A}{p^o_B}.\frac{1}{y_A} + \left(1 - \frac{p^o_A}{p^o_B}\right)$$

$$= \frac{p^o_A}{p^o_B}.\frac{1}{y_A} + \frac{p^o_B - p^o_A}{p^o_B}$$
This is equation of straight line.

$$\text{Slope} = \frac{p^o_A}{p^o_B}, \quad \text{Intercept} = \frac{p^o_B - p^o_A}{p^o_B}$$

4. **(b)** $\Delta T_f = 0.3°\,C$

$$\Delta T_f = 0.3°\,C = \frac{K_f \times W_B \times 1000}{M_B \times W_A}$$

$$0.3 = \frac{1.86 \times W_B \times 1000}{62 \times 5000}$$

$$\therefore \quad W_B = 50\,g$$
The amount used should be more than 50 g.

5. **(b)** $\pi V = nRT = \frac{m}{M}RT$ or $M_2 = \left(\frac{m_2}{V}\right)\frac{RT}{\pi}$
Where M_2 = molecular mass of solute
and m_2 = mass of solute

6. **(d)** According to Henry's law,
$m = k \times p$
given $K_H = 1.4 \times 10^{-3}$

$p_{O_2} = 0.5$ or

$p_{O_2} = K_H \times x_{O_2}$

$$\therefore x_{O_2} = \frac{0.5}{1.4 \times 10^{-3}}$$

No. of moles; $n = \frac{m}{M}$

$$0.7 \times 10^{-4} = \frac{m}{32}$$

$m = 22.4 \times 10^{-4}\,g = 2.24$ mg

7. **(c)** Let α be the give of dissociation then

$$\underset{1-\alpha}{NaCl} \rightleftharpoons \underset{\alpha}{Na^+} + \underset{\alpha}{Cl^-}$$

$$\text{Van't Hoff's factor } i = \frac{1 - \alpha + \alpha + \alpha}{1} = 1 + \alpha$$

Again Van't Hoff's factor

$$= \frac{\text{Normal mol . wt}}{\text{Observed mol.wt}} = \frac{58.5}{31.8} = 1.83$$

Equating to both values of i, $\therefore 1 + \alpha = 1.83$

$\therefore \alpha = 0.83$

8. **(c)** These two components A and B follows the condition of Raoult's law if the force of attraction between A and B is equal to the force of attraction between A and A or B and B.

9. **(c)** There is no change in vapour pressure.

10. **(b)** $p_s = x_A(p^o_A - p^o_B) + p^o_B;$

$p_s = p^o_A \times x_A - p^o_B \times x_A + p^o_B;$

$p_s = p^o_A \times x_A - p^o_B(1 - x_B) + p^o_B$

$\therefore p_s = p^o_A \times x_A + p^o_B \times x_B.$
This is condition for ideal solution.

11. **(d)** $\Delta T_f = 0 - (-0.00732°) = 0.00732$
$\Delta T_f = i \times K_f \times m$

$$i = \frac{\Delta T_f}{K_f \times m} = \frac{0.00732}{1.86 \times 0.002} = 2$$

12. **(b)** As $\Delta T_f = K_f . m$
$\Delta T_b = K_b . m$

Hence, we have $m = \frac{\Delta T_f}{K_f} = \frac{\Delta T_b}{K_b}$

or $\Delta T_f = \Delta T_b \frac{K_f}{K_b}$

$\Rightarrow [\Delta T_b = 100.18 - 100 = 0.18°C]$

$= 0.18 \times \frac{1.86}{0.512} = 0.654°C$

As the Freezing Point of pure water is 0°C,

$\Delta T_f = 0 - T_f$

$0.654 = 0 - T_f$

$\therefore T_f = -0.654$

Thus the freezing point of solution will be – 0.654°C.

13. **(b)** $[\Delta H_{mix} < 0]$

14. **(d)** C_2H_5I and C_2H_5OH form non-ideal solution.

