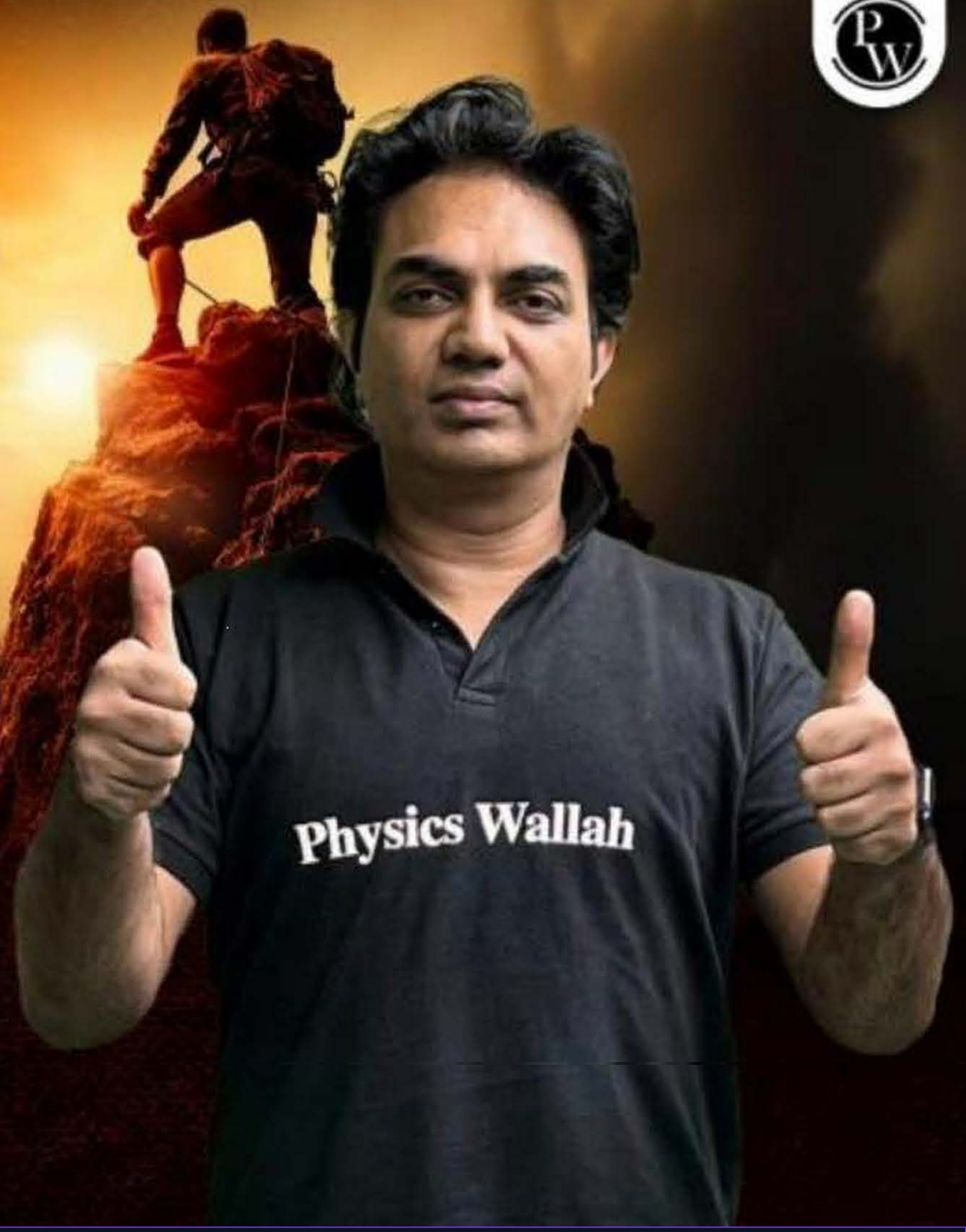
PRAYAS

JEE 2026

PHYSICAL CHEMISTRY

SOLUTIONS



FAISAL RAZAQ

Topics to be covered

ATDB.uno

Home Work Discussion

NCERT

(1) The boiling point of benzene is 353.23 K. When 1.8 g of a non-volatile solute was dissolved in 90 g of benzene, the boiling point is raised to 354.11 K. Calculate the molar mass of solute. ($K_b = 2.53\ K\ Kg\ mol^{-1}$)

