

Solutions — NEET Chemistry PYQ (2005-2021)

Class 12 Chemistry · 33 real NEET & AIPMT questions, year-tagged · answers checked by RankUp

NEET 2021

1. The following solutions were prepared by dissolving 10 g of glucose ($C_6H_{12}O_6$) in 250 ml of water (P_1), 10 g of urea (CH_4N_2O) in 250 ml of water (P_2) and 10 g of sucrose ($C_{12}H_{22}O_{11}$) in 250 ml of water (P_3). The right option for the decreasing order of osmotic pressure of these solutions is :

- (A) $P_2 > P_1 > P_3$
- (B) $P_1 > P_2 > P_3$
- (C) $P_2 > P_3 > P_1$
- (D) $P_3 > P_1 > P_2$

NEET 2021

2. The correct option for the value of vapour pressure of a solution at $45^\circ C$ with benzene to octane in molar ratio 3 : 2 is :

[At $45^\circ C$ vapour pressure of benzene is 280 mm Hg and that of octane is 420 mm Hg. Assume Ideal gas]

- (A) 160 mm of Hg
- (B) 168 mm of Hg
- (C) 336 mm of Hg
- (D) 350 mm of Hg

NEET 2020 · Q105

3. The freezing point depression constant (K_f) of benzene is $5.12 K kg mol^{-1}$. The freezing point depression for the solution of molality 0.078 m containing a non-electrolyte solute in benzene is (rounded off upto two decimal places) :

- (A) 0.20 K
- (B) 0.80 K
- (C) 0.40 K
- (D) 0.60 K

NEET 2020 · Q115

4. The mixture which shows positive deviation from Raoult's law is :

- (A) Ethanol + Acetone
- (B) Benzene + Toluene
- (C) Acetone + Chloroform
- (D) Chloroethane + Bromoethane

NEET 2019 · Q70

5. For an ideal solution, the correct option is:

- (A) $\Delta_{mix} S = 0$ at constant T and P
- (B) $\Delta_{mix} V \neq 0$ at constant T and P
- (C) $\Delta_{mix} H = 0$ at constant T and P
- (D) $\Delta_{mix} G = 0$ at constant T and P

NEET 2017 · Q38

6. Which of the following is dependent on temperature?

- (A) Molality
- (B) Molarity
- (C) Mole fraction
- (D) Weight percentage

NEET 2017 · Q39

7. If molality of the dilute solution is doubled, the value of molal depression constant (K_f) will be:

- (A) doubled
- (B) halved
- (C) tripled
- (D) unchanged

NEET 2017 (Gujarati paper) · Q2

8. Toluene in the vapour phase is in equilibrium with a solution of benzene and toluene having mole fraction of toluene 0.50. If vapour pressure of pure benzene is 119 torr and that of toluene is 37.0 torr at the same temperature, mole fraction of toluene in vapour phase will be:

- (A) 0.462
- (B) 0.237
- (C) 0.506
- (D) 0.325

NEET 2016 Phase 2 · Q53

9. The van't Hoff factor (i) for a dilute aqueous solution of the strong electrolyte barium hydroxide is

- (A) 0
- (B) 1
- (C) 2
- (D) 3

NEET 2016 Phase 2 · Q57

10. Which one of the following is incorrect for ideal solution?

- (A) $\Delta H_{\text{mix}} = 0$
- (B) $\Delta U_{\text{mix}} = 0$
- (C) $\Delta P = P_{\text{obs}} - P_{\text{calculated by Raoult's law}} = 0$
- (D) $\Delta G_{\text{mix}} = 0$

NEET 2016 Phase 1 · Q80

11. Which of the following statements about the composition of the vapour over an ideal 1 : 1 molar mixture of benzene and toluene is correct? Assume that the temperature is constant at 25°C. (Given, Vapour Pressure Data at 25°C, benzene = 12.8 kPa, toluene = 3.85 kPa)

- (A) The vapour will contain a higher percentage of benzene.
- (B) The vapour will contain a higher percentage of toluene.
- (C) The vapour will contain equal amounts of benzene and toluene.
- (D) Not enough information is given to make a prediction.

