Solutions JEE Main PYQ - 3

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

Instructions

Instructions

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. How many grams of methyl alcohol should be added to 10 litre tank of water to prevent its freezing at $268\,K$? $(K_f\ for\ water\ is\ 1.86 K\ kg\ mol^{-1})$ **(+4, -1)**

[Online April 25, 2013]

a. 880.07 g

b. 899.04 g

c. 886.02 g

d. 868.06 g

---

2. K_2HgI_4 is 40% ionised in aqueous solution. The value of its van't Hoff factor (i) is : **(+4, -1)**

[Jan. 11, 2019 (II)]

a. 1.8

b. 2.2

c. 2

d. 1.6

---

3. Liquids A and B form an ideal solution in the entire composition range. At $350\,K$, the vapor pressures of pure A and pure B are 7×10^3 Pa and $12 \times 10^3\,Pa$, respectively. The composition of the vapor in equilibrium with a solution containing 40 mole percent of A at this temperature is : **(+4, -1)**

[Jan. 10,2019(I)]

a. $x_A = 0.37; x_B = 0.63$

b. $x_A = 0.28; x_B = 0.72$

c. $x_A = 0.76; x_B = 0.24$

d. $x_A = 0.4; x_B = 0.6$

---

4. Vapour pressure of pure benzene is 119 torr and that of toluene is 37.0 torr at the same temperature. Mole fraction of toluene in vapour phase which is in **(+4, -1)**

equilibrium with a solution of benzene and toluene having a mole fraction of toluene 0.50, will be :

[Online April 23, 2013]

a. 0.137

b. 0.237

c. 0.435

d. 0.205

---

5. What would be the molality of 20% (mass / mass) aqueous solution of KI? (molar mass of $KI = 166\, g\, mol^{-1}$) **(+4, -1)**

[April9, 2019 (II)]

a. 1.08

b. 1.48

c. 1.51

d. 1.35

---

6. Which of the following statements is false? **(+4, -1)**

a. Two different solutions of sucrose of same molality prepared in different solvents will have the same depression in freezing point.

b. The osmotic pressure of a solution is given by the equation $\pi = CRT$ (where C is the molarity of the solution).

c. Decreasing order of osmotic pressure for $0.01\, M$ aqueous solutions of barium chloride, potassium chloride, acetic acid and sucrose is $BaCl_2 > KCl > CH_3COOH >$ sucrose.

d. According to Raoult?? law, the vapour pressure exerted by a volatile component of a solution is directly proportional to its mole fraction in the solution.

---

7. A solution containing $62\,g$ ethylene glycol in $250\,g$ water is cooled to $-10^{\circ}C$. If K_f for water is $1.86\,K\,kg\,mol^{-1}$, the amount of water (in g) separated as ice is : **(+4, -1)**

[Jan. 9, 2019 (II)]

a. 32

b. 48

c. 16

d. 64

---

8. A solution of copper sulphate $(CuSO_4)$ is electrolysed for 10 minutes with a current of 1.5 amperes. The mass of copper deposited at the cathode (at. mass of $Cu = 63u$) is : **(+4, -1)**

