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Solutions — CBSE Class 12 Chemistry Chapter Test

FREE CHAPTER TEST · CLASS XII · CHEMISTRY (043) · PATTERN OF THE CBSE SAMPLE QUESTION PAPER 2026-27

TIME ALLOWED	MAXIMUM MARKS	QUESTIONS	NAME / ROLL NO.
1½ hours	37	17 (A 8 · B 3 · C 3 · D 1 · E 2)	

GENERAL INSTRUCTIONS

Read the following instructions very carefully and strictly follow them:

1. This question paper contains 17 questions. All questions are compulsory.
2. This question paper is divided into five sections: A, B, C, D and E.
3. Section A (Q1–8) contains 6 multiple choice questions and 2 assertion-reason based questions of 1 mark each.
4. Section B (Q9–11) contains short answer questions of 2 marks each.
5. Section C (Q12–14) contains short answer questions of 3 marks each.
6. Section D (Q15) contains case-based questions of 4 marks each, with sub-parts of 1, 1 and 2 marks.
7. Section E (Q16–17) contains long answer questions of 5 marks each.
8. There is no overall choice. However, an internal choice has been provided in 1 question in Section B, 1 question in Section C, 1 question in Section D, 2 questions in Section E. Attempt only one of the alternatives in such questions.
9. Use of log tables and calculators is not allowed.
10. This chapter test follows the section structure, question types and marks per question of the CBSE Class XII Chemistry (043) Sample Question Paper 2026-27, at about half the length of the 70-mark board paper: 37 marks in 1½ hours.
11. The answer key and the marking scheme are at the end of this booklet. Attempt the paper in 1½ hours before you look at them.

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Chapter: Solutions · **Topics:** Concentration terms · Henry's law · Vapour pressure and Raoult's law · Ideal and non-ideal solutions · Colligative properties · Abnormal molar masses and van't Hoff factor

SECTION A

This section comprises 8 questions of 1 mark each: 6 multiple choice questions (MCQs) and 2 assertion-reason based questions.

1. 4.0 g of NaOH (molar mass 40 g mol^{-1}) is dissolved in 500 g of water. The molality of the solution is 1

(A) 0.10 m (B) 0.40 m

(C) 0.20 m (D) 2.0 m

2. Which of the following is a colligative property? 1

(A) Osmotic pressure (B) Viscosity

(C) Surface tension (D) Density

3. The van't Hoff factor of K_2SO_4, assuming complete dissociation in water, is 1

(A) 1 (B) 2

(C) 4 (D) 3

4. At a given temperature and partial pressure, a gas with a larger Henry's law constant K_H has 1

(A) a higher solubility in the liquid (B) a lower solubility in the liquid

(C) the same solubility as any other gas (D) no solubility at all

5. The mole fraction of the solute in a 1.0 molal aqueous solution is about 1

(A) 0.177 (B) 0.0555

(C) 1.0 (D) 0.0177

6. Which of the following mixtures shows a negative deviation from Raoult's law? 1

(A) Ethanol + acetone (B) Chloroform + acetone

(C) Benzene + toluene (D) Carbon disulphide + acetone

7. **Assertion (A) :** A 0.1 M aqueous solution of NaCl boils at a higher temperature than a 0.1 M aqueous solution of glucose. 1

Reason (R) : NaCl dissociates in water and gives about twice as many solute particles as glucose.

(A) Both A and R are true, and R is the correct explanation of A.

(B) Both A and R are true, and R is not the correct explanation of A.

(C) A is true but R is false.

(D) A is false but R is true.

8. **Assertion (A) :** An azeotropic mixture can be separated into its components by fractional distillation. 1

Reason (R) : An azeotrope boils at a constant temperature, and its vapour has the same composition as the liquid.

(A) Both A and R are true, and R is the correct explanation of A.

(B) Both A and R are true, and R is not the correct explanation of A.

(C) A is true but R is false.

(D) A is false but R is true.

SECTION B

This section comprises 3 short answer questions of 2 marks each.

9. Liquids A and B form an ideal solution. At a certain temperature the vapour pressures of pure A and pure B are 300 mm Hg and 800 mm Hg. Find the vapour pressure of a solution in which the mole fraction of A is 0.60, and the mole fraction of A in the vapour. 2

10. (a) Define osmotic pressure. Why is the measurement of osmotic pressure preferred to other colligative properties for finding the molar masses of proteins and polymers? 2

OR

(b) Define molarity and molality. Which of them changes with temperature, and why?

