

# VAISHALI EDUCATION POINT

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## SOLUTIONS

Class :- XII

Subject :- Chemistry

### General Instructions

QNo.	Questions
1	Give two examples of gaseous solutions.
2	When Would Dissolution of solute in a solvent lead to the liberation of energy?
3	Explain the term 'Mole-Fraction'.
4	Why are soda water and soft drink bottles sealed under pressure?
5	What is the effect of temperature on the solubility of gas in liquid?
6	Name two factors on which the vapour pressure of the liquid depends.
7	Define an ideal solution.
8	What are the values of $P_{\text{total}}$ , $H$ , $V$ for negative deviation from ideality? Give one example.
9	What are minimum boiling azeotropes? Give one example
10	A and B liquids on mixing produce a warm solution. Which type of deviation from Raoult's law is there?
11	Show that the relative lowering of vapour pressure is a colligative property.
12	Calculate the mass percentage of benzene ( $C_6H_6$ ) and carbon tetrachloride ( $CCl_4$ ) if 22 g of benzene is dissolved in 122 g of carbon tetrachloride.
13	Calculate the mole fraction of benzene in solution containing 30% by mass in carbon tetrachloride.
14	Calculate the molarity of each of the following solutions: (a) 30 g of $Co(NO_3)_2 \cdot 6H_2O$ in 4.3 L

of solution (b) 30 mL of 0.5 M  $\text{H}_2\text{SO}_4$  diluted to 500 mL.

- 15 Calculate the mass of urea ( $\text{NH}_2\text{CONH}_2$ ) required in making 2.5 kg of 0.25 molal aqueous solution.
- 16 Calculate (a) molality (b) molarity and (c) mole fraction of KI if the density of 20% (mass/mass) aqueous KI is  $1.202 \text{ g mL}^{-1}$ .
- 17  $\text{H}_2\text{S}$ , a toxic gas with rotten egg like smell, is used for the qualitative analysis. If the solubility of  $\text{H}_2\text{S}$  in water at STP is 0.195 m, calculate Henry's law constant.
- 18 The vapour pressure of pure liquids A and B are 450 and 700 mm Hg respectively, at 350 K. Find out the composition of the liquid mixture if total vapour pressure is 600 mm Hg. Also find the composition of the vapour phase.
- 19 Vapour pressure of pure water at 298 K is 23.8 mm Hg. 50 g of urea ( $\text{NH}_2\text{CONH}_2$ ) is dissolved in 850 g of water. Calculate the vapour pressure of water for this solution and its relative lowering.
- 20 Boiling point of water at 750 mm Hg is  $99.63^\circ\text{C}$ . How much sucrose is to be added to 500 g of water such that it boils at  $100^\circ\text{C}$ . Molal elevation constant for water is  $0.52 \text{ K kg mol}^{-1}$ .
- 21 Calculate the mass of ascorbic acid (Vitamin C,  $\text{C}_6\text{H}_8\text{O}_6$ ) to be dissolved in 75 g of acetic acid to lower its melting point by  $1.5^\circ\text{C}$ .  $K_f = 3.9 \text{ K kg mol}^{-1}$ .
- 22 Calculate the osmotic pressure in pascals exerted by a solution prepared by dissolving 1.0 g of polymer of molar mass 185,000 in 450 mL of water at  $37^\circ\text{C}$ .
- 23 Define the term solution. How many types of solutions are formed? Write briefly about each type with an example.
- 24 Give an example of solid solution in which the solute is a gas.
- 25 Define the following terms: (i) Mole fraction (ii) Molality (iii) Molarity (iv) Mass percentage.
- 26 Concentrated nitric acid used in laboratory work is 68% nitric acid by mass in aqueous solution. What should be the molarity of such a sample of the acid if the density of the solution is  $1.504 \text{ g mL}^{-1}$ ?

