Q1 - 24 January - Shift 1

In the depression of freezing point experiment

A. Vapour pressure of the solution is less than that of pure solvent

B. Vapour pressure of the solution is more than that of pure solvent

C. Only solute molecules solidify at the freezing point

D. Only solvent molecules solidify at the freezing point

(1) A and D only (2) B and C only

(3) A and C only (4) A only

Space for your notes:

Q2 - 24 January - Shift 2

The Total pressure observed by mixing two liquid A and B is 350 mm Hg when their mole fractions are 0.7 and 0.3 respectively.

The Total pressure becomes 410 mm Hg if the mole fractions are changed to 0.2 and 0.8 respectively for A and B. The vapour pressure of pure A is _____ mm Hg. (Nearest integer)

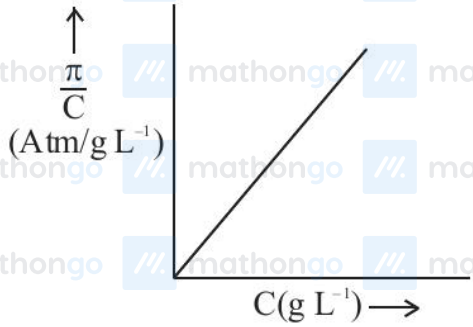
Consider the liquids and solutions behave ideally.

Space for your notes:

Q3 - 25 January - Shift 1

The osmotic pressure of solutions of PVC in cyclohexanone at 300 K are plotted on the graph.

The molar mass of PVC is _____ g mol^{-1} (Nearest integer)



(Given : R = 0.083 L atm K^{-1} mol^{-1})

Space for your notes:

Q4 - 25 January - Shift 2

The number of pairs of the solution having the same value of the osmotic pressure from the following is _____.

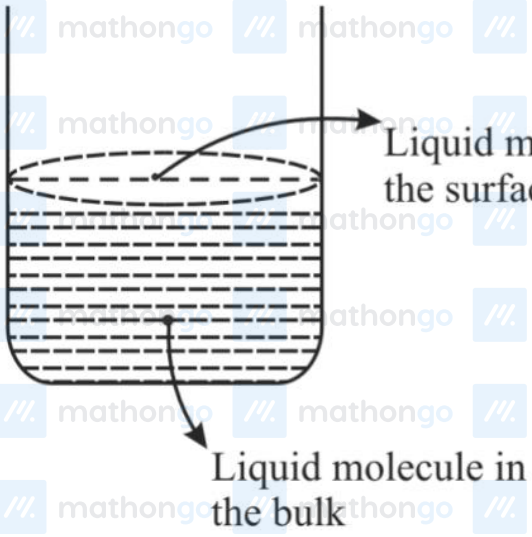
(Assume 100% ionization)

A. 0.500 M C_2H_5OH (aq) and 0.25 M KBr (aq)
B. 0.100 M $K_4[Fe(CN)_6]$ (aq) and 0.100 M $FeSO_4(NH_4)_2SO_4$ (aq)
C. 0.05 M $K_4[Fe(CN)_6]$ (aq) and 0.25 M NaCl (aq)
D. 0.15 M NaCl (aq) and 0.1 M $BaCl_2$ (aq)
E. 0.02 M KCl. $MgCl_2$. $6H_2O$ (aq) and 0.05 M KCl (aq)

Space for your notes:

Q5 - 25 January - Shift 2

Based on the given figure, the number of **correct** statement/s is/are _____



A. Surface tension is the outcome of equal attractive and repulsion forces acting on the liquid molecule in bulk.

B. Surface tension is due to uneven forces acting on the molecules present on the surface.

C. The molecule in the bulk can never come to the liquid surface.

D. The molecules on the surface are responsible for vapour pressure if the system is a closed system.

Space for your notes:

Q6 - 29 January - Shift 1

Solid Lead nitrate is dissolved in 1 litre of water. The solution was found to boil at 100.15°C. When 0.2 mol of NaCl is added to the resulting solution, it was observed that the solution froze at –0.8° C. The solutbility product of $PbCl_2$ formed is _____ $\times 10^{-6}$ at 298 K. (Nearest integer)

Given : $K_b = 0.5$ K kg mol^{-1} and $K_f = 1.8$ kg mol^{-1}. Assume molality to be equal to molarity in all cases.

