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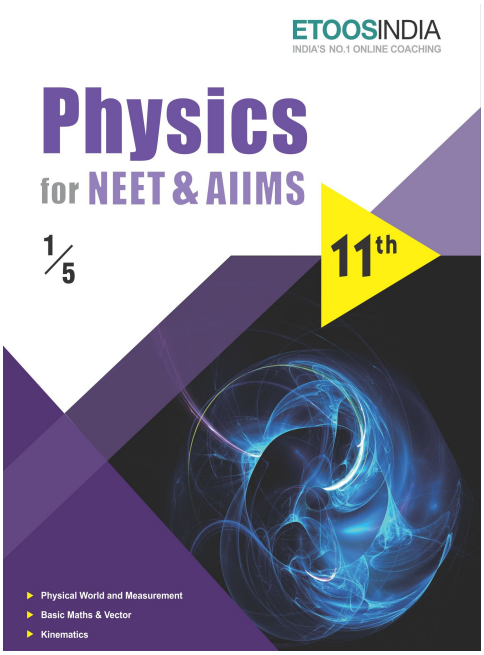
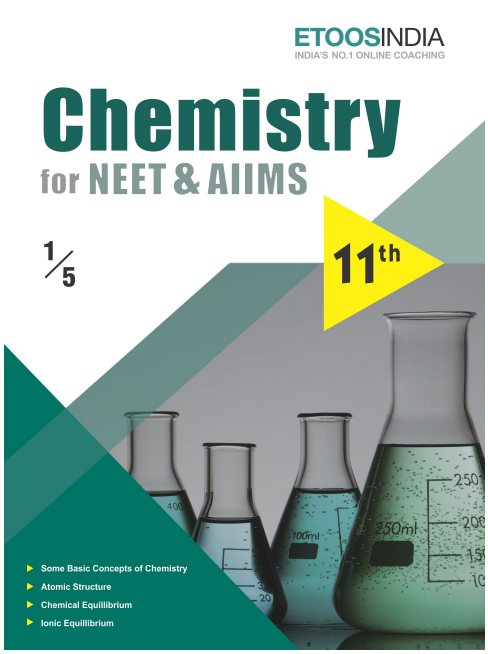
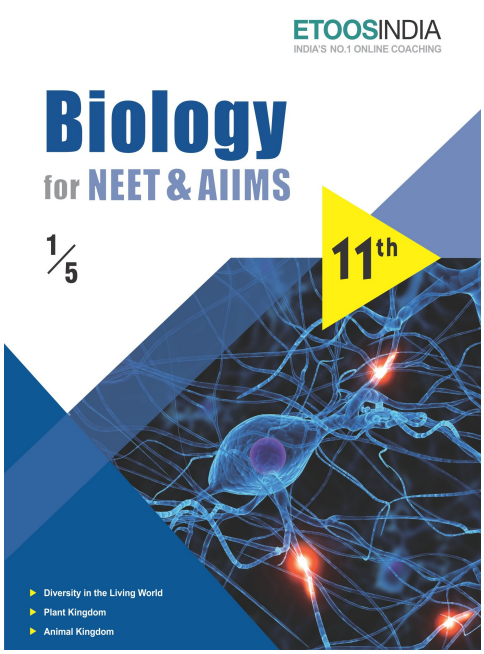
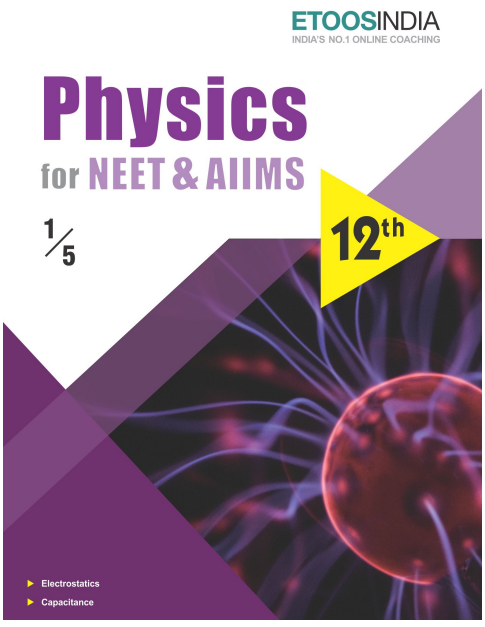
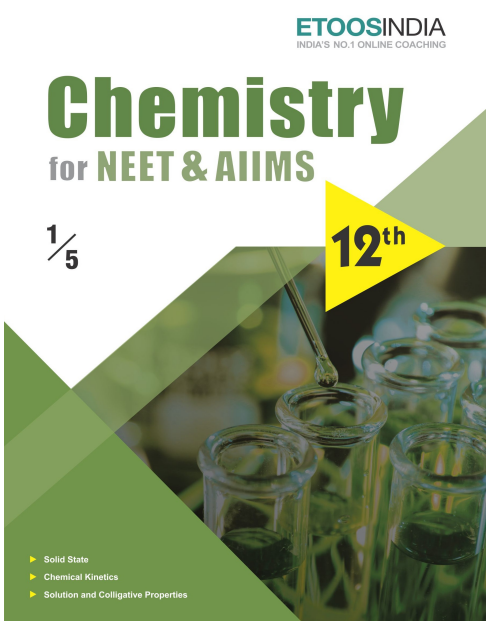
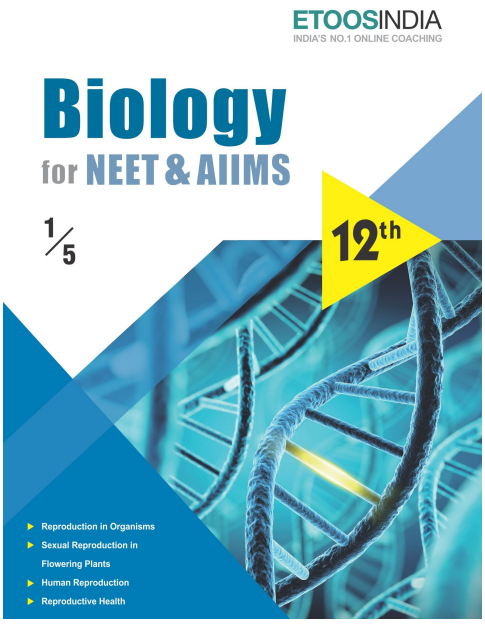












