

Q1. JEE Main 2026 (21 January Shift 2)

A substance 'X' (1.5 g) dissolved in 150 g of a solvent 'Y' (molar mass = 300 g mol^{-1}) led to an elevation of the boiling point by 0.5 K. The relative lowering in the vapour pressure of the solvent 'Y' is $\text{_____} \times 10^{-2}$. (nearest integer)

[Given : K_b of the solvent = $5.0 \text{ K kg mol}^{-1}$]

Assume the solution to be dilute and no association or dissociation of X takes place in solution.

Q2. JEE Main 2026 (21 January Shift 2)

The osmotic pressure of a living cell is 12 atm at 300 K. The strength of sodium chloride solution that is isotonic with the living cell at this temperature is _____ gL^{-1} . (Nearest integer)

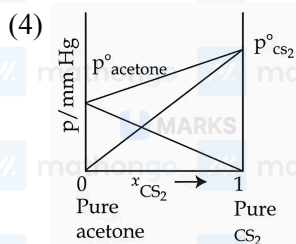
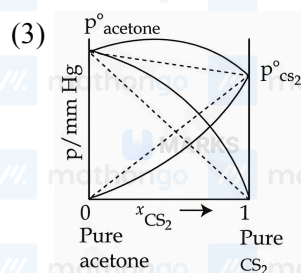
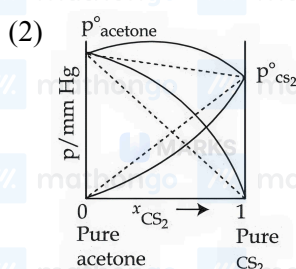
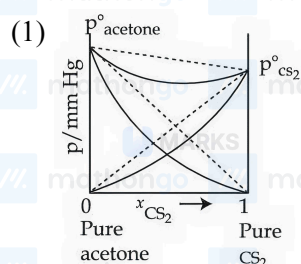
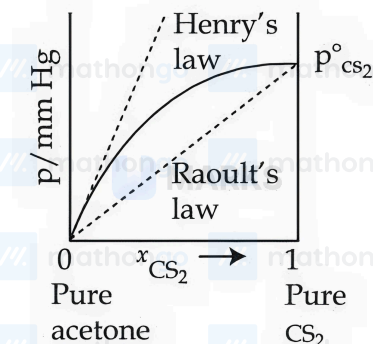
Given : $R = 0.08 \text{ L atm K}^{-1} \text{ mol}^{-1}$

Assume complete dissociation of NaCl

(Given : Molar mass of Na and Cl are 23 and 35.5 g mol^{-1} respectively.)

Q3. JEE Main 2026 (23 January Shift 1)

Which one of the following graphs accurately represents the plot of partial pressure of CS_2 vs its mole fraction in a mixture of acetone and CS_2 at constant temperature?

**Q4. JEE Main 2026 (28 January Shift 2)**

Consider the following aqueous solutions.

I. 2.2 g Glucose in 125 mL of solution.

II. 1.9 g Calcium chloride in 250 mL of solution.

III. 9.0 g Urea in 500 mL of solution.

IV. 20.5 g Aluminium sulphate in 750 mL of solution.

The correct increasing order of boiling point of these solutions will be :

[Given : Molar mass in g mol^{-1} : H = 1, C = 12, N = 14, O = 16, Cl = 35.5, Ca = 40, Al = 27 and S = 32]

(1) III < I < II < IV

(2) I < II < III < IV

(3) II < III < I < IV

(4) II < III < IV < I

Q5. JEE Main 2026 (24 January Shift 2)

At 298 K, the mole percentage of $\text{N}_2(\text{g})$ in air is 80%. Water is in equilibrium with air at a pressure of 10 atm. What is the mole fraction of $\text{N}_2(\text{g})$ in water at 298 K? (K_{H} for N_2 is $6.5 \times 10^7 \text{ mmHg}$)

(1) 1.23×10^{-7}

(2) 1.17×10^{-4}

(3) 9.35×10^5

(4) 9.35×10^{-5}

Q6. JEE Main 2026 (24 January Shift 2)

Two liquids A and B form an ideal solution at temperature T K. At T K, the vapour pressures of pure A and B are 55 and 15 kNm^{-2} respectively. What is the mole fraction of A in solution of A and B in equilibrium with a vapour in which the mole fraction of A is 0.8?

