UNIT-2: SOLUTIONS

One mark questions:	
1. What is a binary solution?	K
2. Give an example for a solution of a solid in a gas.	U
3. 5 g of glucose is dissolved in 95g of water. What is the mass percentage of glucose?	S
4. Write the expression to calculate volume percentage of solute.	K
5. In a binary solution, mole fraction of a component is 0.85. What is the mole fraction of the other component?	U
6. What is the mass of sodium hydroxide present in 500mL of 1M NaOH solution? (Molar mass of NaOH is 40 $gmol^{-1}$).	S
7. Name a concentration term which is independent of temperature.	U
8. How does the solubility of a solid solute in a liquid vary with increase in temperature if the dissolution process is endothermic?	U
9. Write the mathematical expression for Henry's law.	K
10. K_H values for the gases argon and methane in water at 298K are 40.3 /k bar and 0.413 / k bar respectively. Which gas is more soluble at this temperature?	U
11. Cylinders used by Scuba divers is diluted with helium gas. Why?	A
12. State Raoult's law.	K
13. Vapour pressures of chloroform and dichloromethane are 200mm of Hg and 415mm of Hg at 298K respectively. Which one is more volatile?	U
14. What are ideal solutions?	K
15. Give an example for a non ideal solution showing negative deviation from Raoult's law.	U
16. Based on inter molecular interactions, give the reason for a solution of A and B to show positive deviation from Raoult's law.	U
17. Arrange the following aqueous solutions in decreasing order of their relative lowering of vapour pressure: i) 0.1M sucrose ii) 0.1 M NaCl iii) 0.05 M glucose iv) 0.1 M acetic acid	A
18. Molal elevation constant for water is 0.52 $Kkg\ mol^{-1}$. What is the elevation in boiling point produced for one molal aqueous solution of a solute for which i=1?	A
19. Write the SI unit for Ebullioscopic constant.	K
20. Write the relationship between K_b and enthalpy of vapourisation of the solvent.	K

21. Which of the following aqueous solutions should have higher boiling point? 0.01M NaCl or 0.01M Na_2SO_4 (assume both undergo almost complete ionisation)	U
22. Sea water freezes at a temperature lower than that of pure water. Why?	U
23. Ethylene glycol is added as antifreeze to petrol in cold countries. Why?	U
24. Which solution would exhibit lower osmotic pressure? Aqueous solution of urea or aqueous solution of common salt, both of same concentration.	U
25. Give a definition for van't Hoff factor 'i'.	K
26. Write the modified equation to calculate ΔT_b for $i \neq 1$.	K
Two mark questions.	
1. Differentiate molarity and molality of a solution. Which one of these varies with temperature?	U
2. Concentration of urea in an aqueous solution is 45% by mass. Calculate the mass of urea in 100g of water.	S
3. 10mL of ethanol is mixed with 250 mL of water. Calculate the volume percent of ethanol.	S
4. 20g of glucose is present in 500mL of its solution. Calculate the mass by volume percentage of glucose.	S
5. 20g of HCl is present in $2dm^3$ of its solution. Calculate the molarity of HCl solution. Given molar mass of HCl =36.5g/ mol	S
6. 30g of urea is dissolved in 500g of water. Calculate the molality of this solution. Given molar mass of urea =60 g/mol.	S
7. One kg of a sample of hard water contains 3mg of calcium carbonate. Express the concentration of calcium carbonate in ppm.	S
8. State Henry's law. Aquatic species are more comfortable towards respiration in cold water than in warm water. Why?	U
9. Draw the graph of partial pressure of a gas in vapour phase versus mole fraction of the gas in solution. What is the slope of a line equal to?	S
10. Mention any two factors affecting solubility of a gas in a liquid.	K
11. Draw the graph for, the plot of vapour pressure versus mole fraction of an ideal solution.	S
12. Write any two differences between ideal and non ideal solutions.	K
13. What are azeotropes? What type of solutions form minimum boiling azeotropes?	K

14. What are colligative properties? Molal cryoscopic constant of acetic acid is 3.9 Kkgmol^{-1}. What does this mean?	K
15. 3 moles of a non-volatile solute is dissolved in 15 mol of a solvent. Calculate the relative lowering of vapour pressure.	S
16. Vapour pressure of pure benzene at some temperature is 0.95 bar. Calculate the vapour pressure of 1 molal solution of a non-volatile solute (i=1) in it. Given molar mass of benzene = 78 gmol^{-1}.	S
17. Vapour pressure of water at 295 K is 18.5 mm of Hg. Calculate the vapour pressure of the solution containing 25 g urea dissolved in 400 g of water at the same temperature. Given molar mass of urea = 60 g mol^{-1}.	S
18. How does boiling point and freezing point of a solvent vary when a non volatile solute is added to it?	U
19. What is the effect on the i) vapour pressure ii) boiling point of a solvent, when a non-volatile solute is dissolved in it?	U
20. The molal depression constant of water is 1.86 K/m. Calculate the depression in freezing point of 0.1 molal aqueous urea solution.	S
21. Molal elevation constant for benzene is 2.52K/m. A solution of benzene containing a solute (i=1) boils at 0.126°C higher than benzene. Calculate the molality of the solution.	S
22. i) Define osmotic pressure. ii) What are isotonic solutions?	K
23. Molecular mass of polymers or proteins are more often determined by measuring osmotic pressure rather than by any other colligative property. Give two reasons.	A
24. What is the observation made when blood cells are placed in saturated salt solution? What are such solutions called?	A
25. What does the value of Van't-Hoff factor indicate? What is the value i for a solute that dissociates in a solvent?	U
26. The value of i for acetic acid is i) > 1 in water ii) < 1 in benzene What inference can be drawn regarding acetic acid in these solvents?	A
27. Normal molar mass of a solute is 246 g mol^{-1} and molar mass of the same in a solvent is 346 gmol^{-1}. What is the value of i? Comment on the state of the solute in the solvent.	S
28. Explain the desalination of sea water using reverse osmosis technique.	K