11. 1.8 g of glucose (molar mass 180 g mol^{-1}) is dissolved in 100 g of water. Find the freezing point of the solution. (K_f for water = 1.86 K kg mol^{-1}) 2

SECTION C

This section comprises 3 short answer questions of 3 marks each.

12. (a) 1.25 g of a non-volatile, non-electrolyte solute dissolved in 50 g of a solvent raises its boiling point by 0.25 K. Find the molar mass of the solute. (K_b of the solvent = 2.5 K kg mol^{-1}) 3

OR

(b) A solution of 2.0 g of a polymer in 250 mL of water has an osmotic pressure of 8.3×10^{-3} bar at 300 K. Find the molar mass of the polymer. (R = 0.083 L bar K^{-1} mol^{-1})

13. A 0.10 molal aqueous solution of a weak monobasic acid HA freezes at −0.2046 °C. Find the van't Hoff factor and the degree of dissociation of the acid. (K_f for water = 1.86 K kg mol^{-1}) 3

14. (i) Write two characteristics of an ideal solution. 3
(ii) Explain, with one example, why some solutions show a positive deviation from Raoult's law.
(iii) What is a minimum-boiling azeotrope?

SECTION D

This section comprises 1 case-based question of 4 marks, with sub-parts of 1, 1 and 2 marks.

15. Many coastal towns and ships obtain drinking water from seawater by reverse osmosis. Seawater is pushed against a membrane that lets water molecules through but holds back the dissolved salts, so pure water collects on the other side. The pressure needed depends on the osmotic pressure of the seawater, which is mainly due to dissolved sodium chloride. ($R = 0.083$ L bar K^{-1} mol^{-1})

(I) In reverse osmosis, how must the pressure applied to the seawater compare with its osmotic pressure? [1]

(II) Name a material used for the membrane in reverse-osmosis plants. [1]

(III) Treating seawater as a 0.50 M solution of NaCl that is fully dissociated, find its osmotic pressure at 300 K. What is the least pressure needed for reverse osmosis? [2]

OR

(III) A 0.10 M glucose solution and a 0.10 M NaCl solution are separated by a semipermeable membrane at the same temperature. In which direction will water flow? Explain. [2]

SECTION E

This section comprises 2 long answer questions of 5 marks each.

16. (a) (i) State Raoult's law for a solution of two volatile liquids, and show that the total vapour pressure varies linearly with the mole fraction of either component. 5

(ii) Show that for a solution of a non-volatile solute the relative lowering of vapour pressure equals the mole fraction of the solute.

(iii) 6.0 g of urea (molar mass 60 g mol^{-1}) is dissolved in 90 g of water. The vapour pressure of pure water at this temperature is 25.5 mm Hg. Find the vapour pressure of the solution.

OR

(b) (i) What is the van't Hoff factor? What are its values for a solute that dissociates and for one that associates? Write the modified expressions for the elevation of boiling point and for the osmotic pressure.

(ii) 3.05 g of benzoic acid (molar mass 122 g mol^{-1}) dissolved in 50 g of benzene lowers its freezing point by 1.536 K. Benzoic acid forms dimers in benzene. Find the van't Hoff factor and the percentage of benzoic acid that is associated. (K_f for benzene = 5.12 K kg mol^{-1})

17. (a) (i) Explain, using the vapour pressure curves of a solvent and a solution, why a solution of a non-volatile solute boils at a higher temperature than the pure solvent. Show that $\Delta T_b = K_b m$, and define K_b. 5

(ii) Find the boiling point of a solution of 3.42 g of sucrose (molar mass 342 g mol^{-1}) in 100 g of water. (K_b for water = 0.52 K kg mol^{-1}; boiling point of water = 373.15 K)

OR

(b) (i) State Henry's law. Explain why soft-drink bottles are sealed under high pressure, and why deep-sea divers can suffer from 'the bends' if they come up too quickly.

(ii) The Henry's law constant of nitrogen in water at 298 K is 8.0×10^4 bar. Find the mole fraction of nitrogen dissolved in water when its partial pressure is 0.80 bar, and the number of moles of nitrogen dissolved in 1 L of water.