(1) 0.340

(2) 0.663

(3) 0.5217

(4) 0.480

Q7. JEE Main 2026 (22 January Shift 2)

At T(K), 100 g of 98% $\text{H}_2\text{SO}_4(\text{w/w})$ aqueous solution is mixed with 100 g of 49% $\text{H}_2\text{SO}_4(\text{w/w})$ aqueous solution. What is the mole fraction of H_2SO_4 in the resultant solution?

(Given : Atomic mass H = 1u; S = 32u; O = 16u).

(Assume that temperature after mixing remains constant)

(1) 0.663

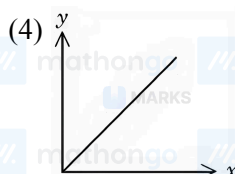
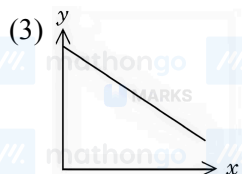
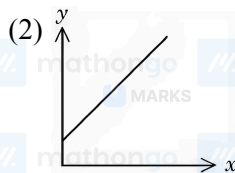
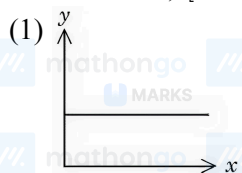
(2) 0.9

(3) 0.337

(4) 0.1

Q8. JEE Main 2026 (22 January Shift 1)

Consider a solution of $\text{CO}_2(\text{g})$ dissolved in water in a closed container. Which one of the following plots correctly represents variation of $\log$ (partial pressure of CO_2 in vapour phase above water) [y -axis] with $\log$ (mole fraction of CO_2 in water) [x -axis] at 25°C ?



Q9. JEE Main 2026 (22 January Shift 1)

Given below are two statements:

Statement I: The Henry's law constant K_H is constant with respect to variations in solution's concentration over the range for which the solution is ideally dilute.

Statement II: K_H does not differ for the same solute in different solvents.

In the light of the above statements, choose the correct answer from the options given below

- (1) Statement I is false but Statement II is true
- (2) Both Statement I and Statement II are false
- (3) Statement I is true but Statement II is false
- (4) Both Statement I and Statement II are true

Q10. JEE Main 2026 (23 January Shift 2)

Two liquids A and B form an ideal solution. At 320 K, the vapour pressure of the solution, containing 3 mol of A and 1 mol of B is 500 mm Hg. At the same temperature, if 1 mol of A is further added to this solution, vapour pressure of the solution increases by 20 mm Hg. Vapour pressure (in mm Hg) of B in pure state is _____. (Nearest integer)

Q11. JEE Main 2026 (21 January Shift 1)

Elements P and Q form two types of non-volatile, non-ionizable compounds PQ and PQ_2 . When 1 g of PQ is dissolved in 50 g of solvent 'A', ΔT_b was 1.176 K while when 1 g of PQ_2 is dissolved in 50 g of solvent 'A', ΔT_b was 0.689 K. (K_b of 'A' = 5 K kg mol⁻¹). The molar masses of elements P and Q (in g mol⁻¹) respectively, are :

- (1) 70, 110
- (2) 65, 145
- (3) 25, 60
- (4) 60, 25

Q12. JEE Main 2026 (28 January Shift 1)

At T(K), 2 moles of liquid A and 3 moles of liquid B are mixed. The vapour pressure of ideal solution formed is 320 mm Hg. At this stage, one mole of A and one mole of B are added to the solution. The vapour pressure is now measured as 328.6 mm Hg. The vapour pressure (in mm Hg) of A and B are respectively:

- (1) 400, 300
- (2) 600, 400
- (3) 300, 200
- (4) 500, 200

Q13. JEE Main 2026 (24 January Shift 1)

A solution is prepared by dissolving 0.3 g of a non-volatile non-electrolyte solute 'A' of molar mass 60 g mol⁻¹ and 0.9 g of a non-volatile non-electrolyte solute 'B' of molar mass 180 g mol⁻¹ in 100 mL H₂O at 27°C. Osmotic pressure of the solution will be

[Given: $R = 0.082 \text{ L atm K}^{-1} \text{ mol}^{-1}$]

- (1) 0.82 atm
- (2) 2.46 atm
- (3) 1.23 atm
- (4) 1.47 atm

Q14. JEE Main 2026 (24 January Shift 1)

'W' g of a non-volatile electrolyte solid solute of molar mass 'M' g mol^{-1} when dissolved in 100 mL water, decreases vapour pressure of water from 640 mm Hg to 600 mm Hg. If aqueous solution of the electrolyte boils at 375 K and K_b for water is $0.52 \text{ K kg mol}^{-1}$, then the mole fraction of the electrolyte solute (x_2) in the solution can be expressed as