- 27 A solution of glucose in water is labelled as 10% w/w, what would be the molality and mole fraction of each component in the solution? If the density of solution is  $1.2 \text{ g mL}^{-1}$ , then what shall be the molarity of the solution?
- 28 How many mL of 0.1 M HCl are required to react completely with 1 g mixture of  $\text{Na}_2\text{CO}_3$  and  $\text{NaHCO}_3$  containing equimolar amounts of both?
- 29 A solution is obtained by mixing 300 g of 25% solution and 400 g of 40% solution by mass. Calculate the mass percentage of the resulting solution.
- 30 An antifreeze solution is prepared from 222.6 g of ethylene glycol ( $\text{C}_2\text{H}_6\text{O}_2$ ) and 200 g of water. Calculate the molality of the solution. If the density of the solution is  $1.072 \text{ g mL}^{-1}$ , then what shall be the molarity of the solution?
- 31 A sample of drinking water was found to be severely contaminated with chloroform ( $\text{CHCl}_3$ ) supposed to be a carcinogen. The level of contamination was 15 ppm (by mass): (i) express this in percent by mass (ii) determine the molality of chloroform in the water sample.
- 32 What role does the molecular interaction play in a solution of alcohol and water?
- 33 Why do gases always tend to be less soluble in liquids as the temperature is raised?
- 34 State Henry's law and mention some important applications?
- 35 The partial pressure of ethane over a solution containing  $6.56 \times 10^{-3} \text{ g}$  of ethane is 1 bar. If the solution contains  $5.00 \times 10^{-2} \text{ g}$  of ethane, then what shall be the partial pressure of the gas?
- 36 Define osmotic pressure. **(2007)**
- 37 An antifreeze solution is prepared from 222.6 g of ethylene glycol ( $\text{C}_3\text{H}_4(\text{OH})_2$ ) and 200 g of water. Calculate the molality of the solution. If the density of this solution be  $1.072 \text{ g mL}^{-1}$ , what will be the molarity of the solution ? **(2007)**
- 38 State Henry's law correlating the pressure of a gas and its solubility in a solvent and mention two applications for the law. **(2008)**
- 39 Calculate the temperature at which a solution containing 54g of glucose. ( $\text{C}_6\text{H}_{12}\text{O}_6$ ), in 250g of water will freeze. ( $K_f$  for water =  $1.86 \text{ K mol}^{-1} \text{ kg}$ ) **(2008)**

- 40 Differentiate between molality and molarity of a solution. What is the effect of change in temperature of a solution on its molality and molarity? **(2009)**
- 41 100 mg of a protein is dissolved in just enough water to make 10.0 ml. of solution. If this solution has an osmotic pressure of 13.3 mm Hg at 25 °C, what is the molar mass of the protein?  
( $R = 0.0821 \text{ L atm mol}^{-1} \text{ K}^{-1}$  and  $760 \text{ mm Hg} = 1 \text{ atm.}$ ) **(2009)**
- 42 What is an emulsion? **(2010)**
- 43 Non-ideal solutions exhibit either positive or negative deviations from Raoult's law. What are these deviations and why are they caused? Explain with one example for each type. **(2010)**
- 44 A solution prepared by dissolving 1.25 g of oil of winter green (methyl salicylate) in 99.0 g of benzene has a boiling point of 80.31 °C. Determine the molar mass of this compound. (B.P. of pure benzene = 80.10°C and  $K_b$  for benzene =  $2.53^\circ\text{C kg mol}^{-1}$ ) **(2010)**
- 45 Express the relation between conductivity and molar conductivity of a solution held in a cell. **(2011)**
- 46 (a) Differentiate between molarity and molality for a solution. How does a change in temperature influence their values?  
(b) Calculate the freezing point of an aqueous solution containing 10.50 g of  $\text{MgBr}_2$  in 200 g of water. (Molar mass of  $\text{MgBr}_2 = 184 \text{ g}$ )  
( $K_f$  for water =  $1.86 \text{ K kg mol}^{-1}$ ) OR (a) Define the terms osmosis and osmotic pressure. Is the osmotic pressure of a solution a colligative property? Explain. (b) Calculate the boiling point of a solution prepared by adding 15.00 g of NaCl to 250.0 g of water. ( $K_b$  for water =  $0.512 \text{ K kg mol}^{-1}$ , Molar mass of NaCl =  $58.44 \text{ g}$ ) **(2011)**
- 47 State the condition resulting in reverse osmosis.
- 48 State Raoult's law for a binary solution containing volatile components.
- 49 Two liquids A and B boil at 145°C and 190°C respectively. Which of them has a higher vapour pressure at 80°C?
- 50 What is expected value of van't Hoff factor for  $\text{K}_3[\text{Fe}(\text{CN})_6]$  in dilute solution?
- 51 Of 0.1 molal solutions of glucose and sodium chloride respectively, which one will have a higher boiling point?