ETOOS Comprehensive Study Material
For NEET & AIIMS

CHAPTER 03

SOLUTION AND COLLIGATIVE PROPERTIES

I was captured for life by chemistry and by crystals.

"DOROTHY HODGKIN"

INTRODUCTION

Solution is a mixture of more than one pure substances. A dilute aqueous solution of sugar revives the size of partially dried resins while a concentrated aqueous solution of sugar decreases the size of fresh resins by dehydration. Dysentery and dehydration is treated by aqueous solution of salt, ORS. A "kulfi" vendor uses aqueous solution of salt as freezing mixture to freeze kulfis as this solution provides sub zero temperature.

When two or more chemically non-reacting substances are mixed and form homogeneous mixture is called **solution**.

When the solution is composed of only two chemical substances, it is termed a binary solution, similarly, it is called tertiary and quaternary if it is composed of three and four components respectively.

Solution = solute + solvent

Ex. 1 mole heptane (V.P. = 92 mm of hg) is mixed with 4 mol. Octance (V.P. = 31 mm of Hg), form an ideal solution. Find out the vapour pressure of solution

Sol. Total mole = 1 + 4 = 5

Mole fraction of heptane $X_A = 1/5$

Mole fraction of octane $X_B = 4/5$

$$P_S = X_A P_A^0 + X_B P_B^0 = \frac{1}{2} \times 92 + \frac{4}{5} \times 32 = 43.2 \text{ mm of Hg}$$

Ex. At 88ºC benzene has a vapour pressure of 900 torr and toluene has a vapour pressure of 360 torr. What is the mole fraction of benzene in the mixture with toluene that will be boil at 88ºC. at 1 atm pressure, benzene – toluene form an ideal solution.

Sol. $P_s = 760$ torr, because solution boils at 88ºC

$\therefore \quad P_s = P_B^0 X_B^0 + P_t^0 X_t$

$760 = 900a + 360 - 360\,a$

$a = 0.74$ where 'a' is mole fraction of $C_6H_6(X_B)$

ETOOS KEY POINTS

Konowaloff's rule

(i) Konowaloff's rule : - At any fixed temperature, the vapour phase is always richer in the more volatile component as compared to the solution phase. In other words, mole fraction of the more volatile component is always greater in the vapour phase than in the solution phase. Alternatively, vapour phase is relatively richer in the component whose addition to the liquid mixture results in an increase in the total vapour pressure.

