



PRAAYAS

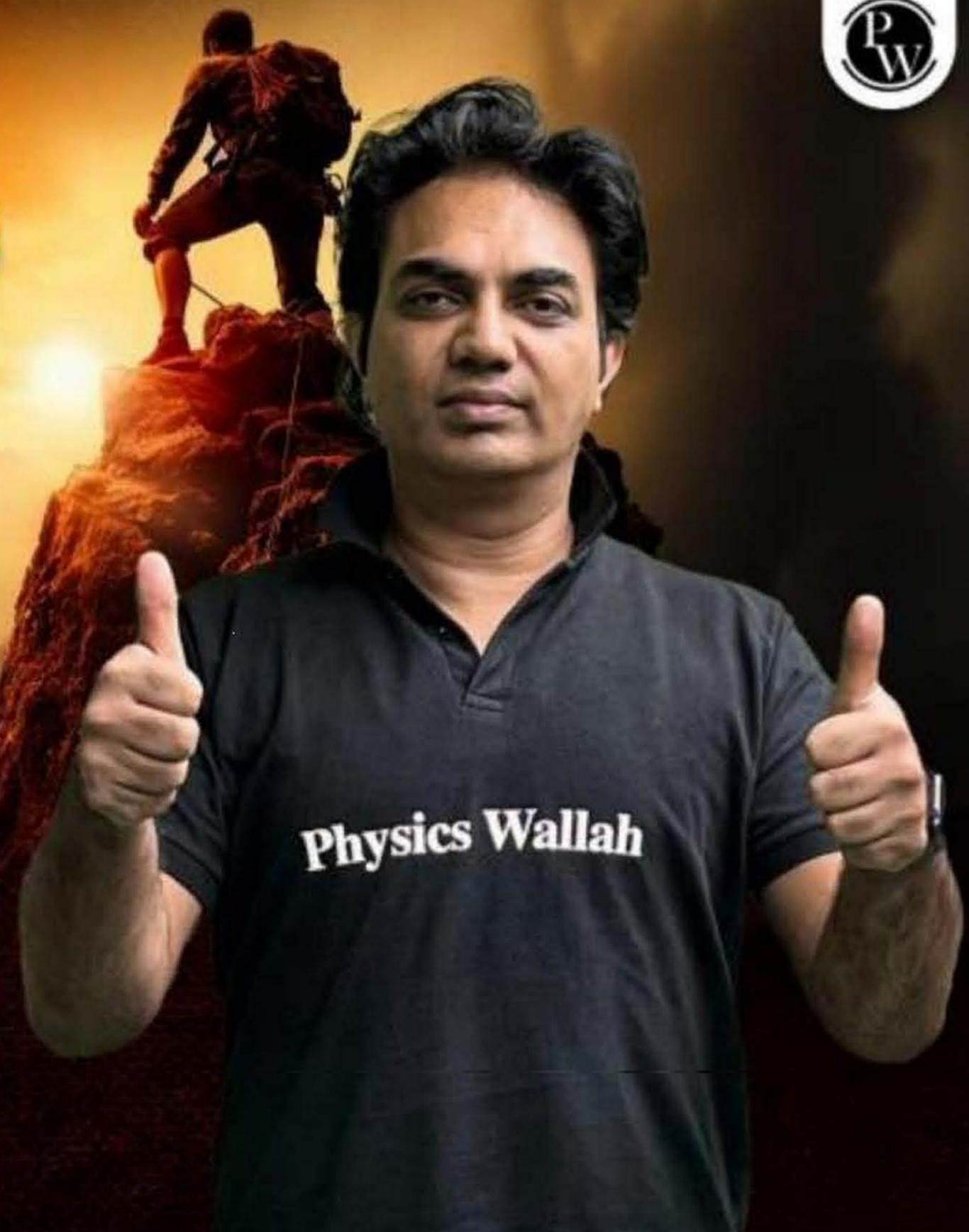
JEE 2026

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PHYSICAL CHEMISTRY

SOLUTIONS

FAISAL RAZAQ





Topics to be covered



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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. ($K_b = 2.53 \text{ K Kg mol}^{-1}$)



$$\Delta T_b = (354.11 - 353.23)$$

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

$$M = ?$$

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

$$99.63^\circ \rightarrow 100^\circ\text{C}$$

$$\Delta T_b = K_b \cdot m$$

$$\Delta T_b = 0.37$$

$$K_b = 0.52$$

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

$$n_{\text{sucrose}} = 0.3557$$

$$W_{\text{sucrose}} = 0.3557 \times 342\text{g}$$
$$= 121.6\text{g}$$



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]