a. 0.3892 g

b. 0.2938 g

c. 0.2398 g

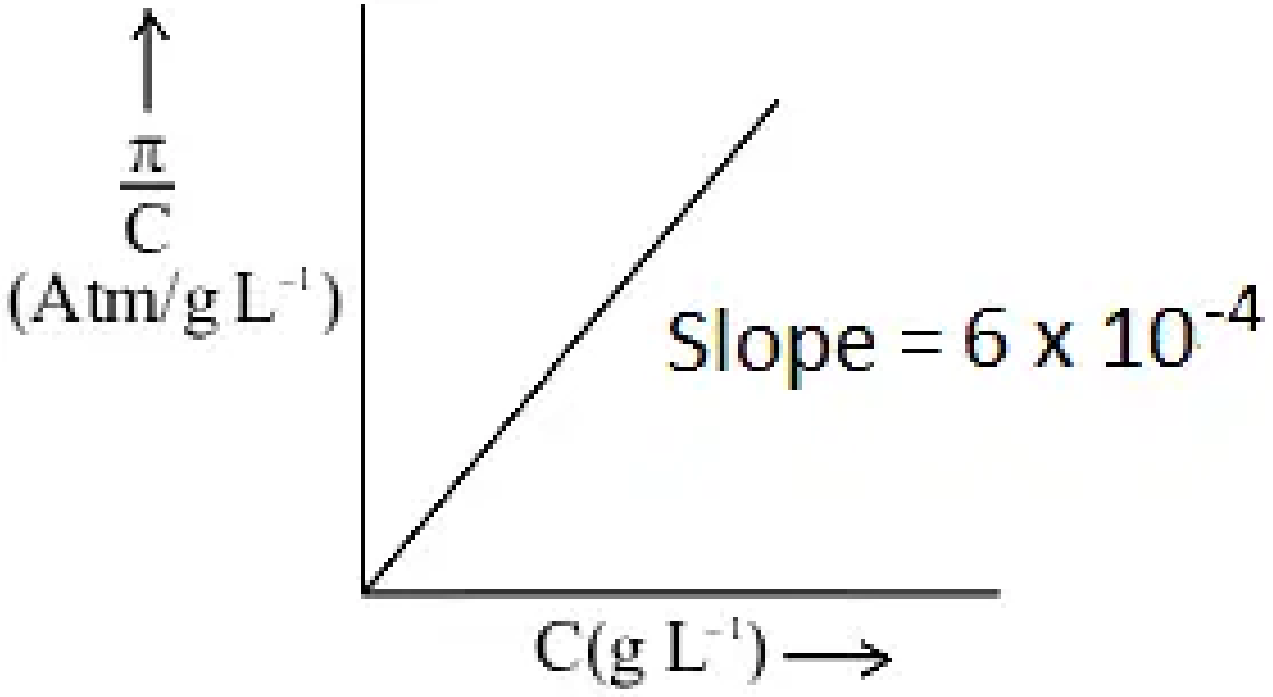
d. 0.3928 g

---

9. 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 $227\,L\,mol^{-1}$ **(+4, -1)**

---

10. The osmotic pressure of solutions of PVC in cyclohexanone at $300K$ are plotted on the graph The molar mass of PVC is ____$g\,mol^{-1}$ (Nearest integer) **(+4, -1)**



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

Answers

1. **Answer: d**

Explanation:

$\Delta T_f = K_f m$
where m = molality
273 - 268= 1.86 x $\frac{w}{M \times V}$
$5 = 1.86 \times \frac{w}{32 \times 10}$
$W = \frac{5 \times 32 \times 10}{1.86}$
$= 860.2 \approx 868.06g$

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.
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.
3. **Supersaturated Solution-** A solution that contains more solute than the maximum amount at a certain temperature is known as a supersaturated

solution.

---

2. **Answer: a**

Explanation:

For $K2[HgI4]$
$i = 1 + 0.4(3 - 1)$
$= 1.8$

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.
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.
3. **Supersaturated Solution-** A solution that contains more solute than the maximum amount at a certain temperature is known as a supersaturated solution.

3. **Answer: b**

Explanation:

$$y_A = \frac{P_A}{P_{Total}} = \frac{P_A^\circ x_A}{P_A^\circ x_A \times p_B^\circ x_B}$$
$$= \frac{7\times10^3\times0.4}{7\times10^3\times0.4+12\times10^3\times0.6}$$
$$= \frac{2.8}{10} = 0.28$$
$$y_B = 0.72$$

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.
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.
3. **Supersaturated Solution-** A solution that contains more solute than the maximum amount at a certain temperature is known as a supersaturated solution.

4. **Answer: b**

Explanation:

$P_A = P_A^0 \times x_A =$ total pressure $\times y_A$
$P_B = P_B^0 \times x_B =$ total pressure $\times y_B$
where x and y represents mole fraction in liquid and vapour phase respectively.
$\frac{P_B^0 x_B^0}{P_A^0 x_A} = \frac{y_B}{y_A}; \frac{P_B^0(1-x_A)}{P_A^0 x_A} = \frac{1-y_A}{y_A}$
on putting values $\frac{119(1-0.50)}{37\times 0.50} = \frac{1-y_A}{y_A}$
on solving $y_A = 0.237$

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.
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.
3. **Supersaturated Solution-** A solution that contains more solute than the maximum amount at a certain temperature is known as a supersaturated

solution.

---

5. **Answer: c**

Explanation:

$\frac{W}{W}\% = 20$
$100\,gm$ solution has $20\,gm\,KI$
$80\,gm$ solvent has $20\,gm\,KI$
$m = \frac{\frac{20}{166}}{\frac{80}{1000}} = \frac{20\times1000}{166\times80} = 1.506 \simeq 1.51\,mol/kg$

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.
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.
3. **Supersaturated Solution-** A solution that contains more solute than the maximum amount at a certain temperature is known as a supersaturated

solution.

---

6. **Answer: a**

Explanation:

The value of K_f depends upon the nature of the solvent. Thus, two different solutions of sucrose of same molality prepared in different solvents will have the different depression in freezing point.