- 52 Give reason when 30 ml of ethyl alcohol and 30 ml of water are mixed, the volume of resulting solution is more than 60 ml.
- 53 What would be the value of van't Hoff factor for a dilute solution of  $K_2SO_4$  in water?
- 54 Two liquids X and Y boil at  $110^\circ C$  and  $130^\circ C$  respectively. Which of them has higher vapour pressure at  $50^\circ C$ ?
- 55 10 ml of liquid A was mixed with 10 ml of liquid B. The volume of the resulting solution was found to be 19.9 ml. What do you conclude?
- 56 What is the sum of the mole fraction of all the components in a three component system?
- 57 Which will have higher boiling point, 0.1 M NaCl or 0.1 M  $BaCl_2$  solution in water?
- 58 How is it that the boiling points of the following solutions in water are different;  
(a) 0.1 M NaCl solution?  
(b) 0.1 M sugar solution?
- 59 Solution A is obtained by dissolving 1 g of urea in 100 g of water and solution B is obtained by dissolving 1 g of glucose in 100 g of water. Which solution will have a higher boiling point and why?
- 60 Why does molality of a solution remain unchanged with change in temperature while its molarity changes?
- 61 An aqueous solution of sodium-chloride freezes below 273 K. Explain the lowering in freezing point of water with the help of a suitable diagram.
- 62 Calculate the volume of 80% (by mass) of  $H_2SO_4$  (density = 1.80 g/ml) required to prepare 1 litre of 0.2 molar  $H_2SO_4$ . (Relative atomic masses: H = 1, O = 16, S = 32)
- 63 Calculate the osmotic pressure of a solution obtained by mixing  $100\text{ cm}^3$  of 0.25 M solution of urea and  $100\text{ cm}^3$  of 0.1 M solution of cane sugar at 293 K. [ $R = 0.082\text{ L atm mol}^{-1}\text{ K}^{-1}$ ]
- 64 Draw a suitable diagram to express the relationship for ideal solutions of A and B between vapour pressures and mole fractions of components at constant temperature.

- 65 How is relative lowering of vapour pressure defined for a solution consisting of volatile solvent and non-volatile solute? How is this function related to the mole fraction of the solvent and of the solute?
- 66 “The solution of a non-volatile solute boils at a higher temperature than the pure solvent”. Show this relationship on a graphic diagram.
- 67 With the help of a neat diagram indicate why the solution of a non-volatile solute should freeze at a temperature lower than the freezing point of the pure solvent.
- 68 Give one example each of miscible liquid pairs showing positive and negative deviations from Raoult’s law. Give one reason each for such deviations.
- 69 An aqueous solution of glucose is made by dissolving 10 g of glucose ( $C_6H_{12}O_6$ ) in 90 g of water at 303 K. If vapour pressure of pure water at 303 K be 32.8 mm Hg, what would be the vapour pressure of the solution?
- 70 What is osmotic pressure and how is it related with the molecular mass of non-volatile solute?
- 71 Calculate molarity and molality of a 13% solution (by weight) of sulphuric acid. Its density is  $1.020 \text{ g cm}^{-3}$ , (Atomic mass H = 1, O = 16, S = 32 u)
- 72 Explain with a suitable diagram and appropriate examples why some non-ideal solutions show positive deviation from ideal behaviour.
- 73 What is meant by abnormal molecular mass of solute? Discuss the factors which bring abnormality in the experimentally determined molecular masses of solutes using colligative properties.
- 74 The vapour pressure of pure liquids A and B are 70 mm Hg and 90 mm Hg respectively at  $25^\circ\text{C}$ . The mole fraction of ‘A’ in a solution of the two is 0.3. Assuming that A and B form an ideal solution, calculate the partial pressure of each component in equilibrium with the solution.
- 75 The solubility of  $Ba(OH)_2 \cdot 8H_2O$  in water at 288 K is 5.6 g per 100 g of water. What is the molality of the hydroxide ions in saturated solution of  $Ba(OH)_2 \cdot 8H_2O$  at 288 K? [At mass of Ba = 137, O = 16, H = 1]
- 76 An antifreeze solution is prepared from 222.6 g of ethylene glycol ( $C_2H_4(OH)_2$ ) and 200 g of water. Calculate the molality of the solution. If the density of this solution be  $1.072 \text{ g ml}^{-1}$ ,

