Solutions JEE Main PYQ - 1

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. A solution of sodium sulfate contains $92\,g$ of Na^+ ions per kilogram of water. The molality of Na^+ ions in that solution in $mol\ kg^{-1}$ is: **(+4, −1)**

   a. 16   **[Jan 9, 2019(I)]**

   b. 8

   c. 4

   d. 12

2. The solubility of N_2 in water at 300 K and 500 torr partial pressure is 0.01 g L^{-1}. The solubility (in g L^{-1}) at 750 torr partial pressure is :   **(+4, −1)**

   a. 0.0075   **[Online April9, 2016]**

   b. 0.015

   c. 0.02

   d. 0.005

3. A graph of vap our pressure and temperature for three different liquids X, Y, and Z is shown below : The following inferences are made : (A) X has higher intermolecular interactions compared to Y. (B) X has lower intermolecular interactions compared to Y. (C) Z has lower intermolecular interactions compared to Y. The correct inference(s) is/are :   **(+4, −1)**

   a. (C)

   b. (A)

   c. (B)

   d. (A) and (C)

4. At $35°C$, the vapour pressure of CS_2 is 512 mm Hg and that of acetone is 344 mm Hg. A solution of CS_2, in acetone has a total vapour pressure of 600 mm Hg. The false statement amongst the following is :   **(+4, –1)**

   [Jan. 07,2020(I)]

   a. heat must be absorbed in order to produce the solution at $35°C$

   b. a mixture of 100 mL CS_2, and 100 mL acetone has a volume < 200 mL

   c. CS_2, and acetone are less attracted to each other than to themselves

   d. Raoult's law is not obeyed by this system

5. Two open beakers one containing a solvent and the other containing a mixture of that solvent with a non volatile solute are together sealed in a container. Over time: **(+4, –1)**

   [Jan. 07,2020 (II)]

   a. the volume of the solution and the solvent does not change

   b. the volume of the solution increases and the volume of the solvent decreases

   c. the volume of the solution decreases and the volume of the solvent increases

   d. the volume of the solution does not change and the volume of the solvent decreases

6. Which one of the following statements regarding Henry's law not correct ?   **(+4, –1)**

   a. The value of K_H increases with function of the nature of the gas

   b. Higher the value of K_H at a given pressure, higher is the solubility of the gas in the liquids.

   c. The partial of the gas in vapour phase is proportional to the mole fraction of the gas in the solution.

   d. Different gases have different K_H (Henry's law constant) values at the same temperature.

7. A solution at $20°C$ is composed of $1.5\,mol$ of benzene and $3.5\,mol$ of toluene. If the vapour pressure of pure benzene and pure toluene at this temperature are 74.7 torr and 22.3 torr, respectively, then the total vapour pressure of the solution and the benzene mole fraction in equilibrium with it will be, respectively : $(+4, -1)$

a. 35.0 torr and 0.480

b. 38.0 torr and 0.589

c. 30.5 torr and 0.389

d. 35.8 torr and 0.280

8. Choose the correct statement with respect to the vapour pressure of a liquid among the following : $(+4, -1)$

a. Increases linearly with increasing temperature

b. Increases non-linearly with increasing temperature

c. Decreases linearly with increasing temperature

d. Decreases non-linearly with increasing temperature

9. The density of $3M$ solution of $NaCl$ is $10\,g\,mL-1$ Molality of the solution is $_____ \times 10^{-2}m$ (Nearest integer) Given: Molar mass of Na and Cl is 23 and $355\,g\,mol^{-1}$ respectively $(+4, -1)$

10. 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 amu respectively [Given : Molal depression constant and density of water are $186\,K\,kg\,mol^{-1}$ and $1\,g\,cm^{-3}$ respectively $(+4, -1)$

Answers

1. **Answer: c**

Explanation:

$n_{Na^+} = \frac{92}{23} = 4$
So molality = 4

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.
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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.
2. Saturated Solution- A solution in which no solute can be dissolved after reaching a certain amount of temperature is known as an unsaturated saturated solution.
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2. **Answer: b**

Explanation:

Partial Pressure = Mole fraction ? solubility

$\frac{p_1}{p_2} = \frac{s_1}{s_2} \Rightarrow \frac{500}{0.01} = \frac{750}{x}$

$\therefore x = 0.015 \, g/L$

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3. **Answer: c**

Explanation:

Order of $B.P.$ is : $Z > Y > X$

Order of vapour pressure : $Z < Y < X$

order of intermolecular interaction : $Z > Y > X$.

