



# R.H.M. Public Sr. Sec. School

Social Reforms By Education With Edutainment

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## Class XII Assignment

### Solutions

1. State Henry's Law. What are the applications of Henry's Law?
2. What factors affect the solubility of gas in a liquid?
3. State Raoult's law for a binary solution containing volatile components.
4. Define an ideal solution. State the characteristics of ideal solution.
5. What type of solution is formed by mixing equal volumes of n- hexane and n-heptane or bromoethane and chloroethane or benzene and toluene? Explain.
6. What are non ideal solutions? Give examples.
7. Give one example each of miscible pairs showing positive and negative deviations from Raoult's Law. Give reasons for such deviations. (or) Explain with a suitable diagram and appropriate examples why some non ideal solutions show positive deviation from ideal behaviour.(or)What are non ideal solutions?
8. What role does intermolecular interaction play in deciding the vapour pressure of solutions (i) alcohol and acetone (ii) chloroform and acetone. (or) Draw a suitable diagram to express the relationship of ideal solutions of A and B between vapour pressures and mole fractions of components at constant temperature.
9. What are azeotropes? Classify them with examples.
10. What do you understand by colligative properties?
11. How is relative lowering of vapour pressure defined for a solution containing a volatile solvent and a non volatile solute? How is this function related to mole fraction of the solute and the solvent? (or)What is relative lowering of vapour pressure? Derive an expression for it. How is it useful in determining molecular mass of solute?
12. The solution of a non volatile solute boils at a higher temperature than the pure solvent. Show this relationship on a graphic diagram. (or) Why is the boiling point of solvent elevated when a non volatile solute is added to it?
13. 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? (or) Why is the freezing point of a solvent depressed when a non volatile solute is added to it?
14. How can you say that osmotic pressure is a colligative property? How can it be used to determine the molecular mass of a non volatile solute?
15. 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.
16. What is Van't Hoff factor?
17. Define the following terms. Mass percentage, Mass percentage, Mass by volume percentage, Parts per million, Mole fraction, Molarity, Molality.
18. What are isotonic solutions?
19. Define the term solution. How many types of solutions are formed? Write briefly about each type with an example.
20. Suppose a solid solution is formed between two substances, one whose particles are very large and the other whose particles are very small. What kind of solid solution is this likely to be?

21. What role does the molecular interaction play in a solution of alcohol and water?
22. Why do gases always tend to be less soluble in liquids as the temperature is raised?
23. Suggest the most important type of intermolecular attractive interaction in the following pairs.
  - a. n-hexane and n-octane (ii)  $I_2$  and  $CCl_4$  (iii)  $NaClO_4$  and water (iv) methanol and acetone (v) acetonitrile ( $CH_3CN$ ) and acetone ( $C_3H_6O$ ).
24. Based on solute-solvent interactions, arrange the following in order of increasing solubility in n-octane and explain. Cyclohexane,  $KCl$ ,  $CH_3OH$ ,  $CH_3CN$ .
25. Amongst the following compounds, identify which are insoluble, partially soluble and highly soluble in water? (i) phenol (ii) toluene (iii) formic acid (iv) ethylene glycol (v) chloroform (vi) pentanol.
26. What are the advantages of using Osmotic property to determine molecular mass of solids over other colligative properties?
27. What do you mean by boiling point elevation constant (ebullioscopic constant) and freezing point depression constant (cryoscopic constant) for a solvent.
28. What is the effect of temperature on molality and molarity?

### Concept Based Questions

1. Why does molality of a solution remain unchanged with temperature while molarity changes? (or) Why is it advantageous to use molality over molarity?
2. Two liquids boil at  $145^\circ C$  and  $190^\circ$  respectively. Which one has a higher vapour pressure at  $80^\circ C$ ?
3. What would be the Van't Hoff factor of  $K_3[Fe(CN)_6]$ ,  $K_2SO_4$ ,  $K_4[Fe(CN)_6]$ ,  $MgSO_4$ ,  $NaCl$ ,  $KCl$ ?
4. Of 0.1 molal solutions of glucose and sodium chloride respectively, which one will have a higher boiling point?
5. A and B on mixing produced a warm solution. What type of deviation is there and why? (or) Why is an increase in temperature observed on chloroform and acetone.
6. When 30 ml of ethyl alcohol and 30 ml of water are mixed, the volume of resulting solution is more than 60 ml. Explain.
7. 10 ml of liquid A was mixed with 10ml of liquid B. The volume of the resulting solution was found to be 19.9 ml. What would you conclude?
8. A and B on mixing produced a colder solution. What type of deviation is there and why?
9. Why is the elevation of boiling point of water different in 0.1 molar  $NaCl$  solution and 0.1 molar sugar solution?
10. Which will have higher boiling point, 0.1M  $NaCl$  or 0.1M  $BaCl_2$ ?
11. Solution A is obtained by dissolving 1g of glucose in 100g of water and solution B by dissolving 1 g of urea in 100g of water. Which will have a higher boiling point and why?
12. Why is cooking temperature in a pressure cooker higher than in an open pan?
13. When is the value of Van't Hoff factor greater than 1 and less than 1?
14. In determination of molar mass of  $A^+B^-$ , using colligative property, what may be the value of Van't Hoff factor if the solute is 50% dissociated?
15. Give an example of a compound in which hydrogen bonding results in form of dimer?
16. Give an example of a solution containing a solid in solid solvent.
17. What is anti freeze? (or) Why is it advised to add ethylene glycol in a car radiator while driving in hill station?
18. What is de-icing agent? Sodium chloride or calcium chloride is used to clear snow from roads. Why?
19. What happens when RBCs are placed in
  - a) 1%  $NaCl$  solution
  - b) 0.5%  $NaCl$  solution
20. What happens when blood cells are placed in pure water?
21. Which has the highest freezing point?