$NH_2CONH_2 = i = 1$

$C_6H_{12}O_6 = i = 1$

$C_{12}H_{22}O_{11} = i = 1$

$\Delta T_b = (354.11 - 353.23)$

$\Delta T_b = i K_b m = K_b m = 2.53 \times \left(\frac{1.8/M}{90/1000}\right)$

$M = ?$

Question Boiling point of water at 750 mm Hg is 99.63°C. How much sucrose should be added to 500 g of water such that it boils at 100°C? ($K_b = 0.52$) (121.6 g)

(2)

Mains-2026

$99.63° \longrightarrow 100°C$

$\Delta T_b = K_b \cdot m$

$\Delta T_b = 0.37$

$K_b = 0.52$

$0.37 = 0.52 \times \left(\frac{n \times 1000}{500}\right)$

$n_{sucrose} = 0.3557$

$W_{sucrose} = 0.3557 \times 342\ g$

$= 121.6\ g.$

Q. **06 Sept, 2020 (Shift-II)** (3)

$\frac{10}{100}$, $\frac{10}{200}$, $\frac{10}{10000}$

A set of solutions is prepared using 180 g of water as a solvent and 10 g of different non-volatile solutes A, B and C. The relative lowering of vapour pressure in the presence of the solutes are in the order [Given, molar mass of A = 100 g mol^{-1}; B = 200 g mol^{-1} ; C = 10,000 g mol^{-1}]

(C)

$$\frac{p^0 - p_s}{p^0} = \frac{n_{solute}}{n_{solute} + n_{solvent}} = RLVP$$

RLVP ↑ molar wt of solute ↓

A. A > C > B

B. C > B > A

C. A > B > C ✓

D. B > C > A

Q. **27 July, 2022 (Shift-I)** (4)

Boiling point of a 2% aqueous solution of a non-volatile solute A is equal to the boiling point of 8% aqueous of a non-volatile solute B. The relation between molecular weights of A and B is

(A) $M_A = 4M_B$

(B) $M_B = 4M_A$

(C) $M_A = 8M_B$

(D) $M_B = 8M_A$

2 gm solute$_A$ in 100 gm solution

8 gm solute$_B$ in 100 gm solution

$$(\Delta T_b)_A = (\Delta T_b)_B$$

$$K_b\left(\frac{2/M_A}{98/1000}\right) = K_b\left(\frac{8/M_B}{92/1000}\right)$$

$$\simeq \frac{2}{M_A} = \frac{8}{M_B}$$

$$M_A : M_B = 1 : 4$$

Question

(5)

Elevation in boiling point was 0.52°C when 6g of a compound X was dissolved in 100g of water. Molecular weight of X is : (K_b for water = 0.52 K mol^{-1})

(a) 120 (b) 60 (c) 100 (d) 342

$$0.52 = K_b m = 0.52 \times \frac{6/M}{100/1000}$$

$$M = 60\ g/mol$$

Question 6

At 100°C the vapour pressure of a solution of 6.5g of a solute in 100g water is 732 mm. If $K_b = 0.52°C\ m^{-1}$, the boiling point of this solution will be

(a) 101°C (b) 100°C (c) 102°C (d) 103°C

$$\frac{760-732}{732} = \frac{n_{solute}}{n_{solvent}} \quad \Big| \quad n_{solvent} = \frac{100}{18}\ mol$$

$$\left(\frac{28}{732} \times \frac{100}{18}\right) = n_{solute}$$

$$\Delta T_b = K_b\, m$$

$$\Delta T_b = 0.52 \times \left(\frac{\frac{28\times 100}{732\times 18}}{\frac{100}{1000}}\right)$$

$$= 1.105$$

Boiling point = 100 + 1.105 = 101.105°C

Question

(7) What will the concentration of sucrose solution which develops an osmotic pressure of 1·5 atm. ($T = 27^\circ C$)

$$\pi = 1{\cdot}5 \text{ atm} = iCRT \quad (i = 1)$$

$$C = \frac{\pi}{RT} = \frac{1{\cdot}5}{0{\cdot}0082 \times 300} \text{ M}$$

Question Calculate the osmotic pressure of these soln_

(8) i) 5% w/v glucose solution at 27°C.