END OF THE QUESTION PAPER

ANSWER KEY — SECTION A

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
(C)	(A)	(D)	(B)	(D)	(B)	(A)	(D)

MARKING SCHEME AND WORKED SOLUTIONS

Marks for each step are shown in brackets, as in the CBSE marking scheme. Any correct alternative method earns full marks.

Q1. Answer (C). Moles = 4.0/40 = 0.10; molality = 0.10/0.500 kg = 0.20 mol kg^{-1}.

Q2. Answer (A). Osmotic pressure depends only on the number of solute particles, not on their nature.

Q3. Answer (D). $K_2SO_4 \rightarrow 2K^+ + SO_4^{2-}$: three ions per formula unit, i = 3.

Q4. Answer (B). $p = K_H x$, so $x = p/K_H$: a larger K_H means a smaller mole fraction dissolved.

Q5. Answer (D). 1 mol solute in 1000 g water (1000/18 = 55.6 mol): x = 1/56.6 ≈ 0.0177.

Q6. Answer (B). Chloroform forms hydrogen bonds with acetone: A–B attractions are stronger than A–A and B–B, so the vapour pressure is lower than Raoult's law predicts.

Q7. Answer (A). Elevation of boiling point ∝ i × m; i ≈ 2 for NaCl and 1 for glucose. R explains A. Answer A.

Q8. Answer (D). Because the vapour has the same composition as the liquid, distillation cannot separate an azeotrope: A is false, R is true. Answer D.

Q9. (2 marks) Answer: 500 mm Hg; 0.36.
$p = x_A p^\circ_A + x_B p^\circ_B = 0.60 \times 300 + 0.40 \times 800 = 180 + 320 = 500$ mm Hg. [1]
$y_A = p_A/p = 180/500 = 0.36$. [1]

Q10. (2 marks) Answer: (a) large at low concentration, room temperature; (b) molarity changes with temperature.
(a) The excess pressure that must be applied to a solution to stop the flow of solvent into it through a semipermeable membrane. [1]
It is large even for very dilute solutions (easy to measure), it is measured at room temperature (proteins are not damaged by heating), and molarity rather than molality is used. [1]
OR (b) Molarity = moles of solute per litre of solution; molality = moles of solute per kilogram of solvent. [1] Molarity changes with temperature, because the volume of the solution changes; molality does not, because masses do not change. [1]

Q11. (2 marks) Answer: ≈ 272.96 K (−0.186 °C).
m = (1.8/180)/0.100 = 0.10 mol kg^{-1}. [1]
$\Delta T_f = K_f m = 1.86 \times 0.10 = 0.186$ K; freezing point = 273.15 − 0.186 ≈ 272.96 K (−0.186 °C). [1]

Q12. (3 marks) Answer: (a) 250 g mol^{-1}; (b) 2.4×10^4 g mol^{-1}.
(a) $\Delta T_b = K_b \times (w_2/M_2)/(W_1/1000)$, so $M_2 = K_b \times w_2 \times 1000/(\Delta T_b \times W_1)$. [1]
$M_2 = 2.5 \times 1.25 \times 1000/(0.25 \times 50)$ [1] = 3125/12.5 = 250 g mol^{-1}. [1]
OR (b) $\pi = (w/M)RT/V$, so $M = wRT/(\pi V)$. [1]
$M = 2.0 \times 0.083 \times 300/(8.3 \times 10^{-3} \times 0.250)$ [1] = $49.8/(2.075 \times 10^{-3}) = 2.4 \times 10^4$ g mol^{-1}. [1]

Q13. (3 marks) Answer: i = 1.1; α = 0.10.
Expected ΔT_f without dissociation = 1.86 × 0.10 = 0.186 K. [1]
i = observed/expected = 0.2046/0.186 = 1.1. [1]
$HA \rightleftharpoons H^+ + A^-$: particles = 1 − α + 2α = 1 + α = i, so α = 0.10 (10 %). [1]

Q14. (3 marks) Answer: (i) obeys Raoult's law, $\Delta_{mix}H = 0$, $\Delta_{mix}V = 0$.

(i) Any two: it obeys Raoult's law at all compositions; $\Delta_{mix}H = 0$; $\Delta_{mix}V = 0$. [1]

(ii) When the A–B attractions are weaker than the A–A and B–B attractions, molecules escape more easily and the vapour pressure is higher than Raoult's law predicts; e.g. ethanol + acetone (acetone breaks the hydrogen bonds between ethanol molecules). [1]

(iii) A mixture of a solution with a large positive deviation that boils at a constant temperature lower than either component, its vapour having the same composition as the liquid (e.g. about 95 % ethanol in water). [1]

Q15. (4 marks) Answer: (I) greater than π; (II) cellulose acetate; (III) ≈ 24.9 bar, or water flows into the NaCl solution.