i) 1 M glucose b) 1 M NaCl c) 1 M CaCl<sub>2</sub> d) 1 M AlF<sub>3</sub>

16. When 20g of naphtholic acid ( $C_{11}H_8O_2$ ) is dissolved in 50g of benzene ( $K_f = 1.72 \text{ K Kg/mol}$ ) a freezing point depression of 2K is observed. The van't Hoff factor is  
a) 0.5 b) 1 c) 2 d) 3
17. Vapour pressure of water at  $20^\circ\text{C}$  is 17.5 mm Hg. If 18 g of glucose is added to 178.2g of water at  $20^\circ\text{C}$ , the vapour pressure of the resulting solution will be  
a) 17.325 mm Hg b) 17.675mm Hg c) 15.75mm Hg d) 16.5mmHg
18. Two liquids X and Y form ideal solutions. The mixture has a vapour pressure of 400mm at 300K when mixed in the molar ratio of 1:1 and a vapour pressure of 350mm of Hg when mixed in the molar ratio of 1:2 at the same temperature. The vapour pressure of two pure liquids are  
a) 250 mm, 550mm b) 350mm, 450mm c) 550mm, 700mm d) 550mm, 500mm e) 550mm, 250mm
19. A binary solution is prepared by mixing n-heptane and ethanol. Which statement is true regarding the behaviour of the solution.  
a) The solution is an ideal solution b) The solution is non ideal showing positive deviation from Raoult's law. c) The solution is non ideal showing negative deviation from Raoult's law d) n-heptane shows positive deviation while ethanol shows negative deviation from Raoult's law
20. Two liquids X and Y form an ideal solution. At 300 K vapour pressure of a solution containing 1 mol of X and 3 mol of Y is 550 mm Hg. At the same temperature, if 1mol of Y is further added to the solution, vapour pressure increases by 10 mm Hg. Vapour pressure in mm Hg of X and Y in the pure state will be  
a) 200, 300 b) 300, 400 c) 400, 600 d) 500, 600.
21. The Henry's Law constant for solubility of  $N_2$  gas in water at 298K is  $1 \times 10^5 \text{ atm}$ . The mole fraction of  $N_2$  in air is 0.8. The number of moles of  $N_2$  from air dissolved in 10 moles of water at 298 K and 5 atm pressure is  
a)  $4 \times 10^{-4}$  b)  $4 \times 10^{-5}$  c)  $5 \times 10^{-4}$  d)  $4 \times 10^{-6}$
22. If sodium sulphate is considered to be completely dissociated into cations and anions in aqueous solution, the change in freezing point of water, when 0.01 mol of sodium sulphate is dissolved in 1 Kg of water ( $K_f = 1.86 \text{ K Kg/mol}$ )  
a) 0.0744 K b) 0.0186 K c) 0.0372 K d) 0.0558 K
23. On mixing heptane and octane they form an ideal solution at 373 K the vapour pressures of heptane and octane are 105 kPa and 45 kPa respectively. Vapour pressure of the solution obtained by mixing 25g heptane and 35g of octane will be  
a) 96.2 kPa b) 144.5 kPa c) 72 kPa d) 36.1 kPa
24. An aqueous solution is 1.00 molal in KI. Which change will cause vapour pressure of solution to increase?  
a) Addition of NaCl b) Addition of sodium sulphate c) Addition of 1.00 molal KI d) Addition of water
25. A solution of sucrose (342g/mol) has been prepared by dissolving 68.5 g of sucrose in 1000 g of water. The freezing point of the solution will be ( $K_f = 1.86 \text{ K Kg/mol}$ )  
a)  $-0.372^\circ\text{C}$  b)  $-0.52^\circ\text{C}$  c)  $0.3772^\circ\text{C}$  d)  $-0.57^\circ\text{C}$

### Numericals

1. A solution to be used in hand lotion is made by mixing 90.0g of water, 9.2g of ethyl alcohol and 18.4g of glycerol ( $C_3H_8O_3$ ). Calculate the mole fraction of glycerol present in it. (0.037)
2. The density of 10% by mass of KCl solution is 1.06g/cc. Calculate molarity of the solution. (1.42M)
3. Find the molarity of the solution obtained by mixing 100mL of 0.3M  $H_2SO_4$  and 200mL of 1.5M  $H_2SO_4$  (1.1M)
4. What volume of 96% of  $H_2SO_4$  solution (density = 1.83g/mL) is required to make 4 litres of 3M  $H_2SO_4$ ? (669 mL of diluted to 4 litres).