(ii) Mole fraction of component in the vapour phase

$$= \frac{\text{Partial pressure of that component}}{\text{Total vapour pressure}} = \frac{p_A^0 \chi_A}{p_A^0 \chi_A + p_B^0 \chi_B}$$

where p_A^0 = vapour pressure of A

χ_A = Mole fraction of A

p_B^0 = Vapour pressure of B

χ_B = Mole fraction of GB

AZEOTROPIC MIXTURES

This type of liquid mixture, having a definite composition and boiling like a pure liquid is called azeotropic mixture or constant boiling mixture. The azeotropic mixture cannot be separated by fractional distillation, such solutions are called azeotropic solutions and this phenomenon is known as azeotropy. In azeotropic conditions combination of solute and solvent (solution) starts behaving like one single molecule (with reference to boiling point). This happens due to certain inter-molecular pattern of attractive forces leaving no molecule out of this network, so no component is free to show it's own boiling point but solution behaves like one single entity and therefore boils at a particular boiling point and therefore solution becomes inseperable by fractional distillation method as this method is only helpful when components differ in their boiling points. Two type of non-ideal solution form two different azeotropes.

Etoos Tips & Formulas

1. **Vapour Pressure :** Pressure of any volatile substance at any given temperature.

$T \uparrow \Rightarrow$ V.P. $\uparrow$

Attractive forces $\uparrow \Rightarrow$ V.P. $\downarrow$

2. **Raoult's law**

Non volatile solute and volatile solvent solution.

If $\begin{cases} B = \text{Non volatile solid} \\ P_B = 0 \end{cases}$

$$P_A = P_A^\circ X_A$$

3. **Colligative Properties :** Properties depends on no. of particles of Non volatile solute in solution.

No. of particle of Non volatile solute ↑ Colligative Properties ↑

(1) **Relative lowering of V.P.**

$$\frac{P_A^\circ - P_A}{P_A^\circ} = i\frac{n_B}{n_A + n_B} \simeq i\frac{n_B}{n_A}$$

Where n_B = mole of Non-volatile solute.

i = Vant Hoff's factor.

(2) **Elevation in B.P.**

$\Delta T_b = (T_b' - T_b) = i.\, k_b \times m.$

where $K_b = \dfrac{RT_b^2}{1000 \times \ell_v}$

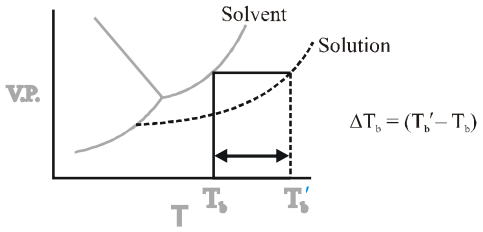
where T_b = B.P. of pure solvent.

ℓ_v = Latent heat of vapourization per gm

K_b = molal elevation constant

M = molar mass

where $\ell_v = \left(\dfrac{\Delta H_{vap}}{M}\right)$



(3) **Depression** in FP.

$\Delta T_f = T_f - T_f' = i\, k_f \times m$

where $k_f = \dfrac{RT_f^2}{1000 \times \ell_f}$

T_f = f.p. of pure solvent

k_f = molal depression contsant

ℓ_f = latent heat of fusion per gm.

SOLVED EXAMPLE

Ex.1 Which of the following units is useful in relating concentration of solution with its vapoup pressure
(A) Mole fraction **(B)** Parts per million
(C) Mass percentage **(D)** Molality

Sol. **(A)** According to Henry's law partial pressure of gas in the solution is proportional to the mole fraction of gas in the solution.

$$p = K_H X$$

where, K_H = Henry's constant.

Ex.2 On dissolving sugar in water at room temperature solution feels cool to touch. Under which of the following cases dissolution of sugar will be most rapid
(A) Sugar crystals in cold water
(B) Sugar crystals in hot water
(C) Powdered sugar in cold water
(D) Powdered sugar in hot water

Sol. **(D)** Dissolution of sugar in water will be most rapid when powdered sugar is dissolved in hot water because powder from can easily insert in the vacancies of liquid particles. Further dissolution of sugar in water is an endothermic process. Hence, high temperature will favour the dissolution of sugar in water.