15. **(b)** For this solution intermolecular interactions between *n*-heptane and ethanol are weaker than *n*-heptane-*n*-heptane & ethanol-ethanol interactions hence the solution of *n*-heptane and ethanol is non-ideal and shows positive deviation from Raoult's law.

16. **(c)**

17. **(a)** Liquid solvent and solid solvent are in equilibrium.

18. **(d)**

19. **(b)** The molality involves weights of the solute and the solvent. Since weight does not change with the temperature, therefore molality does not depend upon the temperature.

20. **(d)** $\text{Molarity (M)} = \frac{\text{wt} \times 1000}{\text{mol. wt.} \times \text{vol (ml)}}$

$2 = \frac{\text{wt.}}{63} \times \frac{1000}{250}$

$\text{wt.} = \frac{63}{2}$ gm

$\text{wt. of 70\% acid} = \frac{100}{70} \times 31.5 = 45$ gm

21. **(c)** Vant Hoff factor $i = 4$ in case of $(NH_4)_3PO_4$,

$(NH_4)_3PO_4 \rightleftharpoons 3NH_4^+ + PO_4^{3-}$

22. **(d)** $\Delta T_b = iK_b m$

Given, $(\Delta T_b)_X > (\Delta T_b)_Y$

$\therefore \; i_X K_b m > i_Y K_b m$

(K_b is same for same solvent)

$i_X > i_Y$

So, x is undergoing dissociation in water. 1= u/c

23. **(a)** Depression in F.P. $\propto$ No. of particles.

$Al_2(SO_4)_3$ provides five ions on ionisation

$Al_2(SO_4)_3 \longrightarrow 2Al^{3+} + 3SO_4^{2-}$

while KCl provides two ions

$KCl \rightleftharpoons K^+ + Cl^-$

$C_6H_{12}O_6$ and $C_{12}H_{22}O_{11}$ are not ionised so they have single particle.

Hence, $Al_2(SO_4)_3$ have maximum value of depression in F.P or lowest F.P

24. **(b)** Sodium sulphate dissociates as

$Na_2SO_4(s) \longrightarrow 2Na^+ + SO_4^{--}$

hence van't hoff factor $i = 3$

Now $\Delta T_f = i k_f . m$

$= 3 \times 1.86 \times 0.01 = 0.0558$ K

25. **(a)** $K_4[Fe(CN)_6]$ and $Al_2(SO_4)_3$ both dissociates to give 5 ions or $i = 5$

$K_4[Fe(CN)_6] \rightleftharpoons 4K^+ + [Fe(CN)_6]^{4-}$

and $Al_2(SO_4)_3 \rightleftharpoons 2Al^{3+} + 3SO_4^{--}$

26. **(b)** 1 molal solution means 1 mole of solute dissolved in 1000 gm solvent.

$\therefore \; n_{solute} = 1 \qquad w_{solvent} = 1000g$

$\therefore \; n_{solvent} = \frac{1000}{18} = 55.56$

$X_{solute} = \frac{1}{1 + 55.56} = 0.0177$

27. **(b)** Concentration of

$Na_2CO_3 = \frac{25.3}{106} \times \frac{1000}{250} = 0.955$ M

$[Na^+] = 2 \times 0.955 = 1.91$ M

$\left[CO_3^{2-}\right] = 0.955$ M

28. **(d)** Azeotrope of $HCl + H_2O$ contains 20.2% HCl.

29. **(d)** $\Delta T_f = i.k_f.m$; $\Delta T_b = i.k_b.m$

$\frac{\Delta T_f}{\Delta T_b} = \frac{k_f}{k_b}$

$\Delta T_f = 0 - (-0.186°C) = 0.186°C$

$\frac{0.186}{\Delta T_b} = \frac{1.86}{0.52} \Rightarrow \Delta T_b = \frac{0.52 \times 0.186}{1.86} = 0.052$

30. **(a)** Mole fraction of any component A

$x = \frac{\text{No. of moles of A}}{\text{Total No. of moles}}$

As total no. of moles > no. of moles of A

thus x can never be equal to one or zero.