CBSE 12 Chemistry

Chapter - Solutions

Competency-Based Questions 2024-25

Q.1 In a chemistry laboratory, Richa took 5g of a solute from an unknown box and prepared a 0.25 M basic solution. The volume of the solution was 500 ml.

Based on the above data, which of the following is likely to be the unknown substance used by Richa?

(Approx. Atomic masses of Ca = 40 u; Na = 23 u; Li = 7 u; Cs = 133 u; O = 16 u; H = 1 u)

A. Ca(OH)2
B. NaOH
C. LiOH
D. CsOH

Answer. B. NaOH

Q.2 A glycerine solution, at 293 K, has a molality of 3.89 molal and molarity of 5.33 M.

Which of these would be CORRECT for molarity and molality of the same glycerine solution at 450K?

A. Molarity < 5.33 M; Molality = 3.89 molal
B. Molarity < 5.33 M; Molality < 3.89 molal
C. Molarity > 5.33 M; Molality = 3.89 molal
D. Molarity = 5.33 M; Molality = 3.89 molal

Answer. A. Molarity < 5.33 M; Molality = 3.89 molal

Q.3 A mixture of acetone and chloroform forms a maximum boiling azeotrope at a specific composition.

Which of these is CORRECT for the mixture?

A. Change in volume on mixing will be positive.
B. Change in enthalpy on mixing will be positive.

C. Interaction between unlike molecules is stronger than that between like molecules in the mixture.
D. The proportion of acetone and chloroform in the mixture in the liquid phase is not the same as in the vapor phase.

Answer. C. Interaction between unlike molecules is stronger than that between like molecules in the mixture.

Q.4 In a chemistry laboratory, a student has 0.01 L of 10-2 mol dm-3 sulphuric acid solution. The lab assistant asked the student to reduce its concentration to

2 x 10-4 mol dm-3 by adding water into it.

What should be the volume of the water added?

A. 200 ml
B. 490 ml
C. 500 ml
D. 510 ml

Answer. B. 490 ml

Q.5 As per Henry's law KH= p/x; where p is the partial pressure, x is the mole fraction of the gas, and KH is the Henry law constant.

If, the concentration of N2 gas in water at constant pressure increases quadratically, how will the value of KH change?

A. Increases linearly
B. Decreases quadratically
C. Decreases linearly
D. Remains the same

Answer. D. remains the same

Q.6 342.3 g of sucrose is dissolved in 1 kg of water in a pot to form a solution. The boiling point of water (solvent) is 373.15 K.

Which of the following is likely to be the boiling point of the solution?

(Molar mass of sucrose= 342.3 g/mol; Atmospheric pressure= 1.013 bar; K_H= 0.52 K kg mol^{-1})

A. 373 K
B. 373.15 K
C. 373.67 K
D. 372.63 K

Answer. C. 373.67 K

Q.7 The molarity of a solution of NaOH in water is '5p' during the winter season (Temperature = 275K).

Which of the following could be the molarity of the same solution in terms of p during the warm days in summer (Temperature = 325K)?

[Note: p is an integer]

A. 5p + 50
B. 5p
C. 4.95p
D. 250p

Answer. C. 4.95p

Q.8 Which of the following statements is/are true:

(i) The freezing point of 0.1M KCl is higher than that of 0.1M C2H5OH.
(ii) The freezing point of a 4% aqueous solution of X having molecular weight as “m” is equal to the freezing point of 12% aqueous solution of Y having molecular weight “3m” (assume that i=1 for both X and Y)
(iii) The boiling point of pure water at sea level is greater than that at Mt. Everest.

A. i and ii
B. i, ii, and iii
C. ii and iii
D. i and iii

Answer. C. ii and iii

Q.9 Which of the following statements is/are correct?

(i) Sea water boils at a lower temperature than fresh water.
(ii) ΔS is higher for the vaporization of pure solvent than the vaporization of solvent from a solution containing a non-volatile electrolytic solute.
(iii) The boiling point of water is lower than that of glucose water.

A. i and iii
B. ii and iii
C. i, ii, and iii
D. i only

Answer. B. ii and iii

Q.10 Which of the following should be done to change 100 ml of 0.1M KCl solution to 0.2M?