(Given : density of water = 1 g/mL and boiling point of water = 373 K)

(1) $\frac{2.6}{16} \times \frac{M}{W}$ (2) $\frac{16}{2.6} \times \frac{W}{M}$ (3) $\frac{1.3}{8} \times \frac{M}{W}$ (4) $\frac{1.3}{8} \times \frac{W}{M}$

ANSWERS AND SOLUTIONS

1. 3 2. 15 3. (1) 4. (2) 5. (4) 6. (3) 7. (3) 8. (2)
 9. (3) 10. 200 11. (3) 12. (4) 13. (2) 14. (4)

1. (3) Using boiling point elevation to find molality:

$$\Delta T_b = K_b \times m \text{ gives } 0.5 = 5.0 \times m, \text{ so } m = 0.1 \text{ mol/kg.}$$

Converting molality to moles of solute:

$$0.1 = \frac{\text{moles of X}}{0.15}, \text{ giving moles of X} = 0.015 \text{ mol.}$$

$$\text{Molar mass of X} = 1.5 \text{ g} / 0.015 \text{ mol} = 100 \text{ g/mol.}$$

For vapor pressure lowering, the relative lowering equals the mole fraction of solute.

$$\text{Moles of solvent Y} = 150 \text{ g} / 300 \text{ g/mol} = 0.5 \text{ mol.}$$

Relative lowering of vapor pressure

$$\begin{aligned} &= \frac{n_X}{n_X + n_Y} = \frac{0.015}{0.015 + 0.5} \\ &= \frac{0.015}{0.515} = 0.0291 \approx 3 \times 10^{-2} \end{aligned}$$

2. (15) For osmotic pressure, using the van 't Hoff equation: $\pi = iMRT$.

The living cell has osmotic pressure of 12 atm.

For an isotonic NaCl solution, the osmotic pressures must be equal.

For NaCl solution: $\pi = i \times M \times R \times T$, where $i = 2$ (complete dissociation into Na^+ and Cl^-).

$$12 = 2 \times M \times 0.08 \times 300$$

$$12 = 48M$$

$$M = 0.25 \text{ mol/L}$$

$$\text{Molar mass of NaCl} = 23 + 35.5 = 58.5 \text{ g/mol.}$$

$$\text{Concentration in g/L} = 0.25 \times 58.5 = 14.625 \approx 15 \text{ g/L}$$

3. (1) The partial pressure of a component in a binary mixture follows Raoult's law for ideal solutions: $P_i = x_i \cdot P_i^\circ$, which is linear. However, the acetone- CS_2 system exhibits positive deviation from ideality due to different molecular interactions. When acetone and CS_2 mix, the hydrogen bonding between acetone molecules is disrupted, and the weaker interactions between unlike molecules allow molecules to escape more easily into the vapor phase. This results in partial pressures higher than predicted by Raoult's law, causing the pressure vs mole fraction curve to bow upward above the ideal line. Graph (1) shows this positive deviation curve correctly.

4. (2) $\Delta T_b = i \cdot k_b \cdot m$

For dilute solution ($M = m$)

	Molarity	$i \times m$
(I) $M_{\text{glucose}} = \frac{2.2}{180} \times \frac{1000}{125} = 0.098$		0.098×1
(II) $M_{\text{CaCl}_2} = \frac{1.9}{111} \times \frac{1000}{250} = 0.068$		0.068×3

(III) $M_{urea} = \frac{9}{60} \times \frac{1000}{500} = 0.3$	0.3×1
(IV) $M_{Al_2(SO_4)_3} = \frac{20.5}{342} \times \frac{1000}{750} \approx 0.08$	0.08×5

Order of $\Delta T_b = Al_2(SO_4)_3 > Urea > CaCl_2 > Glucose$

So order of BP = $Al_2(SO_4)_3 > Urea > CaCl_2 > Glucose$

So Answer will be $I < II < III < IV$

5. (4) Using Henry's Law: Mole fraction = $\frac{P}{K_H}$

N_2 mole percentage in air = 80%, total pressure = 10 atm

Partial pressure of $N_2 = 0.80 \times 10 = 8 \text{ atm} = 8 \times 760 = 6080 \text{ mmHg}$

K_H for $N_2 = 6.5 \times 10^7 \text{ mmHg}$

Mole fraction of $N_2 = \frac{6080}{6.5 \times 10^7} = \frac{6.08 \times 10^3}{6.5 \times 10^7} = 0.935 \times 10^{-4} = 9.35 \times 10^{-5}$

6. (3) For an ideal solution with Raoult's law, the partial pressure of A in vapour is $P_A = P_A^0 y_A$ where $y_A = 0.8$ is the mole fraction in vapour phase. Thus $P_A = 55 \times 0.8 = 44 \text{ kNm}^{-2}$.

