

GRADE: 12

TOPIC: 1. SOLUTIONS

CASE STUDY

Read the passage given below and answer the following questions:

The properties of the solutions which depend only on the number of solute particles but not on the nature of the solute are called colligative properties. Relative lowering in vapour pressure is also an example of colligative properties.

For an experiment, sugar solution is prepared for which lowering in vapour pressure was found to be 0.061 mm of Hg. (Vapour pressure of water at 200C is 17.5 mm of Hg)

The following questions are multiple choice questions. Choose the most appropriate answer:

(i) Relative lowering of vapour pressure for the given solution is

- (a) 0.00348
- (b) 0.061
- (c) 0.122
- (d) 1.75

(ii) The vapour pressure (mm of Hg) of solution will be

- (a) 17.5
- (b) 0.61
- (c) 17.439
- (d) 0.00348

(iii) Mole fraction of sugar in the solution is

- (a) 0.00348
- (b) 0.9965
- (c) 0.061
- (d) 1.75

(iv) If weight of sugar taken is 5 g in 108 g of water then molar mass of sugar will be

- (a) 358
- (b) 120
- (c) 240
- (d) 400

(v) The vapour pressure (mm of Hg) of water at 293K when 25g of glucose is dissolved in 450 g of water is

- (a) 17.2
- (b) 17.4
- (c) 17.120
- (d) 17.0

MCQ

i. A plant cell shrinks when it is kept in a

- (a) hypotonic solution
- (b) hypertonic solution
- (c) isotonic solution
- (d) pure water.

ii. Which of the following fluoride is used as rat poison?

- (a) CaF_2
- (b) KF
- (c) NaF
- (d) MgF

iii. Vapour pressure of a pure liquid X is 2 atm at 300 K. It is lowered to 1 atm on dissolving 1 g of Y in 20 g of liquid X. If molar mass of X is 200, what is the molar mass of Y?

- (a) 20
- (b) 50
- (c) 100
- (d) 200

iv. Molarity of liquid HCl will be, if density of solution is 1.17 gm/cc

- (a) 36.5
- (b) 32.05
- (c) 18.25
- (d) 42.10

v. 1 M, 2.5 litre NaOH solution is mixed with another 0.5 M, 3 litre NaOH solution. Then find out the molarity of resultant solution

- (a) 0.80 M
- (b) 1.0 M
- (c) 0.73 M
- (d) 0.50 M

vi. What weight of glycerol should be added to 600 g of water in order to lower its freezing point by 10°C ?

- (a) 496 g
- (b) 297 g
- (c) 310 g
- (d) 426 g

3. Assertion-Reason

In the following questions (Q.no. 12 to 16) a statement of Assertion followed by a statement of Reason is given. Choose the correct answer out of the following choices.

- (a) Assertion and reason both are correct statements and reason is correct explanation for assertion.
- (b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.
- (c) Assertion is correct statement but reason is wrong statement.
- (d) Assertion is wrong statement but reason is correct statement.
- (e) If the assertion and reason both are false.

i. Assertion: When a solution is separated from the pure solvent by a semi- permeable membrane, the solvent molecules pass through it from pure solvent side to the solution side

Reason: Diffusion of solvent occurs from a region of high concentration solution to a region of low concentration solution.

ii. Assertion: When NaCl is added to water a depression in freezing point is observed.

Reason: The lowering of vapour pressure of a solution causes depression in the freezing point.

iii. Assertion: Azeotropic mixtures are formed only by non-ideal solutions and they may have boiling points either greater than both the components or less than both the components.

Reason: The composition of the vapour phase is same as that of the liquid phase of an azeotropic mixture.

iv. Assertion: If one component of a solution obeys Raoult's law over a certain range of composition, the other component will not obey Henry's law in that range.

Reason: Raoult's law is a special case of Henry's law.

v. Assertion: Molarity of a solution in liquid state changes with temperature.

Reason: The volume of a solution changes with change in temperature.

2 marks Short answer type

4. A 1.00 molal aqueous solution of trichloroacetic acid (CCl_3COOH) is heated to its boiling point. The solution has the boiling point of 100.18°C . Determine the van't Hoff factor for trichloroacetic acid. (K_b for water = $0.512 \text{ K kg mol}^{-1}$)
5. Calculate the mass of compound (molar mass = 256 g mol^{-1}) to be dissolved in 75 g of benzene to lower its freezing point by 0.48 K ($K_f = 5.12 \text{ K kg mol}^{-1}$).
6. State Henry's law. What is the effect of temperature on the solubility of a gas in a liquid?
7. Calculate the freezing point depression expected for 0.0711 m aqueous solution of Na_2SO_4 . If this solution actually freezes at -0.320°C , what would be the value of Van't Hoff factor? (K_f for water is $1.86^\circ\text{C mol}^{-1}$)

3 marks Short answer type II

8. 18 g of glucose, $\text{C}_6\text{H}_{12}\text{O}_6$ (Molar mass = 180 g mol^{-1}) is dissolved in 1 kg of water in a sauce pan. At what temperature will this solution boil? (K_b for water = $0.52 \text{ K kg mol}^{-1}$, boiling point of pure water = 373.15 K)
9. 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 = $2.53^\circ\text{C kg mol}^{-1}$)

5 Marks Long answer type

10. A 5% solution (by mass) of cane-sugar in water has freezing point of 271 K . Calculate the freezing point of 5% solution (by mass) of glucose in water if the freezing point of pure water is 273.15 K .

[Molecular masses : Glucose $\text{C}_6\text{H}_{12}\text{O}_6$: 180 amu; Cane-sugar $\text{C}_{12}\text{H}_{22}\text{O}_{11}$: 342 amu]

State Raoult's law and mention two important applications of Henry's law

11. Calculate the freezing point of solution when 1.9 g of MgCl_2 ($M = 95 \text{ g mol}^{-1}$) was dissolved in 50 g of water, assuming MgCl_2 undergoes complete ionization.

(K_f for water = $1.86 \text{ K kg mol}^{-1}$)

(b) (i) Out of 1 M glucose and 2 M glucose, which one has a higher boiling point and why?

(ii) What happens when the external pressure applied becomes more than the osmotic pressure of solution?