Space for your notes:

Q7 - 29 January - Shift 2

Match **List I** with **List II**.

	List I		**List II**
A.	van't Hoff factor, i	I.	Cryoscopic constant
B.	k_f	II.	Isotonic solutions
C.	Solutions with same osmotic pressure	III.	$\frac{\text{Normal molar mass}}{\text{Abnormal molar mass}}$
D.	Azeotropes	IV.	Solutions with same composition of vapour above it

Choose the correct answer from the options given below :

(A) A-III, B-I, C-II, D-IV

(B) A-III, B-II, C-I, D-IV

(C) A-III, B-I, C-IV, D-II

(D) A-I, B-III, C-II, D-IV

Space for your notes:

Q8 - 29 January - Shift 2

Match **List-I** and **List-II**.

List-I	List-II
A. Osmosis	I. Solvent molecules pass through semi permeable membrane towards solvent side.
B. Reverse osmosis	II. Movement of charged colloidal particles under the influence of applied electric potential towards oppositely charged electrodes.
C. Electro osmosis	III. Solvent molecules pass through semi permeable membrane towards solution side.
D. Electrophoresis	IV. Dispersion medium moves in an electric field.

Choose the correct answer from the options given below:

(1) A-I, B-III, C-IV, D-II

(2) A-III, B-I, C-IV, D-II

(3) A-III, B-I, C-II, D-IV

(4) A-I, B-III, C-II, D-IV

Space for your notes:

Q9 - 30 January - Shift 1

A solution containing 2 g of a non–volatile solute in 20 g of water boils at 373.52 K. The molecular mass of the solute is _____ $g\,mol^{-1}$. (Nearest integer)

Given, water boils at 373 K, K_b for water $= 0.52\,K\,kg\,mol^{-1}$

Space for your notes:

Q10 - 30 January - Shift 1

A 300 mL bottle of soft drink has 0.2 M CO_2 dissolved in it. Assuming CO_2 behaves as an ideal gas, the volume of the dissolved CO_2 at STP is _____ mL. (Nearest integer)

Given: At STP, molar volume of an ideal gas is $22.7\,L\,mol^{-1}$

Space for your notes:

Q11 - 30 January - Shift 2

Lead storage battery contains 38% by weight solution of H_2SO_4. The van't Hoff factor is 2.67 at this concentration. The temperature in Kelvin at which the solution in the battery will freeze is ____ (Nearest integer).

Given $K_f = 1.8\ K\ kg\ mol^{-1}$

Space for your notes:

Q12 - 31 January - Shift 1

The total pressure of a mixture of non-reacting gases X (0.6 g) and Y (0.45 g) in a vessel is 740 mm of Hg. The partial pressure of the gas X is _____ mm of Hg. (Nearest Integer)

(Given : molar mass X = 20 and Y = 45 $g\ mol^{-1}$)

Space for your notes:

Q13 - 31 January - Shift 1

At 27°C, a solution containing 2.5 g of solute in 250.0 mL of solution exerts an osmotic pressure of 400 Pa. The molar mass of the solute is ____ g mol^{-1} (Nearest integer)

(Given : R = 0.083 L bar K^{-1} mol^{-1})

Space for your notes:

Q14 - 31 January - Shift 2

Evaluate the following statements for their correctness.

(A) The elevation in boiling point temperature of water will be same for 0.1 M NaCl and 0.1 M urea.

