Solutions JEE Main PYQ - 2

Total Time: 25 Minute **Total Marks:** 40

Instructions

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1. Test will auto submit when the Time is up.
2. The Test comprises of multiple choice questions (MCQ) with one or more correct answers.
3. The clock in the top right corner will display the remaining time available for you to complete the examination.

Navigating & Answering a Question

1. The answer will be saved automatically upon clicking on an option amongst the given choices of answer.
2. To deselect your chosen answer, click on the clear response button.
3. The marking scheme will be displayed for each question on the top right corner of the test window.

Solutions

1. 1 g 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: **(+4, -1)**

[27-Jun-2022-Shift-1]

a. 5:01

b. 10:01

c. 1:05

d. 01:00.2

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2. $12\,g$ of a nonvolatile solute dissolved in $108\,g$ of water produces the relative lowering of vapor pressure of 0.1.The molecular mass of the solute is : **(+4, -1)**

[Online April 9, 2013]

a. 80

b. 60

c. 20

d. 40

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3. The mass of a non-volatile, non-electrolyte solute (molar mass $= 50\,g\,mol^{-1}$) needed to be dissolved in $114\,g$ octane to reduce its vapour pressure to 75%, is : **(+4, -1)**

a. 37.5 g

b. 75 g

c. 150 g

d. 50 g

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4. A solution is prepared by dissolving $0.6\,g$ of urea (molar mass = $60\,g\,mol^{-1}$) and $1.8\,g$ of glucose (molar mass = $180\,g$ mol-1) in $100\,mL$ of water at $27^{\circ}C$. **(+4, -1)**

The osmotic pressure of the solution is : $(R = 0.08206\ L\ atm\ K^{-1}\ mol^{-1})$

[April 12, 2019 (II)]

a. 4.92 atm

b. 1.64 atm

c. 2.46 atm

d. 8.2 atm

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5. An aqueous solution of a salt MX_2 at certain temperature has a van?t Hoff factor of 2. The degree of dissociation for this solution of the salt is : **(+4, -1)**

[Online April 10,2016]

a. 0.33

b. 0.5

c. 0.67

d. 0.8

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6. Determination of the molar mass of acetic acid in benzene using freezing point depression is affected by : **(+4, -1)**

[Online April 11, 2015]

a. dissociation

b. association

c. partial ionization

d. complex formation

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7. For 1 molal aqueous solution of the following compounds, which one will show the highest freezing point ? **(+4, -1)**

[25 Feb 2021 Shift 1]

a. $[Co(H_2O)6]Cl_3$

b. $[Co(H_2O)_5Cl]Cl_2.H_2O$

c. $[Co(H_2O)_4Cl_2]Cl.{}_2H_2O$

d. $[Co(H_2O)_3Cl_3].{}_3H_2O$

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8. Freezing point of a 4% aqueous solution of X is equal to freezing point of 12% aqueous solution of Y. If molecular weight of X is A, then molecular weight of Y is : **(+4, -1)**

[Jan 12,2019 (I)]

a. A

b. 3A

c. 4A

d. 2A

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9. A solution containing $2\,g$ of a non-volatile solute in $20\,g$ of water boils at $373.52K$. The molecular mass of the solute is _____ $g\,mol^{-1}$ (Nearest integer). Given, water boils at $373\,K$, K_b for water $= 0.52\,K\,kg\,mol^{-1}$ **(+4, -1)**

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10. Some amount of dichloromethane (CH_2Cl_2) is added to $671.141\,mL$ of chloroform $(CHCl_3)$ to prepare $2.6 \times 10^{-3}M$ solution of CH_2Cl_2 (DCM) The concentration of DCM is _____ ppm (by mass) Given: atomic mass : $C = 12$ $H = 1$ $Cl = 35.5$ density of $CHCl_3 = 1.49\,g\,cm^{-3}$ **(+4, -1)**

Answers

1. **Answer: c**

Explanation:

$$\Delta T_b = K_b \times m$$
$$\therefore \frac{\Delta T_{b(A)}}{\Delta T_{b(B)}} = \frac{K_{b(A)}}{K_{b(B)}} as\ m_A = m_B$$
$$\therefore \frac{\Delta T_{b(A)}}{\Delta T_{b(B)}} = \frac{1}{5}$$

Concepts:

1. Solutions:

A solution is a homogeneous mixture of two or more components in which the particle size is smaller than 1 nm.