NEET 2016 Phase 1 · Q86

12. At 100°C the vapour pressure of a solution of 6.5 g of a solute in 100 g water is 732 mm. If $K_b = 0.52$, the boiling point of this solution will be:

- (A) 101°C
- (B) 100°C
- (C) 102°C
- (D) 103°C

AIPMT 2015

13. Which one is not equal to zero for an ideal solution?

- (A) $\Delta P = P(\text{observed}) - P(\text{Raoult})$
- (B) $\Delta H(\text{mix})$
- (C) $\Delta S(\text{mix})$
- (D) $\Delta V(\text{mix})$

AIPMT 2015

14. 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) Y is undergoing dissociation in water while X undergoes no change
- (B) X is undergoing dissociation in water
- (C) Molecular mass of X is greater than the molecular mass of Y
- (D) Molecular mass of X is less than the molecular mass of Y

AIPMT 2015

15. Which one of the following electrolytes has the same value of van't Hoff's factor (i) as that of Al₂(SO₄)₃ (if all are 100% ionised)?

- (A) K₄[Fe(CN)₆]
- (B) K₂SO₄
- (C) K₃[Fe(CN)₆]
- (D) Al(NO₃)₃

AIPMT 2014

16. Of the following 0.10 m aqueous solutions, which one will exhibit the largest freezing point depression?

- (A) C₆H₁₂O₆
- (B) Al₂(SO₄)₃
- (C) K₂SO₄
- (D) KCl

NEET 2013

17. 6.02 × 10²⁰ molecules of urea are present in 100 mL of its solution. The concentration of solution is

- (A) 0.02 M
- (B) 0.01 M
- (C) 0.001 M
- (D) 0.1 M

AIPMT 2012 Prelims

18. p_A and p_B are the vapour pressures of pure liquid components A and B, respectively, of an ideal binary solution. If x_A represents the mole fraction of component A, the total pressure of the solution will be

- (A) p_B + x_A(p_A – p_B)
- (B) p_A + x_A(p_B – p_A)
- (C) p_A + x_A(p_A – p_B)
- (D) p_B + x_A(p_B – p_A)

AIPMT 2011 Mains

19. A 0.1 molal aqueous solution of a weak acid is 30% ionized. If K_f for water is 1.86°C/m, the freezing point of the solution will be

- (A) –0.36°C
- (B) –0.24°C
- (C) –0.18°C
- (D) –0.54°C

AIPMT 2011 Mains

20. 200 mL of an aqueous solution of a protein contains 1.26 g of the protein. The osmotic pressure of this solution at 300 K is found to be 2.57 × 10⁻³ bar. The molar mass of protein will be (R = 0.083 L bar mol⁻¹ K⁻¹)

- (A) 31011 g mol⁻¹
- (B) 61038 g mol⁻¹
- (C) 51022 g mol⁻¹
- (D) 122044 g mol⁻¹

AIPMT 2011 Prelims

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

- (A) 1.7700
- (B) 0.1770
- (C) 0.0177
- (D) 0.0344

AIPMT 2011 Prelims

22. The van't Hoff factor i for a compound which undergoes dissociation in one solvent and association in other solvent is respectively

- (A) Greater than one and greater than one
- (B) Less than one and greater than one
- (C) Less than one and less than one
- (D) Greater than one and less than one

AIPMT 2011 Prelims

23. The freezing point depression constant for water is $-1.86^{\circ}\text{C m}^{-1}$. If 5.00 g Na_2SO_4 is dissolved in 45.0 g H_2O , the freezing point is changed by -3.82°C . Calculate the van't Hoff factor for Na_2SO_4

- (A) 0.381
- (B) 2.05
- (C) 2.63
- (D) 3.11

AIPMT 2010 Prelims · Q56

24. An aqueous solution is 1.00 molal in KI. Which change will cause the vapour pressure of the solution to increase?

- (A) Addition of water
- (B) Addition of NaCl
- (C) Addition of Na_2SO_4
- (D) Addition of 1.00 molal KI

AIPMT 2010 Prelims · Q100

25. A solution of sucrose (molar mass = 342 g mol^{-1}) has been prepared by dissolving 68.5 g of sucrose in 1000 g of water. The freezing point of the solution obtained will be (K_f for water = $1.86\text{ K kg mol}^{-1}$)

- (A) -0.570°C
- (B) -0.372°C
- (C) -0.520°C
- (D) $+0.372^{\circ}\text{C}$

AIPMT 2009 Prelims · Q164

26. A 0.0020 m aqueous solution of an ionic compound $\text{Co}(\text{NH}_3)_5(\text{NO}_2)\text{Cl}$ freezes at -0.00732°C . Number of moles of ions which 1 mol of ionic compound produces on being dissolved in water will be ($K_f = -1.86^{\circ}\text{C/m}$)

- (A) 3
- (B) 4
- (C) 1
- (D) 2

AIPMT 2007 Prelims · Q73

27. 0.5 molal aqueous solution of a weak acid (HX) is 20% ionised. If K_f for water is $1.86\text{ K kg mol}^{-1}$, the lowering in freezing point of the solution is