$i = 1$

5 g glucose in 100 ml soln.

ii) 0·1 M urea solution at 300 K.

$i = 1$

i) $\pi = iCRT = CRT$

$$\pi = \left(\frac{5/180}{0.1}\right) \times 0.0821 \times 300 \text{ atm}$$

ii) $\pi = CRT = 0.1 \times 0.0821 \times 300$ atm

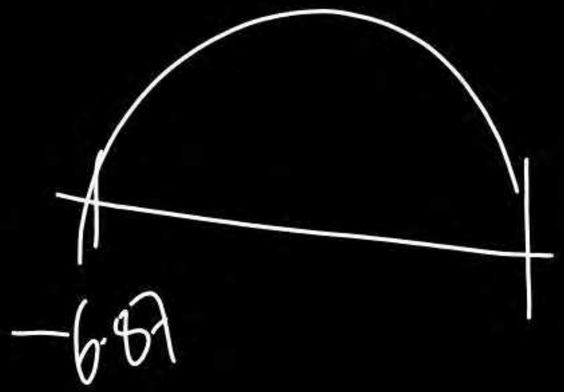
Question

What should be the F.P. of aqueous solution containing 17 g. of C_2H_5OH in 100 gm of water?

($K_f = 1.86$ K molal^{-1})

(-6.87 °C)

(9)



$$\Delta T_f = K_f \cdot m = 1.86 \times \frac{17/46}{100/1000}$$

$$= \frac{1.86 \times 10 \times 17}{46}$$

$$= 6.87$$

$(F.P)_{soln} = -6.87°C$

ΔT_f = F.P of solvent − F.P of solution = 0 − F.P of soln

Question

10

The relationship between osmotic pressure at 273 K when 10 g glucose ($i=1$) (P_1), 10 g urea ($i=1$) (P_2) and 10 g sucrose ($i=1$) (P_3) are dissolved in 250 ml water is

A) $P_1 > P_2 > P_3$

B) $P_3 > P_1 > P_2$

C) $P_2 > P_1 > P_3$

D) $P_2 > P_3 > P_1$

$\pi = iCRT$

$C \uparrow \quad \pi \uparrow$

$M_{sucrose} = 342$

$M_{glucose} = 180$

$M_{urea} = 60$

$$\text{Conc} = \frac{\text{mol of solute}}{\text{Vol of soln}}$$

(C)

Question

11

A solution of urea in water has boiling point of 100.15°C. Calculate the freezing point of the same solution. K_f and K_b for water are 1.87 K Kg mol^{-1} and 0.52 K Kg mol^{-1} respectively.

(−0.54°C)

Question

(12)

A solution contains 62 gm ethylene glycol ($CH_2OH - CH_2OH$) in 250 gm H_2O is cooled upto $-10^\circ C$. If $K_f = 1.86\ K\ Kg\ mol^{-1}$, then amount of water (in gm) separated as ice is –

[JEE-Mains 2019]

A) 32

B) 48

C) 64

D) 16

Question

13

Calculate the amount of ice that will separate out on cooling a solution containing 50 g of ethylene glycol in 200 g of water to -9.3^0C .
(K_f of water is 1.86 K mol^{-1} Kg)

Question

14

The vapour pressure of a solution of a non volatile electrolyte B in a solvent A is 95% of the vapour pressure of the solvent at the same temperature . If the molecular weight of the solvent is 0.3 times the molecular weight of solute, the weight ratio of the solvent and solute is

(a) 0.15 (b) 5.7 (c) 0.2 (d) 4.0

Q. 10 April, 2019 (Shift-II)

15

1g of non-volatile non-electrolyte solute is dissolved in 100g of two different solvents A and B whose ebulliopscopic constant are in the ratio of 1 : 5. The ratio of the elevation in their boiling points, $\frac{\Delta T_b(A)}{\Delta T_b(B)}$ is :