Ex.3 At equilibrium the rate of dissolution of a solid solute in a volatile liquid is .....
(A) Less than the rate of crystallisation
(B) Greater than the rate of crystallisation
(C) Equal to the rate of crystallisation
(D) Zero

Sol. **(C)** At equilibrium the rate of dissolution of solid in a volatile liquid solvent is equal to the rate of crystallization.

Ex.4 A beaker contains a solution of substance 'A' Precipitation of substance 'A' takes place when small amount of 'A' is added to the solution. The solution is .....
(A) Saturated **(B)** Supersaturated
(C) Unsaturated **(D)** Concentrated

Sol. **(D)** When solute is added to the solution three cases may arise
(i) It dissolves into solution then solution is unsaturated.
(ii) It does not dissolve in the solution then solution is known as saturated.
(iii) When solute get precipitated solution is known as supersaturated solution.

Ex.5 Maximum amount of a solid that can be dissolved in a specified amount of a given liquid solvent does not depend upon .....
(A) Temperature **(B)** Nature of solute
(C) Pressure **(D)** Nature of solvent

Sol. **(C)** Maximum amount of solid that can be dissolved in a specified amount of a given solvent does not depend upon pressure. This is because solid and liquid are highly incompressible is because solid and liquid are highly incompressible and practically remain unaffected by change in pressure.

Ex.6 Low concentration of oxygen in the blood and tissues of people living at high altitude is due to .....
(A) Low temperature
(B) Low atmospheric pressure
(C) High atmospheric pressure
(D) Both low temperature and high atmospheric pressure

Sol. **(B)** Low concentration of oxygen in the blood and tissues of people living at high altitude is due to low atmospheric pressure. Because at high altitiude, the partial pressure of oxygen is less than at the ground level. This decreased atmospheric pressure causes release of oxygen from blood.

Ex.7 Considering the formation, breaking and strength of hydrogen bond, predict which of the following mixtures will show a positive deviation from Raoult's law
(A) Methanol and acetone
(B) Chloroform and acetone
(C) Nitric acid and water
(D) Phenol and aniline

Sol. **(A)** In pure methanol, molecules are hydrogen bonded. One adding acetone, its molecules get in between the host molecules and break some of the hydrogen bonds between them.
Therefore, the intermolecular attractive forces between the solute-solvent molecules are weaker than those between the solute-solute and solvent-solvent molecules.
ON the other hand, other three remaining options will show negative deviation from Raoult's law where the intermolecular attractive forces between the solute -solvent molecules are stronger than those between the solute-solute and solvent-solvent molecules.

Exercise # 1 SINGLE OBJECTIVE NEET LEVEL

1. The solubility of a gas in water depends on
(A) Nature of the gas (B) Temperature
(C) Pressure of the gas (D) All of the above

2. Which of the following is not correct for D_2O
(A) Boiling point is higher than H_2O
(B) D_2O reacts slowly than H_2O
(C) Viscosity is higher than H_2O at 25°
(D) Solubility of NaCl in it is more than H_2O

3. The statement " The mass of a gas dissolved in a given mass of a solvent at any temperature is proportional to the pressure of the gas above the solvent" is
(A) Dalton's Law of Partial Pressures
(B) Law of Mass Action
(C) Henry's Law
(D) None of these

4. Which is correct about Henry's law
(A) The gas in contact with the liquid should behave as an ideal gas
(B) There should not be any chemical interaction between the gas and liquid
(C) The pressure applied should be high
(D) All of these

5. The statement "If 0.003 moles of a gas are dissolved in 900 g of water under a pressure of 1 atmosphere, 0.006 moles will be dissolved under a pressure of 2 atmospheres", illustrates
(A) Dalton's law of partial pressure
(B) Graham's law
(C) Raoult's law
(D) Henry's law

6. The solution of sugar in water contains
(A) Free atoms
(B) Free ions
(C) Free molecules
(D) Free atom and molecules

7. 25 ml of 3.0 M HNO_3 are mixed with 75 ml of 4.0 M HNO_3. If the volumes are additive, the molarity of the final mixture would be
(A) 3.25 M (B) 4.0 M
(C) 3.75 M (D) 3.50 M

8. The amount of anhydrous Na_2CO_3 present in 250 ml of 0.25 M solution is
(A) 6.225 g (B) 66.25 g
(C) 6.0 g (D) 6.625 g