Using the equilibrium condition $y_A = \frac{P_A^0 \chi_A}{P_{total}}$ where χ_A is mole fraction in liquid and $P_{total} = P_A^0 \chi_A + P_B^0 (1 - \chi_A)$

:

$$0.8 = \frac{55\chi_A}{55\chi_A + 15(1 - \chi_A)}$$

$$0.8(55\chi_A + 15 - 15\chi_A) = 55\chi_A$$

$$44\chi_A + 12 - 12\chi_A = 55\chi_A$$

$$12 = 23\chi_A$$

$$\chi_A = 0.5217$$

7. (3) Molar mass of $H_2SO_4 = 98 \text{ g/mol}$.

Solution 1: 100 g at 98% gives 98 g $H_2SO_4 = 1 \text{ mol}$; water = 2 g = 0.111 mol.

Solution 2: 100 g at 49% gives 49 g $H_2SO_4 = 0.5 \text{ mol}$; water = 51 g = 2.833 mol.

Mixed solution: Total $H_2SO_4 = 1 + 0.5 = 1.5 \text{ mol}$.

Total water = 0.111 + 2.833 = 2.944 mol.

Mole fraction of $H_2SO_4 = 1.5 / (1.5 + 2.944) = 1.5 / 4.444 = 0.337$.

8. (2) According to Henry's Law, the partial pressure of a gas in the vapour phase (p) is proportional to the mole fraction of the gas in the solution (x).

The mathematical expression is: $p = K_H \cdot x$

where K_H is the Henry's law constant.

Taking logarithm on both sides:

$$\log(p) = \log(K_H \cdot x)$$

$$\log(p) = \log(K_H) + \log(x)$$

Comparing this with the equation of a straight line $y = mx + c$:

$$y = \log(p) \text{ (y-axis)}$$

$$x = \log(x) \text{ (x-axis)}$$

$$m = 1 \text{ (slope)}$$

$$c = \log(K_H) \text{ (y-intercept)}$$

Since K_H for CO_2 in water is a positive constant at 25°C , $\log(K_H)$ will be a constant intercept.

The plot of $\log(p)$ vs $\log(x)$ is a straight line with a positive slope and a positive y-intercept.

This corresponds to graph (2).

9. (3) Statement I: K_H is constant with respect to concentration variations in ideally dilute solutions.

TRUE - Henry's law constant depends only on temperature and the nature of the solute-solvent interaction. For ideally dilute solutions, $K_H = P_{\text{gas}}/x_{\text{solute}}$ remains constant regardless of solute concentration within the dilute range.

Statement II: K_H does not differ for the same solute in different solvents.

FALSE - Henry's law constant is solvent-dependent. The same gas or solute has different K_H values in different solvents at the same temperature because the solute-solvent interactions differ. For example, CO_2 dissolves differently in water versus ethanol, giving different K_H values.

Therefore, Statement I is true but Statement II is false.

10. (200) For an ideal solution, Raoult's law states:

$$P_{\text{total}} = P_A^\circ x_A + P_B^\circ x_B.$$

Initial condition: 3 mol of A and 1 mol of B give a total vapor pressure of 500 mm Hg.

Mole fractions are $x_A = \frac{3}{4} = 0.75$ and $x_B = \frac{1}{4} = 0.25$.

This gives: $500 = 0.75P_A^\circ + 0.25P_B^\circ \dots (1)$.

After adding 1 mol of A: 4 mol of A and 1 mol of B give a total vapor pressure of 520 mm Hg.

Mole fractions are $x_A = \frac{4}{5} = 0.8$ and $x_B = \frac{1}{5} = 0.2$.

This gives: $520 = 0.8P_A^\circ + 0.2P_B^\circ \dots (2)$.

From equation (1) multiplied by 4: $2000 = 3P_A^\circ + P_B^\circ$.

From equation (2) multiplied by 5: $2600 = 4P_A^\circ + P_B^\circ$.

Subtracting: $600 = P_A^\circ$.

Substituting back into equation (1): $2000 = 3(600) + P_B^\circ$, so $P_B^\circ = 200$ mm Hg.