(A) 5 : 1

(B) 10 : 1

(C) 1 : 5

(D) 1 : 0.2

Q. **27 July, 2022 (Shift-II)** 16

When a certain amount of solid A is dissolved in 100 g of water at 25°C to make a dilute solution, the vapour pressure of the solution is reduced to one-half of that of pure water. The vapour pressure of pure water is 23.76 mmHg. The number of moles of solute A added is _____. (Nearest Integer)

6 moles

Q. **06 Sept, 2020 (Shift-II)**

17

When 3.0 g of a substance 'X' is dissolved in 100g of CCl_4, it raises the boiling point by 0.60 K. The molar mass of the substance 'X' is _____ g mol^{-1}. (Nearest Integer)
[Given : K_b for CCl_4 is 5.0 K kg mol^{-1}]

Q. **08 April, 2023 (Shift-II)** 18

If the boiling points of two solvents X and Y (having same molecular weights) are in the ratio 2 : 1 and their enthalpy of vaporization are in the ratio 1 : 2, then the boiling point elevation constant of X is 'm' times the boiling point elevation constant of Y. The value of m is _____ (Nearest Integer)

i) $\Delta T_b = i\, K_b \cdot m$

ii) $\Delta T_f = i\, K_f \cdot m$

iii) $\pi = i\, C R T$

iv) $RLVP = X_{solute} = \dfrac{i\, n_{solute}}{i\, n_{solute} + n_{solvent}} \simeq \dfrac{i\, n_{solute}}{n_{solvent}}$

v) $\dfrac{M_{cal}}{M_{obs}} = i$

Question

The Van't Hoff factor for a dilute aqueous solution of glucose is

(19)

A) Zero

B) 1.0

C) 1.5

D) 2.0

$C_6H_{12}O_6$ (glucose), $C_{12}H_{22}O_{11}$ (sugar), $NH_2-\overset{\overset{O}{\|}}{C}-NH_2$ (urea)

$i = 1$ $\quad i = 1$ $\quad i = 1$

$$\text{obs CP} = \text{th CP}$$

Question Calculate the van't Hoff factor for AB_2 if degree of dissociation is 0·3.

(20)

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

$$AB_2 \longrightarrow A + 2B$$

$(n = 3)$

Jitne logo mei toota

$$i = 1 + (3-1)\,0.3$$

$$i = 1.6$$

Question If d.o.d and Van't Hoff factor of AB_n is 0.4 and 2.2 respectively then 'n' is –

Jee main 2020

A) 1

B) 2

C) 4

D) 3

$\alpha = 0.4$

$i = 2.2$

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

$2.2 = 1 + (n-1)0.4$

$n = 4$

$A + nB$

$n+1$

Question

21

Maximum freezing point (ΔT_f minimum) for the aqueous solution -

A) 0.01 M $K_4[Fe(CN)_6]$

B) 0.01 M glucose

C) 0.01 M NaCl

D) 0.01 M $CaCl_2$

KB
f.p max ka matlab hai ΔT_f minimum.

KB
b.p max ka matlab hai ΔT_b maximum.

Q. **11 April, 2023 (Shift-I)** 23

0.004 M K_2SO_4 solution is isotonic with 0.01 M glucose solution. Percentage dissociation of K_2SO_4 is _____ (Nearest Integer)

Question

24

The observed and normal molar masses of compound MX_2 are 65.6 and 164 respectively. The Percentage d.o.d of MX_2 is ____ % (Nearest integer)

[JEE Mains 2025]

Question

Maximum freezing point depression for same concentrated Soln

25

A) solute = NaCl ($\alpha = 0.9$), solvent ($K_f = 0.3$ K Kg mol^{-1})

B) solute = K_2SO_4 ($\alpha = 0.7$); solvent ($K_f = 0.3$ K Kg mol^{-1})

C) Solute = $CaCl_2$ ($\alpha = 0.8$); Solvent ($K_f = 0.2$ K Kg mol^{-1})

4) solute = urea ($\alpha = 0$); Solvent ($K_f = 0.4$ K Kg mol^{-1})

Question

Maximum boiling point will be for the solution.

