Solution

1. The molality of pure water is;
    (a) 55.5   (b) 50.5   (c) 18   (d) 60.5

Explanation:
(a) Molality = Number of moles/kg of solvent

$$= \frac{\frac{1000}{18}}{\text{kg of solvent}} = 55.5 \text{ moles/kg}$$

2. The number of moles of NaCl in 3 litres of 3M solution is
    (a) 1   (b) 3   **(c) 9**   (d) 27

Explanation:
(c) 3M solution means 3 moles in 1 litre.
                    ∴ 9 moles in 3 litres

3. 4L of 0.02 M aqueous solution of NaCl was diluted by adding one litre of water. The molality of the resultant solution is _____ .
    (a) 0.004   (b) 0.008   (c) 0.012   **(d) 0.016**

Explanation:
        (d) $M_1V_1 = M_2V_2$
        $0.02 \times 4 = M_2 \times (4 + 1)$
        $\Rightarrow M_2 = \frac{0.08}{5} = 0.016$

4. Low concentration of oxygen in the blood and tissues of people living at high altitude is due to _____ .
    (a) low temperature   **(b) low atmospheric pressure**
    (c) high atmospheric pressure
    (d) both low temperature and high atmospheric pressure

Explanation:
(b) Low atmospheric pressure will lead to low concentration of oxygen blood.

5. Considering the formation, breaking and strength of hydrogen bond, predict which of the following mixtures will show a positive deviation from Raoult's law?

    (a) Methanol and acetone.   (b) Chloroform and acetone.
    (c) Nitric acid and water.   (d) Phenol and aniline.

Explanation:
(a) CH_3OH and acetone, on mixing force of attraction will decrease.

6. Which of the following aqueous solutions should have the highest boiling point?

(a) 1.0 M NaOH   **(b) 1.0 M Na$_2$SO$_4$**

(c) 1.0 M NH$_4$NO$_3$ (d) 1.0 M KNO$_3$

Explaination:

(b) Because i = 3, $\Delta T_b \propto$ i, Boiling point $\propto \Delta T_b$.

7. In comparison to a 0.01 M solution of glucose, the depression in freezing point of a 0.01 M MgCl2 solution is about _____ .

(a) the same   (b) twice   **(c)three times**   (d) six times

Explaination:

(c) It will be nearly 3 times because number of particles in MgCl$_2 \rightarrow$ Mg^{2+} + 2Cl$^-$ are thrice than glucose.

8. An unripe mango placed in a concentrated salt solution to prepare pickle, shrivels because _____ .

(a) it gains water due to osmosis.

(b) it loses water due to reverse osmosis.

(c) it gains water due to reverse osmosis.

(d) it loses water due to osmosis.

Explaination:

(d) Concentrated salt solution is hypertonic solution, therefore, fluids inside mango will come out and it shrivels.

9. Which of the following statements is false?

(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 π = 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$_3$COOH > sucrose.

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

Explaination:

(a) is false because ΔT_f will depend upon nature of solvent and their K$_f$.

10. The value of Henry's constant K$_H$ is _____ .

(a) greater for gases with higher solubility.

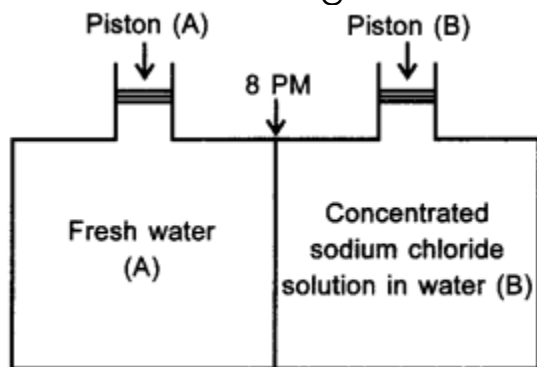**(b) greater for gases with lower solubility.**

(c) constant for all gases.

(d) not related to the solubility of gases.

Explaination:

(b) Higher the value of K$_H$, lower will be solubility.

11. Consider the figure and mark the correct option.

Piston (A)　　　Piston (B)

8 PM

Fresh water (A)　|　Concentrated sodium chloride solution in water (B)

(a) water will move from side (A) to side (B) if a pressure lower than osmotic pressure is applied on piston (B).

(b) water will move from side (B) to side (A) if a pressure greater than osmotic , pressure is applied on piston (B).

(c) water will move from side (B) to side (A) if a pressure equal to osmotic pressure is applied on piston (B).

(d) water will move from side (A) to side (B) if pressure equal to osmotic pressure is applied on piston (A).

Explaination:
(b) Reverse osmosis will take place.

12. We have three aqueous solutions of NaCl labelled as 'A', 'B' and 'C' with concentrations 0.1M, 0.01M and 0.001M, respectively. The value of Van't Hoff factor for these solutions will be in the order _____ .

(a) $i_A < i_B < i_C$　　(b) $i_A > i_B > i_C$　　**(c) $i_A = i_B = i_C$**　　(d) $i_A < i_B > i_C$

Explaination:
(c) Van't Hoff factor (i) does not depend upon concentration.