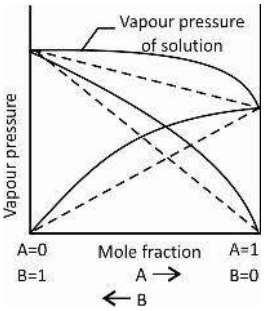
29. Name the phenomenon involved: i) a piece of raw mango in salt solution shrinks. ii) when pressure greater than osmotic pressure is applied on the solution side	A
Three mark questions:	
1. 3 moles of sodium chloride is dissolved in 250 moles of water. What is the mole fraction of NaCl and water in the solution?	S
2. Give reasons: i) solubility of a gas in a solvent is always exothermic ii) there is volume expansion when ethanol is added to water iii) elevation in boiling point is observed when sea water is boiled at 1 bar pressure	A
3. Give reasons: i) Liquids A and B on mixing produce a warmer solution ii) Freezing point depression of 0.1 M aqueous NaCl is nearly twice that of 0.1 M aqueous sucrose solution iii) Blood cells when placed in water swells.	A
4. Give reasons: i) there is no osmosis when 0.1 M urea solution is separated from 0.1 M sucrose solution by a semi-permeable membrane. ii) molar mass of an electrolyte in a polar solvent determined by any colligative property is less than its theoretical molar mass. iii) 95% aq. ethanol by volume cannot be concentrated by fractional distillation	A
5. The vapour pressure of pure water at 50°C is 12260Pa. 18.2g of solute was dissolved in 100g of water at the same temperature. The lowering of vapour pressure produced is 660Pa. Calculate the molar mass of the solute. [A: 60.85 $gmol^{-1}$]	S
6. The vapour pressure of pure water at 298K is 3.3kPa. Calculate the relative lowering of vapour pressure of an aqueous solution containing 20g of glucose dissolved in 90g of water at the same temperature. (Molar mass of glucose = 180$gmol^{-1}$, molar mass of water = 18 $gmol^{-1}$). [A : 0.02173]	S
7. At 100° C, benzene and toluene have vapour pressure of 1375 torr and 558 torr, respectively. Assuming these two form an ideal binary solution, calculate the mole fraction of benzene in vapour phase at 1 atm and 100° C. [A : 0.247]	S
8. The vapour pressure of pure benzene at a certain temperature is 200mm of Hg. At	

the same temperature, the vapour pressure of solution containing 2g of a non volatile, non electrolytic solute in 78g of benzene is 195mm of Hg. Calculate the molar mass of the solute. [A : 80 g mol^{-1}] S

9. 12.6g of a non electrolyte is dissolved in 75g of water. The freezing point of this solution is 271.9K. If molar depression constant is 1.86 Kkgmol^{-1}, calculate the molar mass of the solute. (Freezing point of pure water = 273.15 K)

[A: 250 g mol^{-1}] S

10. Using the graph answer the following:



i) What type of non-ideal solution shows such a behaviour?

ii) What can you infer about the molecular interactions before & after mixing A and B?

iii) What type of azeotrope will the mixture of A and B form? S

11. The boiling point of benzene is 353.23K. When 1.8g of a non volatile solute was dissolved in 90g of benzene, the boiling point is raised to 354.11K. Calculate the molar mass of solute. (K_b = 2.52 K kg mol^{-1}) [A : 57.2 g mol^{-1}] S

12. 20 g of an organic acid is dissolved in 500 g of water. The depression in freezing point of water was by 1°. Calculate the Van't Hoff factor and degree of dissociation of the acid. (Molar mass of acid = 79 $gmol^{-1}$, K_f =1.86 K $kgmol^{-1}$). [A: i = 1.06 ; 0.06] S

13. Acetic acid exists in benzene solution in the dimeric form. In an actual experiment the Van't Hoff factor was found to be 0.52. Calculate the degree of association of acetic acid. [A : 0.96] S

14. Calculate the boiling point of the solution which has 15 g of $MgSO_4$ dissolved in 550 g of water. Assume i = 2 for the solute. Boiling point of pure water = 373.15 K. (Molar mass of $MgSO_4$ = 120 g mol^{-1}, K_b = 0.52 K $kgmol^{-1}$) [A : 373.38 K] S

15. Calculate the osmotic pressure of 5% (m/V) solution of urea at 300K. (The value of R is 0.0821 L atm K^{-1}, Molar mass of urea = 60 g mol^{-1}). [A : 20.5 atm] S

16. A 1.46% solution of a compound has an osmotic pressure of 783 mm of Hg at 300K. Calculate the molar mass of the compound. R = 62.36 L mm Hg K^{-1} mol^{-1}.

[A : 348.8 g mol^{-1}] S

17. Normal saline is 0.9% mass/volume sodium chloride solution. Calculate the osmotic pressure of normal saline at 300 K. Given molar mass of NaCl=58.5 $gmol^{-1}$, R=0.083 Lbar mol^{-1} K^{-1}. [A : 3.8 bar] S