11. (3) Using $\Delta T_b = K_b \times \frac{w}{M} \times \frac{1000}{W}$

$$\text{For PQ: } 1.176 = 5 \times \frac{1}{M_{PQ}} \times \frac{1000}{50} = \frac{100}{M_{PQ}}$$

$$M_{PQ} = \frac{100}{1.176} = 85 \text{ g/mol}$$

$$\text{For } PQ_2: 0.689 = \frac{100}{M_{PQ_2}}$$

$$M_{PQ_2} = \frac{100}{0.689} = 145 \text{ g/mol}$$

$$P + Q = 85 \dots (i)$$

$$P + 2Q = 145 \dots (ii)$$

$$\text{Subtracting: } Q = 60 \text{ g/mol}$$

$$\text{From (i): } P = 85 - 60 = 25 \text{ g/mol}$$

12. (4) For an ideal solution obeying Raoult's Law, total pressure is

$$P = P_A^o x_A + P_B^o x_B.$$

Initially with 2 moles A and 3 moles B:

$$x_A = 0.4, x_B = 0.6, \text{ and } P = 320 = 0.4P_A^o + 0.6P_B^o$$

After adding 1 mole each: 3 moles A and 4 moles B gives

$$x_A = \frac{3}{7}, x_B = \frac{4}{7}, \text{ and } P = 328.6 = \frac{3}{7}P_A^o + \frac{4}{7}P_B^o$$

From the first equation:

$$3200 = 4P_A^o + 6P_B^o$$

From the second:

$$2300.2 = 3P_A^o + 4P_B^o$$

$$\text{Solving: We find } P_B^o = 200 \text{ mm Hg and } P_A^o = 500 \text{ mm Hg.}$$

13. (2) Calculate osmotic pressure using $\pi = \frac{nRT}{V}$ where n is total moles of solute particles.

$$\text{Moles of solute A: } n_A = \frac{0.3 \text{ g}}{60 \text{ g/mol}} = 0.005 \text{ mol}$$

$$\text{Moles of solute B: } n_B = \frac{0.9 \text{ g}}{180 \text{ g/mol}} = 0.005 \text{ mol}$$

$$\text{Total moles: } n_{\text{total}} = 0.005 + 0.005 = 0.01 \text{ mol}$$

$$\text{Volume of solution: } 100 \text{ mL} = 0.1 \text{ L}$$

$$\text{Temperature: } 27^\circ\text{C} = 300 \text{ K}$$

$$\text{Osmotic pressure: } \pi = \frac{0.01 \times 0.082 \times 300}{0.1} = \frac{0.246}{0.1} = 2.46 \text{ atm}$$

14. (4) Given the vapour pressure of pure water $P^o = 640 \text{ mm Hg}$ and vapour pressure of solution $P_s = 600 \text{ mm Hg}$.

According to Raoult's law for an electrolyte solution, the relative lowering of vapour pressure is given by

$$\frac{P^o - P_s}{P^o} = i \cdot x_2, \text{ where } i \text{ is the van't Hoff factor and } x_2 \text{ is the mole fraction of the solute.}$$

$$\text{Substituting the values: } \frac{640 - 600}{640} = i \cdot x_2$$

$$\frac{40}{640} = i \cdot x_2 \implies i \cdot x_2 = \frac{1}{16} \dots (1)$$

The elevation in boiling point is given by $\Delta T_b = i \cdot K_b \cdot m$, where m is the molality.

$$\text{Given } T_b = 375 \text{ K and } T_b^o = 373 \text{ K, so } \Delta T_b = 375 - 373 = 2 \text{ K.}$$

$$\text{Molality } m = \frac{W}{M \times 100} \times 1000 = \frac{10W}{M} \text{ (since mass of water} = 100 \text{ mL} \times 1 \text{ g/mL} = 100 \text{ g).}$$

$$\text{Substituting in the elevation formula: } 2 = i \cdot 0.52 \cdot \frac{10W}{M}$$

$$i = \frac{2M}{5.2W} = \frac{20M}{52W} = \frac{5M}{13W} \dots (2)$$

Substitute the value of i from (2) into (1):

$$\frac{5M}{13W} \cdot x_2 = \frac{1}{16}$$

$$x_2 = \frac{1}{16} \cdot \frac{13W}{5M} = \frac{13}{80} \cdot \frac{W}{M}$$

$$\text{This can be rewritten as } x_2 = \frac{1.3}{8} \times \frac{W}{M}.$$