(B) Azeotropic mixtures boil without change in their composition

(C) Osmosis always takes place from hypertonic to hypotonic solution

(D) The density of 32% H_2SO_4 solution having molarity 4.09 M is approximately 1.26 g mL^{-1}

(E) A negatively charged sol is obtained when KI solution is added to silver nitrate solution.

Choose the **correct** answer from the options given below :

(1) B, D, and E only (2) A, B, and D only

(3) A and C only (4) B and D only

Space for your notes:

Q15 - 01 February - Shift 2

20% of acetic acid is dissociated when its 5 g is added to 500 mL of water. The depression in freezing point of such water is _____ $\times 10^{-3}$ °C.

Atomic mass of C, H and O are 12, 1 and 16 a.m.u. respectively.

[Given : Molal depression constant and density of water are 1.86 K kg mol^{-1} and 1 g cm^{-3} respectively.

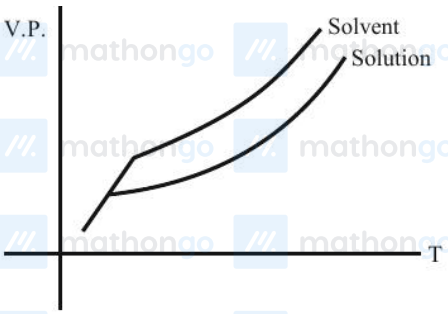
Space for your notes:

Answer Key

(As per Official NTA Key released on 2 Feb)

Q1 (1)	**Q2** (314)	**Q3** (41500)	**Q4** (4)
Q5 (2)	**Q6** (13)	**Q7** (1)	**Q8** (2)
Q9 (100g)	**Q10** (1362)	**Q11** (243)	**Q12** (555)
Q13 (62250)	**Q14** (4)	**Q15** (372)	

Q1 (1)



Vapour pressure (V.P.) of solvent is greater than vapour pressure (V.P.) of solution.

Only solvent freezes.

Q2 (314)

Let V.P. of pure A be P_A^0

Let V.P of pure B be P_B^0

When $X_A = 0.7$ & $X_B = 0.3$

$P_s = 350$

$\Rightarrow P_A^0 \times 0.7 + P_B^0 \times 0.3 = 350 \quad \ldots(i)$

When $X_A = 0.2$ & $X_B = 0.8$

$P_s = 410$

$\Rightarrow P_A^0 \times 0.2 + P_B^0 \times 0.8 = 410 \quad \ldots(ii)$

Solving (i) and (ii)

$P_A^0 = 314$ mm Hg

$P_B^0 = 434$ mm Hg

$= (314)$

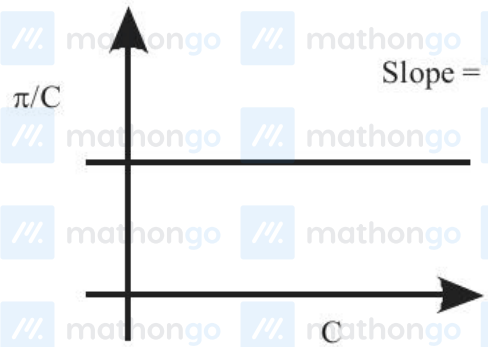
Q3 (41500)

$$\pi = M'RT = \left(\frac{W/M}{V}\right)RT$$

$$\Rightarrow \quad \pi = \left(\frac{W}{V}\right)\left(\frac{1}{M}\right)RT = C\left(\frac{RT}{M}\right)$$

$$\Rightarrow \quad \frac{\pi}{C} = \frac{RT}{M} \neq f(c)$$

If we assume graph between $\frac{\pi}{C}$ and C



Assuming π vs C graph

$$\text{Slope} = \frac{RT}{M} = \frac{0.083 \times 300}{M} = 6 \times 10^{-4}$$

$$\therefore \quad M = \frac{0.083 \times 300}{6 \times 10^{-4}} = \frac{830 \times 300}{6}$$

$$= 41{,}500 \text{ gm/mole}$$

Q4 (4)

$\pi = iCRT$

$\pi \propto iC$

A, B, D and E have same value of osmatic pressure.