For example, salt and sugar is a good illustration of a solution. A solution can be categorized into several components.

Types of Solutions:

The solutions can be classified into three types:

- **Solid Solutions -** In these solutions, the **solvent** is in a Solid-state.
- **Liquid Solutions-** In these solutions, the solvent is in a Liquid state.
- **Gaseous Solutions -** In these solutions, the solvent is in a Gaseous state.

On the basis of the amount of solute dissolved in a solvent, solutions are divided into the following types:

1. **Unsaturated Solution-** A solution in which more solute can be dissolved without raising the temperature of the solution is known as an unsaturated solution.
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2. **Answer: c**

Explanation:

$$\frac{P^o - P_s}{P^o} = \frac{n}{N} = \frac{w}{m} \times \frac{M}{W}$$
$$0.1 = \frac{12}{m} \times \frac{18}{108}$$
$$m = \frac{12 \times 18}{0.1 \times 108} = 20$$

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3. **Answer: c**

Explanation:

Relative lowering of vapour pressure is given by

$$\frac{\Delta p}{p} = x_{\text{solute}} = \frac{w_B/M_B}{w_A/M_A + w_a/M_B}$$

where w_A and w_B are the masses of solvent and solute taken and M_A and M_B are the molar masses of the solvent and solute.

$$\frac{75}{100} = \frac{w_B/50}{w_B/50 + 114/114}$$
$$0.75 = \frac{w_B/50}{w_B/50+1} \Rightarrow w_B = 150\,g$$

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4. Answer: a

Explanation:

$$\Pi = \frac{\left(\frac{0.6}{60} + \frac{1.8}{180}\right)}{0.1} \times 0.08206 \times 30$$
$$\Pi = 4.9236\,\text{atm}$$

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5. Answer: b

Explanation:

$\alpha = \frac{i-1}{k-1}$
$= \frac{2-1}{3-1} = \frac{1}{2} = 50\%$

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6. **Answer: b**

Explanation:

Acetic acid in benzene dimerize as,

$2CH_3COOH \rightleftharpoons (CH_3COOH)_2$

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7. **Answer: d**

Explanation:

The solution which shows maximum freezing point must have minimum number of solute particles.

(1) $[Co(H_2O)_6]Cl_3 \rightarrow [Co(H_2O)_6]^{3+} + 3Cl^-, i = 4$

(2) $[Co(H_2O)_5 Cl]Cl_2 \cdot H_2O \rightarrow [Co(H_2O)_5 Cl]^{2+} + 2Cl^-, i = 3$

(3) $[Co(H_2O)_4 Cl_2]Cl \cdot 2H_2O \rightarrow [Co(H_2O)_4 Cl_2]^{+} + Cl, i = 2$

(4) $[Co(H_2O)_3 Cl_3] \cdot 3H_2O \rightarrow [Co(H_2O)_3 Cl_3], i = 1$

So, solution of 1 molal $[Co(H_2O)_3 Cl_3] \cdot 3H_2O$ will have minimum number of particles in aqueous state.

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8. Answer: b

Explanation:

For same freezing point, molality of both solution should be same.

$m_x = m_y$

$\frac{4\times1000}{96\times M_x} = \frac{12\times1000}{88\times M_y}$

or, $M_y = \frac{96\times12}{4\times88}M_x = 3.27A$

Closest option is 3A.

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9. **Answer: 100 - 100**

Explanation:

$\Delta T_b = 373.52 - 373 = 0.52$

$\Delta T_b = K_b \cdot m$

$So,\ 0.52 = 0.52 \times \frac{2}{Molar\ mass} \times 20 \times 10^{-31}$

$Molar\ mass = 100 g/mol.$

Therefore, The correct answer is 100.

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10. **Answer: 221 - 221**

Explanation:

The correct answer is 148ppm

$Molarity = \frac{mole}{volume}$

$2.6 \times 10^{-3} = \frac{x/85}{0.67141}$

$x = 0.148g$

conc. Fo DCM in ppm

$= \frac{0.148}{1.49 \times 671.141} \times 10^6$

=148ppm

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