A A > C > B

B C > B > A

C A > B > C

D B > C > A

$$\frac{p^0 - p_s}{p^0} = \frac{n_{\text{solute}}}{n_{\text{solute}} + n_{\text{solvent}}} = \text{RLVP} \quad (C)$$

RLVP \uparrow molar wt of solute \downarrow

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

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

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

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

$M_A : M_B = 1 : 4$

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

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

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$$M = 60 \text{ g/mol}$$

Question

6



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

(a) 101°C

(b) 100°C

(c) 102°C

(d) 103°C

$$\frac{760 - 732}{732} = \frac{n_{\text{solute}}}{n_{\text{solvent}}}$$

$$n_{\text{solvent}} = \frac{100}{18} \text{ mol}$$

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

✓✓

$$\Delta T_b = K_b \cdot m$$

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

$$= 1.105$$

$$\text{Boiling point} = 100 + 1.105 = 101.105^\circ\text{C}$$

Question What will the concentration of sucrose solution



7

which develops an osmotic pressure of 1.5 atm.

($T = 27^{\circ}\text{C}$)

$$\pi = 1.5 \text{ atm} = i c R T \quad (i = 1)$$

$$c = \frac{\pi}{R T} = \frac{1.5}{0.082 \times 300} \text{ M}$$

Question Calculate the osmotic pressure of these solⁿ -



8

i) 5% w/v glucose solution at 27°C.
 $i = 1$

5g glucose in
100 ml solⁿ.

ii) 0.1 M urea solution at 300K.
 $i = 1$

i) $\pi = iCRT = CRT$ **ATDB.uno**

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

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

Question

9

What should be the F.p. of aqueous solution containing
17 g. of C₂H₅OH in 100 gm of water?



(K_f = 1.86 K molal⁻¹)

(-6.87 °C)

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

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

$$= 6.87$$

$$(F.P)_{sol^n} = -6.87^\circ C$$



$$\Delta T_f = F.P \text{ of solvent} - F.P \text{ of solution} = 0 - F.P \text{ of sol}^n$$

Question

The relationship between osmotic pressure at 273 K



10

when 10g glucose (P_1), 10g urea (P_2) and 10g sucrose (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) $P_2 > P_3 > P_1$

$$\pi = i C R T$$

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$$\text{conc} = \frac{\text{mol of solute}}{\text{vol of soln}}$$

$M_{\text{sucrose}} = 342$

$M_{\text{glucose}} = 180$

$M_{\text{urea}} = 60$

(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 $1.87 \text{ K Kg mol}^{-1}$ and $0.52 \text{ K Kg mol}^{-1}$ respectively.

(-0.54°C)

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Question

12

A solution contains 62 gm ethylene glycol ($\text{CH}_2\text{OH}-\text{CH}_2\text{OH}$)
in 250 gm H_2O is cooled upto -10°C . If $K_f = 1.86 \text{ K Kg mol}^{-1}$,
then amount of water (in gm) separated as ice is -

[JEE-Mains 2019]

A) 32

B) 48

C) 64

D) 16

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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°C .
(K_f of water is $1.86 \text{ K mol}^{-1} \text{ Kg}$)

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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

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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 ebullioscopic constants 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

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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

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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 $5.0 \text{ K kg mol}^{-1}$]

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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)

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

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

$$iii) \pi = i CRT$$

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$$iv) \text{RLVP} = X_{\text{solute}} = \frac{i n_{\text{solute}}}{i n_{\text{solute}} + n_{\text{solvent}}} \approx \frac{i n_{\text{solute}}}{n_{\text{solvent}}}$$