- (A) 0.56 K
- (B) 1.12 K
- (C) - 0.56 K
- (D) - 1.12 K

28. A solution containing 10 g per dm³ of urea (molecular mass = 60 g mol⁻¹) is isotonic with a 5% solution of a non-volatile solute. The molecular mass of this non-volatile solute is :

- (A) 200 g mol⁻¹
- (B) 300 g mol⁻¹
- (C) 400 g mol⁻¹
- (D) 500 g mol⁻¹

29. 1.00 g of a non-electrolyte solute (molar mass 250 g mol⁻¹) was dissolved in 51.2 g of benzene. If the freezing point depression constant, K_f of benzene is 5.12 K kg mol⁻¹, the freezing point of benzene will be lowered by :

- (A) 0.4 K
- (B) 0.8 K
- (C) 0.12 K
- (D) 0.24 K

30. A solution of acetone in ethanol :

- (A) shows a negative deviation from Raoult's law
- (B) shows a positive deviation from Raoult's law
- (C) behaves like a near ideal solution
- (D) obeys Raoult's law

31. The vapour pressure of two liquids P and Q are 80 and 60 torr, respectively. The total vapour pressure of solution obtained by mixing 3 moles of P and 2 moles of Q would be :

- (A) 144 torr
- (B) 288 torr
- (C) 14 torr
- (D) 72 torr

32. A solution has a 1 : 4 mole ratio of pentane to hexane. The vapour pressure of the pure hydrocarbons at 20°C are 440 mm of Hg for pentane and 120 mm of Hg for hexane. The mole fraction of pentane in the vapour phase would be :

- (A) 0.178
- (B) 0.278
- (C) 0.378
- (D) 0.478

33. The mole fraction of the solute in one molal aqueous solution is :

- (A) 0.054
- (B) 0.042
- (C) 0.018
- (D) 0.009

Answer key and explanations

1. Answer: (A) $P_2 > P_1 > P_3$

$\pi = (w/M)RT/V$; with the same mass and volume, $\pi \propto 1/M$. Molar masses: urea 60, glucose 180, sucrose 342 g/mol. So $\pi(\text{urea}) > \pi(\text{glucose}) > \pi(\text{sucrose})$, i.e. $P_2 > P_1 > P_3$.

2. Answer: (C) 336 mm of Hg

Mole fractions: benzene $3/5 = 0.6$, octane $2/5 = 0.4$. By Raoult's law $P = 0.6 \times 280 + 0.4 \times 420 = 168 + 168 = 336$ mm Hg. 168 mm Hg is only one component's partial pressure.

3. Answer: (C) 0.40 K

$\Delta T_f = K_f \times m = 5.12 \times 0.078 = 0.399$ K, which rounds to 0.40 K. Since the solute is a non-electrolyte, $i = 1$ and no factor for dissociation is needed.

4. Answer: (A) Ethanol + Acetone

Acetone breaks some of the hydrogen bonds between ethanol molecules, so A-B interactions are weaker than A-A and the vapour pressure is higher than Raoult's law predicts. Acetone + chloroform form a new H-bond and show negative deviation, while benzene + toluene and chloroethane + bromoethane are nearly ideal.

5. Answer: (C) $\Delta_{\text{mix}} H = 0$ at constant T and P

An ideal solution has $\Delta_{\text{mix}} H = 0$ and $\Delta_{\text{mix}} V = 0$. Mixing still increases entropy ($\Delta_{\text{mix}} S > 0$), so $\Delta_{\text{mix}} G$ is negative, not zero.

6. Answer: (B) Molarity

Molarity is moles per litre of solution, and the volume of a solution changes with temperature, so molarity changes too. Molality, mole fraction and weight percentage involve only masses or mole numbers, which do not depend on temperature.

7. Answer: (D) unchanged

K_f is a property of the solvent alone ($K_f = R \cdot M \cdot T_f^2 / 1000 \Delta H_{\text{fus}}$), so it does not change with concentration. Doubling the molality doubles the depression $\Delta T_f = K_f \cdot m$, not K_f itself.

8. Answer: (B) 0.237

By Raoult's law, $p(\text{benzene}) = 0.5 \times 119 = 59.5$ torr and $p(\text{toluene}) = 0.5 \times 37.0 = 18.5$ torr, so total pressure = 78.0 torr. Mole fraction of toluene in vapour = $18.5/78.0 = 0.237$. The vapour is richer in the more volatile benzene, so the toluene fraction must be below 0.50, which rules out 0.506.