Q5 (2)

B and D options are correct

Q6 (13)

Let a mole $Pb(NO_3)_2$ be added

$Pb(NO_3)_2 \rightarrow Pb^{2+} + 2NO_3^-$

a a 2a

$\Delta T_b = 0.15 = 0.5\,[3a] \Rightarrow a = 0.1$

$$Pb^{2+}_{(aq)} + 2Cl^-_{(aq)} \rightarrow PbCl_2(s)$$

$t = 0$ 0.1 0.2

$t = \infty$ $(0.1 - x)$ $(0.2 - 2x)$

In final solution

$$\Delta T_f = 0.8 = 1.8\left[\frac{0.3 - 3x + 0.2 + 0.2}{1}\right]$$

$$\Rightarrow x = \frac{2.3}{27}$$

$$\Rightarrow K_{sp} = \left(0.1 - \frac{2.3}{27}\right)\left(0.2 - \frac{4.6}{27}\right)^2 = 13 \times 10^{-6}$$

Q7 (1)

(A) van't Hoff factor, i

$$i = \frac{\text{Normal molar mass}}{\text{Abnormal molar mass}}$$

(B) k_f = Cryoscopic constant

(C) Solutions with same osmotic pressure are known as isotonic solutions.

(D) Solutions with same composition of vapour over them are called Azeotrope.

Q8 (2)

A. Osmosis	III
B. Reverse osmosis	I
C. Electro osmosis	IV
D. Electrophoresis	II

Q9 (100g)

$$\Delta T_b = 373.52 - 373$$

$$= 0.52$$

$$\Delta T_b = Kb \cdot m$$

$$0.52 = 0.52 \times \frac{2}{\text{Molar Mass}} \times \frac{1}{20 \times 10^{-3}}$$

$$\text{Molar Mass} = 100 \text{g/mol}$$

Q10 (1362)

$$\text{Mole of } CO_2 = 0.2\ M \times (300 \times 10^{-3})\ L$$
$$= 0.06 \text{ Mole}$$
$$\text{Volume of } 0.06 \text{ mole } CO_2 \text{ at S.T.P}$$
$$= 0.06 \times 22.7$$
$$= 1.362\ L$$

Q11 (243)

$$\Delta T_f = i.K_f.m$$
$$\Rightarrow \Delta T_f = 2.67 \times 1.8 \times \frac{38}{98} \times \frac{1000}{62}$$
$$\Rightarrow \Delta T_f = 30.05$$

Q12 (555)

$$P_X = \chi_X P_T$$
$$= \frac{\frac{0.6}{20}}{\frac{0.6}{20} + \frac{0.45}{45}} \times 740$$
$$P_X = 555 \text{ mm Hg}$$

Q13 (62250)

: $\pi = CRT$

$$\frac{400Pa}{10^5} = \frac{\frac{2.5g}{M_o}}{250/1000L} \times 0.83 \frac{L-bar}{K.mol} \times 300K$$

$$M_o = 62250$$

Q14 (4)

(A) $\Delta T_b \propto i \times c$

(B) Azeotropic mixtures have same composition in both liquid and vapour phase.

(C) Osmosis always takes place from hypotonic to hypertonic solution.

(D) $M = \frac{30 \times 10 \times 1.26}{98} \approx 4.09\,M$

(E) When KI solutions is added to $AgNO_3$ solution, positively charged solution results due to adsorption of Ag^+ ions from dispersion medium

AgI / Ag^+

Positively charged

Q15 (372)

$$i = 1 + (n-1)\alpha$$

$$(i = 1 + 0.2\,(2-1) = 1.2$$

$$\Delta T_f = i\,K_f m$$

$$\Delta T_f = 1.2 \times 1.86 \times \frac{5 \times 1000}{60 \times 500}$$

$$\Delta t_f = 3.72$$

$$\Delta T_f = 372 \times 10^{-2}$$