(i) Reduce volume ofsolution to half by evaporation
(ii) Add 50 ml water
(iii) Add 0.1 mol KCl
(iv) Add 0.01 mol KCl

A. i and iii
B. i and iv
C. ii and iv
D. Any of i, ii, iii, and iv

Answer. B. i and iv

Q.11 Rakesh took 20 g of solute A to prepare a 50 ml solution. This solution is isotonic to another solution of the same volume with a weight of 40 g of a different solute B.

(i) If both the solution is prepared at the same temperature, then what is the ratio of molecular mass of solute A to that of B?
(ii) If the two solutions are placed at different temperatures, keeping all other variables constant, and separated by SPM, will the osmosis happen, and why?

Answer. (i) For any solution, osmotic pressure is given by $\pi = (w/MV) \times RT$; w= weight of the solute, V= volume of solution, R = gas constant and T is temperature

- For two solutions to be isotonic, π1= π2 [0.5]
=> 20/M1 = 40/M2
=> M1/M2 = 1/2 [0.5]
(ii) Yes,
- because at different temperatures the solutions are no longer isotonic and hence there will be movement of particles through osmosis

Q.12 A solution containing two non-interacting solid solutes A and B in the mass ratio 5:1 is isotonic with another solution of A and B (with the same volume) having a mass ratio of 3:5.

What is the ratio of the molar mass of A: B?

Answer. The ratio of molar mass A:B:

- Let the molar mass of A is MA and B is MB
- Since the solutions are isotonic,so C1RT = C2RT (equal osmotic pressure) [1 mark]

=> 5/MA + 1/MB = 3/MA + 5/MB
=> 2/MA = 4/MB
=> MA/MB = 1/2 [1 mark]

Q.13 Two solutions A and B are prepared. Both solutions A and B contain an equal amount of organic compounds P and Q respectively as solutes in 500 g benzene (as a solvent).

The boiling point of solution A is 0.4oC higher than that of pure benzene and the boiling point of solution B is 0.8oC higher than that of pure benzene.

(i) Calculate the ratio of molecular weight of P: Q
(ii) If the molecular weight of P is 200, what is the minimum value of the sum of molecular weights of P and Q?

Answer. (i) Ratio of molecular weight of P and Q:

- For solution A, ΔTb = kb x m x i
=> 0.4 = kb x (mass of P/molecular weight of P) x 1000/(weight of benzene) x 1....(equation 1) [1 mark]

- For solution B, ΔTb = kb x m x i
0.8 = kb x (mass of Q/molecular weight of Q) x 1000/(weight of benzene) x

1... equation 2) [0.5 mark]

- Since Mass of P = Mass of Q and kb is the same as both are formed in benzene solution with equal weights, equations i and ii gives
- Molecular weight of P/Molecular weight of Q = 2/1 [0.5 mark]

(ii) Minimum value of the sum of molecular weights of P and Q:
- Since P:Q = 2:1 and molecular weight of P is 200, so Q = 100
- Minimum value= 200+100 = 300

Q.14 The osmotic pressure of a protein solution is 0.6 atm at 283 K. If the temperature of the solution is increased to room temperature (298 K) and a few glasses of water are added to it to make it more dilute, the osmotic pressure becomes 0.3 atm.

Find the volume of the finalsolution in terms of the initial volume of the solution.

Answer. - Initially p1 = 0.6 atm, T1 = 283K and let the volume be V1; Finally, p2 = 0.3, T2= 298K, and let the volume be V2

- Applying osmotic pressure formula

=>p1 x V1/p2 x V2 = nRT1/nRT2 [1mark]
=> 0.6 x V1/0.3 x V2 = 283/298
=> V1/V2 = 283/298 x 0.3/0.6
=> V1/V2 = 0.474 So V2

= 2.10 V1 [1 mark]

Q.15 The osmotic pressure of NaCl in water is 3 times that of the solution of 0.2M $MgCl_2$. If NaCl dissociates completely in water, then calculate the concentration of NaCl.

(Assume the value of R and T as the same for both the solutions)

Answer. The concentration of NaCl:
- Given that $\pi_{NaCl} = 3 \times \pi_{MgCl2}$----- (i)
- Since NaCl, and $MgCl_2$ are ionic compounds, the value of i is 2 and 3 respectively. [1 mark]

From equation (i):

=> 2 x C_{NaCl} x RT = 3 x C_{MgCl2} x RT

=> C_{NaCl} = 3 x 0.2/2 = 0.3 M [1 mark]