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4. Answer: b

Explanation:

The vapour pressure of mixture (= 600 mm Hg) is greater than the individual vapour pressure of its constituents (Vapour pressure of $Cs_2 = 512$ mm Hg, acetone = 344 mm Hg). Hence, the solution formed shows positive deviation from Raoult's law.

$\Rightarrow$ $(1)\,\Delta_{sol}H > 0, (2)$ Raoult's law is not obeyed

$(3)\,\Delta_{sol}.Volume > 0$

$(4)\,Cs_2$ and Acetone are less attracted to each ether than to themselves.

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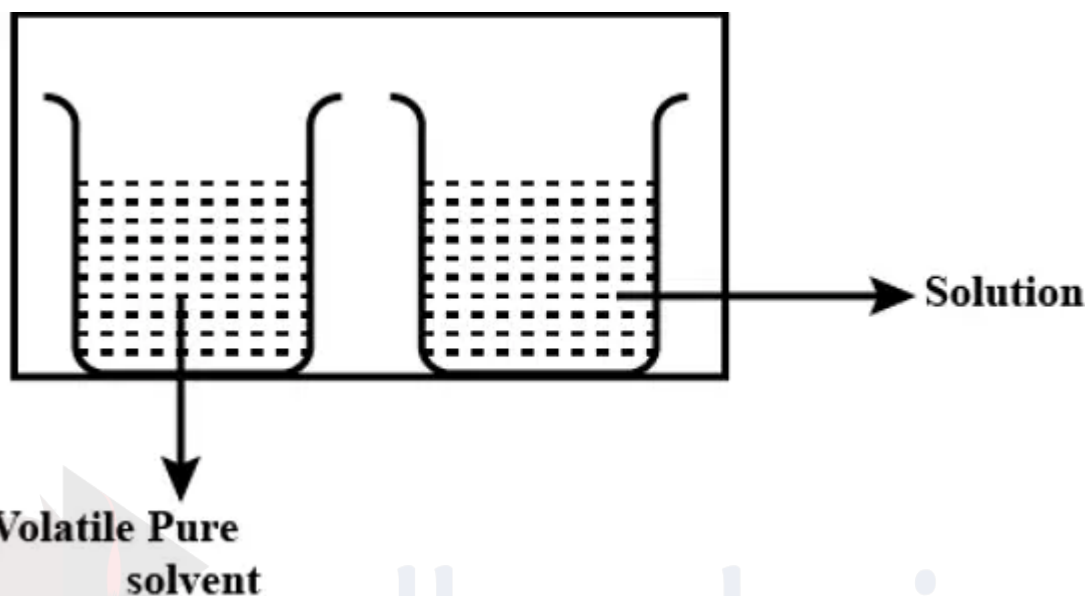
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5. **Answer: b**

Explanation:

As solvent is pure and volatile, so it will vapourise and increase vapour pressure till that vapour pressure will come in equilibrium so volume decrease.

As in solution, there is non-volatile solute, so it will not vapourise for vapour pressure to be in equilibrium solvent vapour will come towards the solution. So, the volume of solution increase.

So, the volume of the solution increases and the volume of the solvent decreases.

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6. **Answer: b**

Explanation:

Liquid solution

$P_{gas} = K_H \times X_{gas}$

More is K_H less is solubility, lesser solubility is at higher temperature. So more is temperature
more is K_H.

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7. **Answer: b**

Explanation:

$$P_{\text{mix}} = P_A^\circ \times A + P_B^\circ X_B = 74.7 \times \frac{1.5}{5} + 22.3 \times \frac{3.5}{5}$$
$$= 38. \text{ And } y_{\text{benzene}} = \frac{22.41}{38} = 0.589$$

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8. Answer: b

Explanation:

If we plot a graph between the vapour pressure and the temperature. We would get a curve that rises faster as T increases, giving a curved line.

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9. Answer: 364 – 364

Explanation:

The correct answer is 364

$$m = \frac{1000 \times M}{1000 \times d - M \times M.W \text{ of solute}}$$
$$= \frac{1000 \times 3}{1000 \times 1 - (3 \times 58.5)} = 3.64$$
$$= 364 \times 10^{-2}$$

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10. **Answer: 372 – 372**

Explanation:

The correct answer is 372.

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

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

$\Delta T_f = iK_fm$

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

$\Delta t_f = 3.72$

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

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