9. Answer: (D) 3

$\text{Ba}(\text{OH})_2$ dissociates completely in dilute solution: $\text{Ba}(\text{OH})_2 \rightarrow \text{Ba}^{2+} + 2\text{OH}^-$, giving three ions per formula unit, so $i = 3$. $i = 2$ would apply to a 1:1 electrolyte like NaCl.

10. Answer: (D) $\Delta G_{\text{mix}} = 0$

For an ideal solution ΔH_{mix} and ΔU_{mix} are zero and the vapour pressure follows Raoult's law exactly. Mixing is still spontaneous because $\Delta S_{\text{mix}} > 0$, so $\Delta G_{\text{mix}} = -T\Delta S_{\text{mix}}$ is negative, not zero.

11. Answer: (A) The vapour will contain a higher percentage of benzene.

For the 1:1 mixture, partial pressures are $0.5 \times 12.8 = 6.4$ kPa (benzene) and $0.5 \times 3.85 \approx 1.93$ kPa (toluene), so benzene's mole fraction in the vapour is $6.4/8.33 \approx 0.77$. The more volatile component is enriched in the vapour; equal liquid amounts do not give equal vapour amounts.

12. Answer: (A) 101°C

Relative lowering: $(760 - 732)/732 = n_2/n_1$ (Raoult's law form), with $n_1 = 100/18 = 5.56$ mol, so $n_2 \approx 0.0383 \times 5.56 \approx 0.213$ mol. Molality = $0.213/0.1 \approx 2.13$ m and $\Delta T_b = 0.52 \times 2.13 \approx 1.1$ K, so the boiling point is about 101°C. 100°C would ignore the elevation altogether.

13. Answer: (C) $\Delta S(\text{mix})$

For an ideal solution $\Delta H_{\text{mix}} = 0$, $\Delta V_{\text{mix}} = 0$ and the vapour pressure obeys Raoult's law exactly, so $\Delta P = 0$. Mixing still increases randomness, so $\Delta S_{\text{mix}} > 0$ (this is what makes ΔG_{mix} negative).

14. Answer: (B) X is undergoing dissociation in water

$\Delta T_b = iK_b m$. At equal molality, a higher boiling point means a larger van't Hoff factor for X, so X dissociates in water. Molecular mass does not matter once molality is fixed.

15. Answer: (A) $\text{K}_4[\text{Fe}(\text{CN})_6]$

$\text{Al}_2(\text{SO}_4)_3 \rightarrow 2\text{Al}^{3+} + 3\text{SO}_4^{2-}$ gives $i = 5$. $\text{K}_4[\text{Fe}(\text{CN})_6] \rightarrow 4\text{K}^+ + [\text{Fe}(\text{CN})_6]^{4-}$ also gives 5 ions. $\text{K}_3[\text{Fe}(\text{CN})_6]$ and $\text{Al}(\text{NO}_3)_3$ give 4 and K_2SO_4 gives 3.

16. Answer: (B) $\text{Al}_2(\text{SO}_4)_3$

$\Delta T_f = iK_f m$, so at equal molality the solute giving most particles wins. $\text{Al}_2(\text{SO}_4)_3$ gives 5 ions ($i = 5$), versus 3 for K_2SO_4 , 2 for KCl and 1 for glucose.

17. Answer: (B) 0.01 M

Moles of urea = $6.02 \times 10^{20} / 6.02 \times 10^{23} = 1 \times 10^{-3}$ mol in 100 mL = 0.1 L. Molarity = $10^{-3}/0.1 = 0.01$ M. 0.001 M forgets to convert 100 mL into litres.

18. Answer: (A) $p_B + xA(p_A - p_B)$

By Raoult's law, $p = p_A \cdot x_A + p_B \cdot x_B$ with $x_B = 1 - x_A$, so $p = p_B + xA(p_A - p_B)$. The expression starting with p_A would require the mole fraction of B to multiply ($p_B - p_A$).

19. Answer: (B) -0.24°C

$\text{HA} \rightleftharpoons \text{H}^+ + \text{A}^-$ with $\alpha = 0.3$ gives $i = 1 + \alpha = 1.3$. $\Delta T_f = iK_f m = 1.3 \times 1.86 \times 0.1 = 0.24^{\circ}\text{C}$, so the freezing point is -0.24°C . Ignoring ionisation gives -0.18°C , and taking full dissociation gives -0.36°C .