$$v) \frac{M_{\text{cal}}}{M_{\text{obs}}} = i$$

Question

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



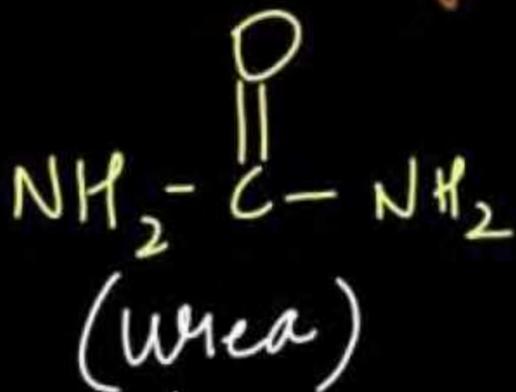
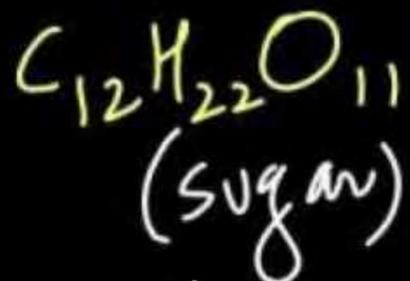
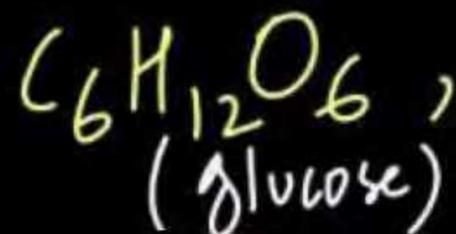
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A) zero

B) 1.0

C) 1.5

D) 2.0



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

Question

Calculate the van't Hoff factor for AB_2 if
degree of dissociation is 0.3.



20

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

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

$$i = 1.6$$



$$(n = 3)$$

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Question

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



Answer
2020

A) 1

B) 2

C) 4

D) 3

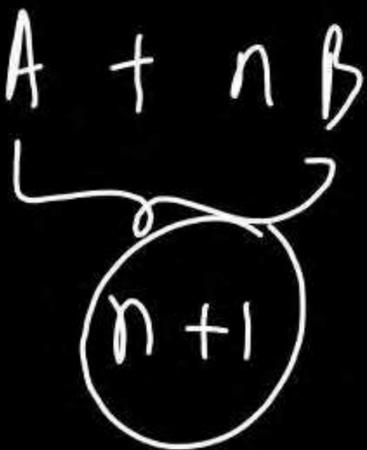
$$\alpha = 0.4$$

$$i = 2.2$$

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

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

$$n = 4$$



Question

21

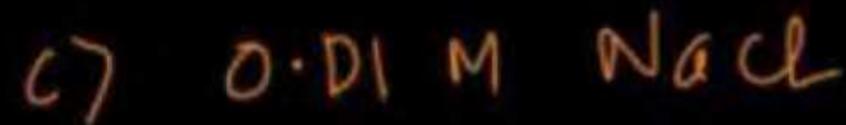
Maximum ^{ΔT_f minimum} freezing point for the aqueous solution -

K_B

F.P max ka matlab hai ΔT_f minimum.

K_B

B.P max ka matlab hai ΔT_b maximum.



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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)

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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]

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(75)

Question

Maximum freezing point^{depression} for same concentrated solⁿ -



25

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

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

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

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

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

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Question

Molal elevation constant for water is 0.52 K/m .



0.1 molal solution of NaCl will boil at _____ $^{\circ}\text{C}$.

27

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$(100.104^{\circ}\text{C})$

Question



Maximum Boiling point for same concentrated solution

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

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

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

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D) solute = urea ; solvent ($K_b = 0.5 \text{ K Kg mol}^{-1}$)

28

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

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(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



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(24.33%)

Question

Molal depression constant for the solvent is 4 K kg mol^{-1} .



31

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

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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) $P_1 > P_2$

(C) $P_1 = P_2$

(B) $P_2 > P_1$

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

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Question

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



33

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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 $(x \times 10^{-1})^\circ C$. The value of x is _____. (Nearest Integer)
(Given $K_f = 3.9 \text{ K mol}^{-1}$; molar mass of ascorbic acid = 176 g mol^{-1})

15

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Question

19.5 g CH_2FCOOH is dissolved in 500g water.



35

The depression in freezing point of water observed is 1.0°C . Calculate the Vanit Hoff factor and dissociation constant (K_a) of CH_2FCOOH . $k_f(\text{H}_2\text{O}) = 1.86 \text{ K kg mol}^{-1}$.

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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 [$K_f(\text{H}_2\text{O}) = 1.86 \text{ K kg mol}^{-1}$]. The number (n) of benzoic acid molecules associated (assuming 100% association) is _____.

$$n = 2$$

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Question The K_{sp} of sparingly salt XY_2 is $3.56 \times 10^{-5} \text{ mol/L}$ 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 $XY_2(s) \rightleftharpoons X_{(aq)}^{2+} + 2Y_{(aq)}^-$.
(vapour pressure for pure water = 31.82 mm Hg)



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(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. ($R = 0.083 \text{ L bar mol}^{-1} \text{ K}^{-1}$)

270



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(415)



THANK

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YOU