what will be the molarity of the solution?

- 77 The vapour pressure of water is 12.3 kPa at 300 K. Calculate the vapour pressure of a one molal solution of a non-volatile, non-ionic solute in water.
- 78 (a) Why is the vapour pressure of a solution of glucose in water lower than that of water?  
(b) A 6.90 M solution of KOH in water contains 30% by mass of KOH. Calculate the density of the KOH solution. [Molar mass of KOH =  $56 \text{ g mol}^{-1}$ ]
- 79 (a) What are non-ideal solutions?  
(b) What role does the molecular interaction play in deciding the vapour pressure of solutions  
(i) alcohol and acetone (ii) chloroform and acetone?
- 80 At 300 K, 36 g of glucose ( $\text{C}_6\text{H}_{12}\text{O}_6$ ) present per litre in its aqueous solution has an osmotic pressure of 4.98 bar. If the osmotic pressure of another solution of glucose is 1.52 bar at the same temperature, what would be its concentration?
- 81 A 0.2 per cent aqueous solution of a non-volatile solute exerts a vapour pressure of 1.004 bar at  $100^\circ \text{C}$ . What is the molar mass of the solute? (Given : Vapour pressure of pure water at  $100^\circ \text{C}$  is 1.013 bar and molar mass of water is  $18 \text{ g mol}^{-1}$ )
- 82 Give reasons for the following:  
(a) When 30 ml of ethyl alcohol and 30 ml of water are mixed, the volume of resulting solution is more than 60 ml.  
(b) Copper is conducting as such while copper sulphate is conducting only in molten state or in aqueous solution.
- 83 (a) A 4% solution of sucrose is isotonic with 3% solution of an unknown organic substance. Calculate the molecular mass of unknown substance.  
(b) What is the mole fraction of a solute, in 2.5 m aqueous solution?
- 84 Calculate the osmotic pressure at  $25^\circ \text{C}$  and f.p. of 1.8% aqueous solution of glucose ( $\text{C}_6\text{H}_{12}\text{O}_6$ ). Assume ideal behaviour of the solution. Take density to be  $1 \text{ g ml}^{-1}$  and  $K_f$  for water to be  $1.86 \text{ K kg mol}^{-1}$ . ( $R = 0.082 \text{ L atm mol}^{-1} \text{ K}^{-1}$ )
- 85 2 g of benzoic acid ( $\text{C}_6\text{H}_5\text{COOH}$ ) dissolved in 25 g of benzene shows a depression in freezing point equal to 1.62 K. Molar depression constant for benzene is  $4.9 \text{ K kg mol}^{-1}$ . What is the percentage association of acid if it forms dimer in solution?
- 86 What is meant by van't Hoff factor? The osmotic pressure of a 0.0103 molar solution of an electrolyte is found to be 0.70 atm at  $27^\circ \text{C}$ . Calculate the van't Hoff factor. [ $R = 0.082 \text{ L atm}$

$\text{mol}^{-1} \text{K}^{-1}$ ]. What conclusion do you draw about the molecular state of the solute in the solution?