13. A solution containing 10 g per dm³ of urea (molar mass 60 g mol⁻¹) is isotonic with 5% solution of non-volatile solute, M_B of solute is

(a) 300 g mol⁻¹　(b) 350 g mol⁻¹　(c) 200 g mol⁻¹　(d) 250 g mol⁻¹

Explaination:

(a) $\frac{1}{60} = \frac{5}{x}$

$\Rightarrow x = 300$ g mol⁻¹　1000 cm³ contains 10 g　100 cm³ contains 1 g, i.e., 1%.

14. Cone. H_2SO_4 is 98 % H_2SO_4 by mass has d = 1.84 g cm⁻³. Volume of acid required to make one litre of 0.1 M H_2SO_4 is

(a) 5.55 ml　　(b) 10 ml　　(c) 20 ml　　(d) 30 ml

Explaination:

(a)　　$M = \dfrac{98 \times 10 \times 1.84}{98} = 18.4$ M

$$\boxed{M_1V_1 = M_2V_2}$$

$18.4 \times V_1 = 0.1 \times 1000$

$V_1 = 5.55$ mL

15. What is mole fraction of solute in 1.00 m aqueous solution?
      (a) 0.0354   **(b) 0.0177**   (c) 0.177   (d) 1.770

Explaination:

(b)
$$x_B = \dfrac{m}{m + \dfrac{1000}{M_A}} = \dfrac{1}{1 + \dfrac{1000}{18}}$$

$$= \dfrac{18}{1018} = 0.0177$$

16. When 1 mole of benzene is mixed with 1 mole of toluene

   (vapour pressure of benzene – 12.8 kPa, Toluene = 3.85 kPa)
   (a) The vapour will contain equal amount of benzene and toluene.
   (b) Not enough information is given for prediction.
   (c) The vapour will contain a higher percentage of benzene.
   (d) The vapour will contain higher percentage of toluene.

Explaination:
(c) It is because benzene has high vapour pressure, it will form more
    vapours as compared to toluene.

17. At 100°C, the vapour pressure of a solution of 6.5 g of solute in 100 g of
   water is 732 mm. If K_b is 0.52 K/m, the boiling point of solution will be
    (a) 102°C   (b) 103°C   **(c) 101 °C**   (d) 100°C

Explaination:

(c)
$$\dfrac{P_A{}^\circ - P_A}{P_A{}^\circ} = x_B$$

$$\Rightarrow \quad \dfrac{760 - 732}{760} = x_B$$

$$x_B = \dfrac{7}{190}$$

$$\Rightarrow \quad x_B = \dfrac{m}{m + \dfrac{1000}{M_A}}$$

$$\Rightarrow \quad \dfrac{7}{190} = \dfrac{m}{m + \dfrac{1000}{18}}$$

$$\Rightarrow 7m + \dfrac{7000}{18} = 190\,m$$

$$\Rightarrow \quad 183m = \dfrac{7000}{18}$$

$$\Rightarrow \quad m = \dfrac{7000}{3294}$$

$$\Rightarrow \Delta T_b = K_b \times m = 0.52 \times \dfrac{7000}{3294} = 1.06$$

$$\text{B.Pt} = 100 + 1.06 = 101°C$$

18. Which of the following is incorrect for an ideal solution?

(a) $\Delta H_{mix} = 0$ (b) $\Delta V_{mix} = 0$ (c) $\Delta P = P_{obs} - P_{calculated} = 0$ **(d) $\Delta G_{mix} = 0$**

Explaination:

(d) ΔG cannot be equal to zero because mixing does not lead to equilibrium.

19. If molality of dilute solution is doubled, the value of molal depression constant (K_f) will be

(a) halved   (b) tripled   **(c) unchanged**   (d) doubled

Explaination:

(c) K_f does not depend upon 'mMt depends upon nature of solvent.

20. The temperature at which 10% aqueous solution of (W/V) of glucose will show the osmotic pressure of 16.4 atom is (R = 0.082 L atom K^{-1} mol^{-1})

(a) 360°C   (b) 180 K   (c) 300 K   **(d) 360 K**

Explaination:

(d) $\pi V = nRT$

$$16.4 \times 0.1 = \frac{10}{180} \times 0.082 \times T$$

$$T = \frac{18 \times 16.4 \times 0.1}{0.082} = 360 \text{ K}$$

21. Which has the highest freezing point?

(a) 1 M glucose   (b) 1 M NaCl   (c) 1 M CaCl$_2$ (d) 1 M AlF$_3$

Explaination:

(a) 1 M glucose solution has highest freezing point because it has lowest ΔT_f because i = I.

22. Which of the following is correct?

a) KJJ increases with increase in temperature (KH is Henry's law constant).
(b) Solubility of gas in liquid decreases with increases in temperature.
(c) KJJ decreases with increase in temperature.
(d) Solubility of gas in liquid increases with increase in temperature.

Explaination:

(a) and (b) are correct $p_{gas} = K_H \times x_{gas}$

K_H increases with increase in temperature, decreases, i.e., solubility of gas in liquid decreases with increase in temperature.

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