26

A) 0·1 m NaCl

B) 0·1 m $Al_2(SO_4)_3$

C) 0·1 m urea

D) 0·1 m K_2SO_4

Question

Molal elevation constant for water is 0·52 K/m.

0·1 molal solution of NaCl will boil at ____ °C.

27

(100·104°C)

Question

Maximum Boiling point for same concentrated solutions

28

solute = NaCl ; solvent ($K_b = 2.0\ K\ Kg\ mol^{-1}$)

B) solute = K_2SO_4 ; solvent ($K_b = 1.5\ K\ Kg\ mol^{-1}$)

C) solute = $Al_2(SO_4)_3$; Solvent ($K_b = 0.3\ K\ Kg\ mol^{-1}$)

D) Solute = urea ; Solvent ($K_b = 0.5\ K\ Kg\ mol^{-1}$)

Question In which of the given cases, Van't Hoff Factor are equal?

29

(a) KCl, 50% ionised

(b) K_2SO_4, 40% ionised

(c) $FeCl_3$, 30% ionised

(d) $SnCl_4$, 20% ionised

(b, d)

Question 5% solution of anhydrous $CaCl_2$ at 0°C developed 15 atm osmotic pressure. What is the degree of dissociation of $CaCl_2$?

30

(24.33%)

Question

(31) Molal depression constant for the solvent is 4 K kg mol^{-1}. The depression in freezing point of the solvent for 0.03 mol/kg solution of K_2SO_4 is (assuming complete dissociation).

A) 0.12 K

B) 0.36 K

C) 0.18 K

D) 0.24 K

Question

32

The relationship between the values of osmotic pressure of 0.1M solution of KNO_3 (P_1) and CH_3COOH (P_2) is

(A) $P_1 > P_2$

(B) $P_2 > P_1$

(C) $P_1 = P_2$

(D) $P_1 / (P_1 + P_2) = P_2/(P_1 + P_2)$

Question

33

find K_a, the ionization constant of a monobasic acid HA if a 0.025 molal aqueous solution of acid freezes at $-0.060^\circ C$ ($K_f = 1.86\ K\ Kg\ mol^{-1}$ and molality = Molarity)

Q. **28 July, 2022 (Shift-I)**

34

150 g of acetic acid contaminated with 10.2 g ascorbic acid ($C_6H_8O_6$) to lower down its freezing point by $(x \times 10^{-1})$°C. The value of x is _____. (Nearest Integer)
(Given $K_f = 3.9$ K mol^{-1}; molar mass of ascorbic acid = 176 g mol^{-1})

15

Question

(33)

19.5 g CH_2FCOOH is dissolved in 500g water. The depression in freezing point of water observed is 1.0°C. Calculate the Vant Hoff Factor and dissociation constant (K_a) of CH_2FCOOH. $k_f(H_2O) = 1.86\ K\ kg\ mol^{-1}$.

Q. **26 Feb, 2021 (Shift-II)**

36

When 12.2 g of benzoic acid is dissolved in 100g of water, the freezing point of solution was found to be $-0.93°C$ $[K_f(H_2O) = 1.86\ K\ kg\ mol^{-1}]$. The number (n) of benzoic acid molecules associated (assuming 100% association) is _____.

$n = 2$

Question

37

The K_{sp} of sparingly salt XY_2 is 3.56×10^{-5} mol/L and at 30°C, the vapour pressure of its saturated solution in water is 31.78 mm Hg. Calculate the enthalpy change for the reaction $XY_{2(s)} \rightleftharpoons X^{2+}_{(aq)} + 2Y^{-}_{(aq)}$.

(vapour pressure for pure water = 31.82 mm Hg)

(52.5 kJ/mol)

Question

The osmotic pressure exerted by a solution prepared by dissolving 2.0 g of protein of molar mass 60 kg mol^{-1} in 200 ml of water at 27°C is ____ Pa. ($R = 0.083\ L\ bar\ mol^{-1}\ K^{-1}$)