So, the correct option is (A).

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.
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.
3. **Supersaturated Solution**- A solution that contains more solute than the maximum amount at a certain temperature is known as a supersaturated

solution.

---

7. **Answer: d**

Explanation:

$$\Delta T_f = k_f.m \ 10 = 1.86 \times \frac{62/62}{W_{kg}} \ W = 0.186 \ kg \ \Delta W = (250 - 186) = 64 \ gm$$

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.
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.
3. **Supersaturated Solution-** A solution that contains more solute than the maximum amount at a certain temperature is known as a supersaturated solution.

---

8. **Answer: b**

Explanation:

W= Zit where Z = Electrochemical equivalent E wt. of copper = $\frac{63}{2} = 31.5$ $Z = \frac{31.5}{96500}$ $W = Zit = \frac{31.5}{96500} \times 1.5 \times 10 \times 60 = 0.2938g$

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.
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.
3. **Supersaturated Solution-** A solution that contains more solute than the maximum amount at a certain temperature is known as a supersaturated solution.

---

9. **Answer: 1362 - 1362**

Explanation:

The correct answer is 1362.

Mole of $CO_2 = 0.2M \times \left(300 \times 10^{-3}\right) L = 0.06$ Mole

Volume of 0.06 mole CO_2 at S.T.P

$= 0.06 \times 22.7$

$= 1.362L$

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.

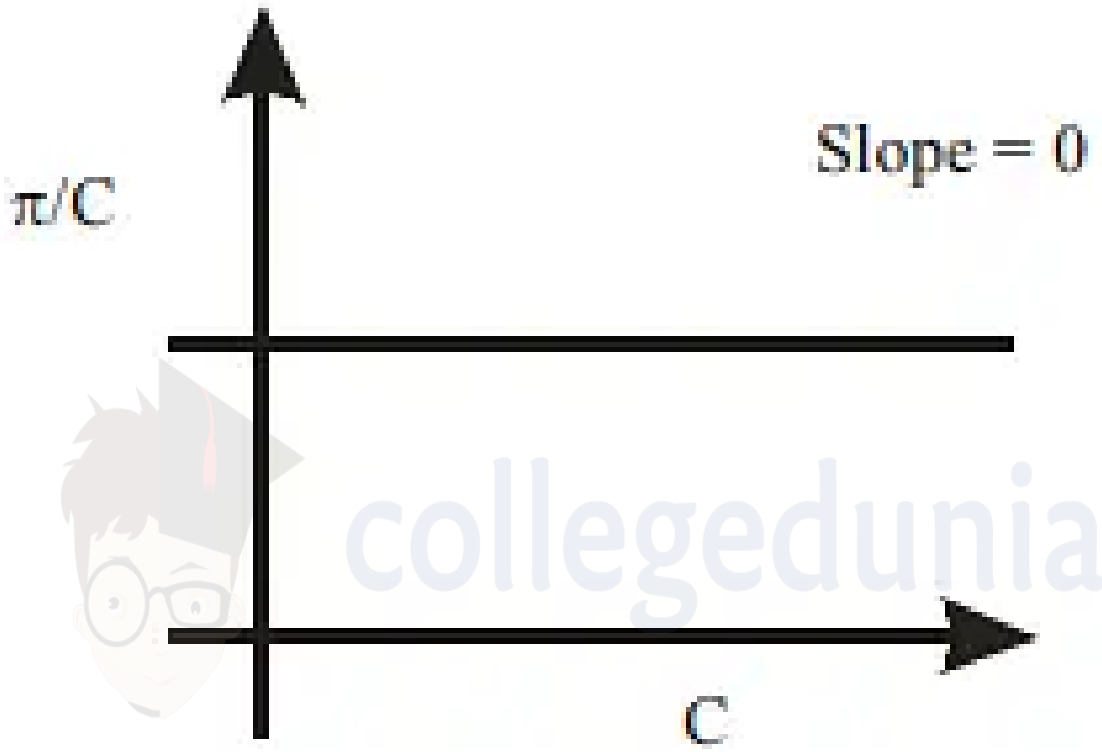
On the basis of the amount of solute dissolved in a solvent, solutions are divided into the following types:

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.
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.
3. **Supersaturated Solution-** A solution that contains more solute than the maximum amount at a certain temperature is known as a supersaturated solution.

10. **Answer: 41500 - 41500**

Explanation:

The correct answer is 41500



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

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

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

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

Assuming π vs C graph

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

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

$= 41,500\, gm/mole$

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.
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.
3. **Supersaturated Solution-** A solution that contains more solute than the maximum amount at a certain temperature is known as a supersaturated solution.