20. Answer: (B) 61038 g mol^{-1}

$\pi = (w/M)RT/V$, so $M = wRT/(\pi V) = 1.26 \times 0.083 \times 300/(2.57 \times 10^{-3} \times 0.200) = 31.37/5.14 \times 10^{-4} \approx 61038 \text{ g mol}^{-1}$. Forgetting to convert 200 mL to 0.200 L or halving/doubling the volume gives the other values.

21. Answer: (C) 0.0177

1.00 molal means 1 mol solute per 1000 g water, i.e. $1000/18 = 55.56$ mol water. Mole fraction of solute = $1/(1 + 55.56) = 0.0177$. Note this is the mole fraction, not the molality, so it must be much smaller than 1; 0.177 is a decimal slip.

22. Answer: (D) Greater than one and less than one

Dissociation increases the number of solute particles, so $i > 1$; association decreases it, so $i < 1$. Reversing these is the trap.

23. Answer: (C) 2.63

Moles of $\text{Na}_2\text{SO}_4 = 5.00/142 = 0.0352$ mol; molality = $0.0352/0.0450 \text{ kg} = 0.782 \text{ m}$. $i = \Delta T_f/(K_f \cdot m) = 3.82/(1.86 \times 0.782) = 3.82/1.455 = 2.63$. Ideal complete dissociation would give 3, so 3.11 is too high.

24. Answer: (A) Addition of water

Vapour pressure lowering depends on solute concentration. Adding water dilutes the solution, so its vapour pressure rises. Adding NaCl or Na_2SO_4 adds solute and lowers it; adding more 1.00 molal KI leaves the concentration unchanged.

25. Answer: (B) -0.372°C

Molality = $(68.5/342)/1 \text{ kg} = 0.200 \text{ mol/kg}$. $\Delta T_f = 1.86 \times 0.200 = 0.372 \text{ K}$, so the freezing point is -0.372°C . $+0.372^{\circ}\text{C}$ has the wrong sign; freezing point is lowered.

26. Answer: (D) 2

$\Delta T_f = iK_f m$, so $i = 0.00732/(1.86 \times 0.0020) \approx 1.97 \approx 2$. The compound is $[\text{Co}(\text{NH}_3)_5(\text{NO}_2)]\text{Cl}$, giving one complex cation and one Cl^- ion. A value of 3 would need two ionisable chlorides.

27. Answer: (B) 1.12 K

For $\text{HX} \rightleftharpoons \text{H}^+ + \text{X}^-$ with $\alpha = 0.2$, $i = 1 + \alpha = 1.2$. $\Delta T_f = iK_f m = 1.2 \times 1.86 \times 0.5 = 1.116 \approx 1.12 \text{ K}$. 0.56 K ignores the van 't Hoff factor and rounds wrongly; the depression itself is a positive quantity.

28. Answer: (B) 300 g mol^{-1}

Isotonic solutions of non-electrolytes have equal molar concentrations. Urea: $10 \text{ g/L} \div 60 = 1/6 \text{ mol/L}$. A 5% solution has 50 g/L (taking 5 g per 100 mL), so $50/M = 1/6$ and $M = 300 \text{ g mol}^{-1}$.

29. Answer: (A) 0.4 K

Molality $m = (1.00/250)/(51.2/1000) = 0.004/0.0512 = 0.078 \text{ mol kg}^{-1}$. $\Delta T_f = K_f \times m = 5.12 \times 0.078 = 0.40 \text{ K}$. Forgetting to convert grams of benzene to kilograms changes the answer by a factor of 1000.

30. Answer: (B) shows a positive deviation from Raoult's law

Ethanol molecules are hydrogen bonded to one another; acetone gets between them and breaks many of these bonds while forming weaker interactions. The escaping tendency increases, so the vapour pressure is higher than Raoult's law predicts, a positive deviation. A negative deviation would need stronger A-B attractions, as in acetone-chloroform.

31. Answer: (D) 72 torr

$x_P = 3/5$ and $x_Q = 2/5$. By Raoult's law $P = (3/5)(80) + (2/5)(60) = 48 + 24 = 72 \text{ torr}$. 144 torr comes from using mole numbers instead of mole fractions.

32. Answer: (D) 0.478

$x(\text{pentane}) = 1/5 = 0.2$. $p(\text{pentane}) = 0.2 \times 440 = 88 \text{ mm}$ and $p(\text{hexane}) = 0.8 \times 120 = 96 \text{ mm}$, total 184 mm. Vapour mole fraction of pentane = $88/184 \approx 0.478$.

33. Answer: (C) 0.018

One molal means 1 mol solute in 1000 g water = 55.5 mol water. $x(\text{solute}) = 1/(1 + 55.5) \approx 0.0177 \approx 0.018$.

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