- 87 When does the measurement of colligative properties of a solution lead of abnormal molecular masses? The freezing point depression of 0.1 m NaCl solution is  $0.372^\circ \text{C}$ . What conclusion would you draw about the state of its formula? [ $K_f$  for water is  $1.86 \text{ K kg mol}^{-1}$ ].
- 88 Calculate the freezing point of a solution containing 0.520 g of glucose ( $\text{C}_6\text{H}_{12}\text{O}_6$ ) dissolved in 80.20 g of water.
- 89 The vapour pressure of pure benzene at  $25^\circ\text{C}$  is 639.7 mm Hg and the vapour pressure of a solution of a non-volatile solute in benzene at the same temperature is 631.9 mm Hg. Calculate mole fraction of solute and molality of solution.
- 90 One litre aqueous solution of sucrose (molar mass =  $342 \text{ g mol}^{-1}$ ) weighing 1015 g is found to record an osmotic pressure = 4.82 atm at 293 K. What is the molality of the sucrose solution? [ $R = 0.0821 \text{ L atm K}^{-1} \text{ mol}^{-1}$ ].
- 91 Explain giving examples the term 'colligative properties'. Why do we sometimes get abnormal molecular masses of the substances using colligative properties of the solution? The freezing point depression of 0.1 molal solution of benzoic acid in benzene is 0.256 K. For benzene  $K_f$  is  $5.12 \text{ K kg mol}^{-1}$ . Calculate the value of van't Hoff factor for benzoic acid in benzene. What conclusion can you draw about the molecular state of benzoic acid in benzene?
- 92 (a) Why does the molality of a solution remains unchanged with temperature? Calculate the molality and molarity of a 15% solution by weight of sulphuric acid of density  $1.020 \text{ g cm}^{-3}$  (Atomic mass H = 1, O = 16, S = 32 u). (b) An element with a face centred cubic structure with cell edge if 0.2 nm. Calculate its density in  $\text{g cm}^{-3}$  if 400 g of this element contains  $48 \times 10^{23}$  atoms,  $N_A = 6.00 \times 10^{23}$ .
- 93 (a) Explain the following terms with suitable examples:  
(i) Ferrimagnetism (ii) n-type semiconductor (iii) Ferromagnetism.  
(b) On dissolving 3.24 g of sulphur in 40 g of benzene boiling point of solution was higher than that of benzene by 0.81 K.  $K_b$  for benzene is 2.53 K/m. What is molecular formula of sulphur? (Atomic mass of sulphur =  $32 \text{ g mol}^{-1}$ )
- 94 (a) An element crystallises in bcc structure. The edge length of its unit cell is 288 pm, the density of the crystal is  $7.2 \text{ g cm}^{-3}$ . What is the atomic mass of the element?  
(b) Calculate the boiling point of a solution containing 0.61 g of benzoic acid in 50 g of  $\text{CS}_2$  assuming 84% dimerization of the acid. The boiling point and  $K_b$  of  $\text{CS}_2$  are 319.2 K and  $2.3 \text{ K kg mol}^{-1}$  respectively.

- 95 (a) Analysis shows that nickel oxide has formula  $\text{Ni}_{0.98} \text{O}_{1.00}$ . What is the percentage of  $\text{Ni}^{2+}$  ion present in it?  
(b) Define Henry's Law. Give two of its applications.
- 96 (a) A motor vehicle radiator was filled with 8 L of water to which 2 litres of  $\text{CH}_3\text{OH}$  ( $d = 0.8$  g/ml) were added. What is the lowest temperature at which vehicle can be parked outdoors without a danger, that water in the radiator will freeze? ( $K_f$  for  $\text{H}_2\text{O} = 1.8$  K/m) (b) The vapour pressure of benzene and toluene at 293 K are 75 mm Hg and 22 mm Hg respectively. 22.4 g of benzene and 64.4 g of toluene are mixed to form an ideal solution, calculate the mole fraction of benzene in vapour phase assuming the vapours are in equilibrium with the liquid mixture at this temperature.
- 97 (a) What is meant by positive deviation from Raoult's Law? Explain with the help of example.  
(b) 0.1 M solution of  $\text{K}_4[\text{Fe}(\text{CN})_6]$  is 50% ionised. Calculate its osmotic pressure at 300 K. [ $R = 0.083$  bar L  $\text{K}^{-1}$   $\text{mol}^{-1}$ ]