(I) The applied pressure must be greater than the osmotic pressure of the seawater. [1]

(II) Cellulose acetate (or another polymer film permeable to water only). [1]

(III) $\pi = iCRT = 2 \times 0.50 \times 0.083 \times 300 \approx 24.9$ bar [1]; more than about 24.9 bar must be applied. [1]

OR (III) NaCl gives $i \approx 2$, so its osmotic pressure is about twice that of the glucose solution. [1] Water flows from the glucose solution (lower osmotic pressure) into the NaCl solution. [1]

Q16. (5 marks) Answer: (a) $p = p^\circ_2 + (p^\circ_1 - p^\circ_2)x_1$; 25.0 mm Hg; (b) $i = 0.60$; 80 % associated.

(a) (i) The partial vapour pressure of each component is proportional to its mole fraction: $p_1 = x_1p^\circ_1$, $p_2 = x_2p^\circ_2$. [½] $p = x_1p^\circ_1 + (1 - x_1)p^\circ_2 = p^\circ_2 + (p^\circ_1 - p^\circ_2)x_1$: a straight line. [1]

(ii) Only the solvent is volatile: $p = x_1p^\circ_1$, so $(p^\circ_1 - p)/p^\circ_1 = 1 - x_1 = x_2$. [1½]

(iii) n(urea) = 0.10 mol, n(water) = 5.0 mol: $x_2 = 0.10/5.10$. [1] $p = p^\circ x_1 = 25.5 \times 5.0/5.1 = 25.0$ mm Hg. [1]

OR (b) (i) i = observed colligative property/calculated colligative property (or total moles of particles after association or dissociation/moles of particles before). [1] $i > 1$ for dissociation (e.g. KCl), $i < 1$ for association (e.g. ethanoic acid in benzene). [½] $\Delta T_f = iK_fm$, $\Delta T_b = iK_bm$, $\pi = iCRT$, $(p^\circ - p)/p^\circ = i\,x_2$. [1½]

(ii) $m = (3.05/122)/0.050 = 0.50$ mol kg⁻¹. [½] $i = \Delta T_f/(K_fm) = 1.536/(5.12 \times 0.50) = 0.60$. [1] $2A \rightleftharpoons A_2$: particles $= 1 - \alpha + \alpha/2 = 1 - \alpha/2 = 0.60$, so $\alpha = 0.80$ (80 % associated). [½]

Q17. (5 marks) Answer: (a) $\Delta T_b = K_bm$; ≈ 373.20 K; (b) $p = K_Hx$; $\approx 5.6 \times 10^{-4}$ mol.

(a) (i) A liquid boils when its vapour pressure equals the external pressure. The solute lowers the vapour pressure, so the curve of the solution lies below that of the solvent at every temperature, and the solution must be heated to a higher temperature T_b before its vapour pressure reaches 1 atm. [1½] For dilute solutions the lowering of vapour pressure, and so ΔT_b, is proportional to the molality: $\Delta T_b = K_bm$. [1] K_b (molal elevation constant) is the elevation of boiling point for a 1 molal solution. [½]

(ii) $m = (3.42/342)/0.100 = 0.10$ mol kg⁻¹; $\Delta T_b = 0.52 \times 0.10 = 0.052$ K. [1] Boiling point = 373.15 + 0.052 ≈ 373.20 K. [1]

OR (b) (i) At constant temperature, the partial pressure of a gas above a solution is proportional to its mole fraction in the solution: $p = K_Hx$. [1] Soft drinks are sealed under a high pressure of CO_2 to dissolve more of it. [1] Divers breathing compressed air deep under water have more nitrogen dissolved in their blood; on rising quickly the pressure falls, the nitrogen comes out as bubbles and blocks capillaries (the bends). [1]

(ii) $x = p/K_H = 0.80/(8.0 \times 10^4) = 1.0 \times 10^{-5}$. [1] n(water) in 1 L ≈ 1000/18 ≈ 55.6 mol, so $n(N_2) \approx 1.0 \times 10^{-5} \times 55.6 \approx 5.6 \times 10^{-4}$ mol. [1]

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