5. Methanol and ethanol form nearly an ideal solution at 300K. A solution is made by mixing 32g methanol and 23g ethanol. Calculate the partial pressures of the components and total vapour pressure of solution at 300K. (90 mmHg, 17mmHg, 77mm Hg)
6. Vapour pressures of pure benzene and toluene at 293 K is 75mm Hg and 22 mm Hg respectively.
7. Vapour pressure of pure benzene and toluene at 293 K is 75 mm Hg and 22 mm Hg respectively. 23.4 g of benzene and 64.4 g of toluene are mixed. If the two form an ideal solution, calculate the mole fraction of benzene in the vapour phase assuming that the vapours are in equilibrium with the liquid mixture at this temperature. (0.59)
8. 18.2 g of urea is dissolved in 100g of water at 50°C. The lowering of vapour pressure produced is 5mm Hg. Calculate the molecular mass of urea. The vapour pressure of water at 50°C is 92 mm Hg. (57.05)
9. The vapour pressure of dilute aqueous solution of glucose is 750 mm Hg. Calculate (i) molality (ii) mole fraction of solute. (0.74m ; 0.0132)
10. The boiling point of water becomes 100.52 50°C. If 1.5 g of a non volatile solute is dissolved in 100 mL of it. Calculate the molecular mass of the solute. ( $K_b = 0.6\text{K/m}$ ) (17.3)
11. 10 g of a non volatile solute when dissolved in 100g of benzene raises its boiling point by 1°C. What is the molecular mass of the solute? (253)
12. The osmotic pressure of a dilute aqueous solution of a compound X containing 0.12g per litre is twice the osmotic pressure of a dilute aqueous solution of another compound Y containing 0.18g per litre. What is the ratio of the molecular mass of X to Y if both remain in molecular form in solution? (1:3)
13. 1 liter aqueous solution of sucrose weighing 1015 g has an osmotic pressure of 4.82 atm at 293 K. What is the molality of sucrose solution? (0.2112m)
14. Assuming complete ionisation, calculate the expected freezing point of solution prepared by adding Glauber's salt  $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$  in 0.1Kg of water?  $K_f = 1.86\text{ K Kg/mol}$ . (271.95)
15. A solution contains 7.45 KCl per litre of the solution, It has an osmotic pressure of 4.68 atm at 300 K. Calculate the degree of dissociation of KCl in this solution. (90%)
16. Calculate the Van't Hoff factor of  $\text{CdSO}_4$  (mol. Mass = 208.4) if the dissociation of 5.21 g of it in half liter of water gives a depression in freezing point of 0.168°C ( $K_f = 1.86\text{ K Kg/mol}$ ). (1.806)
17. A solution of sucrose has been prepared by dissolving 68.4 g of sucrose in 1 Kg of water. Calculate i) Vapour pressure of the solution at 198 K ii) osmotic pressure of solution at 298 K iii) freezing point of the solution. ( $K_f = 1.86\text{ K Kg/mol}$ ) (0.239 atm, 4.887 atm -0.372 °C)
18. Calculate the amount of ethylene glycol to be added to 4 Kg of water to prevent it from freezing at -6 °C ( 804.32)
19. The freezing point of a solution containing 0.3g of acetic acid in 30.0 g of benzene is lowered by 0.45 °C. Calculate van't Hoff factor. ( $K_f = 5.12\text{ K Kg/mol}$ ) ( )
20. How much urea should be dissolved in 50g of water so that the vapour pressure at room temperature is reduced to 25%. Calculate molality of solution obtained. (55.56g; 18.2)
21. An aqueous solution containing 1.24 g of barium chloride in 100g of water boils at 100.0832 °C. Calculate the degree of dissociation of barium chloride. ( $K_b = 0.52\text{ K Kg/mol}$ ) (0.835)
22. The osmotic pressure of 0.013 molar solution of an electrolyte is found to be 0.70 atm at 27 °C. Calculate the van't Hoff factor. (2.76)
23. 2g of  $\text{C}_6\text{H}_5\text{COOH}$  dissolved in 25g of benzene shows a depression in freezing point equal to 1.62 K. What is the percentage association if it exists as a dimer? ( $K_b = 4.9\text{ K Kg/mol}$ ) (99.2%)
24. 45 g of ethylene glycol  $\text{C}_2\text{H}_6\text{O}_2$  is mixed with 600g of water. Calculate i) Freezing point depression ii) freezing point of the solution.  $K_f = 1.86\text{ K Kg/mol}$  (2.25 °C : -2.25 °C)
25. Find the amount of 98% pure  $\text{Na}_2\text{CO}_3$  required to prepare 5 litres of 2N solution. ( 540.8g)

#### Board Questions

2011

1. State the following (2)
  - a) Raoult's Law in its general form in reference to solutions
  - b) Henry's law about partial pressure of a gas in a mixture.
2. A solution prepared by dissolving 8.95 mg of a gene fragment in 35.0 mL of water has an osmotic pressure of 0.335 torr at 25°C. Assuming that the gene fragment is a non electrolyte, calculate the molar mass?