9. Dilute one litre 1 molar solution by 5 litre water, the normality of that solution is
(A) 0.2 N (B) 5N
(C) 10 N (D) 0.33 N

10. If 5.85 gms of NaCl are dissolved in 90 gms of water, the mole fraction of NaCl is
(A) 0.1 (B) 0.2
(C) 0.3 (D) 0.01
(e) 0.0196

11. The molarity of 0.006 mole of NaCl in solution is
(A) 0.6 (B) 0.06
(C) 0.006 (D) 0.066
(e) None of these

12. 9.8 g of H_2SO_4 is present in 2 litres of a solution. The molarity of the solution is
(A) 0.1 M (B) 0.05 M
(C) 0.2 M (D) 0.01 M

13. What will be the molarity of a solution containing 5g of sodium hydroxide in 250 ml solution
(A) 0.5 (B) 1.0
(C) 2.0 (D) 0.1

14. The normality of 0.3 M phosphorus acid (H_3PO_3) is
(A) 0.1 (B) 0.9
(C) 0.3 (D) 0.6

15. Which of the following has maximum number of molecules
(A) 16 gm of O_2 (B) 16 gm of NO_2
(C) 7 gm of N_2 (D) 2 gm of H_2

16. Molarity is expressed as
(A) Gram/litre (B) Moles/litre
(C) Litre/mole (D) Moles/1000 gms

17. 200 ml of HCl solution requires 19.85 ml of 0.01M NaOH solution for complete neutralization. The molarity of HCl solution is
(A) 0.0099 (B) 0.099
(C) 0.99 (D) 9.9

Exercise # 2 SINGLE OBJECTIVE AIIMS LEVEL

1. Persons are medically considered to have lead poisoning if they have a concentration greater than 10 micrograms of lead per decilitre of blood. Concentration in parts per billion is :
(A) 1000 (B) 100
(C) 10 (D) 1

2. Which statement best explains the meaning of the phrase "like dissolves like " ?
(A) A Solute will easily dissolve a solute of similar mass
(B) A solvent and solute with similar intermolecular forces will readily form a solution
(C) The only true solutions are formed when water dissolves a non-polar solute
(D) The only true solutions are formed when water dissolves a polar solute

3. An ionic compound that attracts atmospheric water so strongly that a hydrate is formed is said to be :
(A) Dilute (B) Hygroscopic
(C) Immiscible (D) Miscible

4. The vapour pressure of water depends upon :
(A) Surface area of container
(B) Volume of container
(C) Temperature
(D) All

5. A liquid is kept in a closed vessel. If a glass plate (negligible mass) with a small hole is kept on top of the liquid surface, then the vapour pressure of the liquid in the vessel is :
(A) More than what would be if the glass plate were removed
(B) Same as what would be if the glass plate were removed
(C) Less than what would be if the glass plate were removed
(D) Cannot be predicted

6. At higher altitudes, water boils at temperature < 100ºC because
(A) temperature of higher altitudes is low
(B) atmospheric pressure is low
(C) the proportion of heavy water increases
(D) atmospheric pressure becomes more.

7. Among the following substances, the lowest vapour pressure is exerted by :
(A) Water (B) Mercury
(C) Kerosene (D) Rectified spirit

8. When a liquid that is immiscible with water was steam distilled at 952ºC at a total pressure of 748 torr, the distillate contained 1.25 g of the liquid per gram of water. The vapour pressure of water is 648 torr at 95.2ºC, what is the molar mass of liquid?
(A) 7.975 g/mol (B) 166 g/mol
(C) 145.8 g/mol (D) None of these

9. Two liquids X and Y are perfectly immiscible. If X and Y have molecular masses in ratio 1 : 2, the total vapour pressure of a mixture of X and Y prepared in weight ratio 2 : 3 should be ($P_x^0 = 400$ torr, $P_y^0 = 200$ torr)
(A) 600 torr (B) 400 torr
(C) 800 torr (D) 1000 torr

10. An ideal solution contains two volatile liquids A ($p^o = 100$ torr) and B ($p^o = 200$ torr). If mixture contain 1 mole of A and 4 mole of B then total vapour pressure of the distillate is:
(A) 150 (B) 180
(C) 188.88 (D) 198.88

11.. The vapour pressure of two pure liquids A and B, that form an ideal solution are 100 and 900 torr respectively at temperature T. This liquid solution of A and B is composed of 1 mole of A and 1 mole of B. What will be the pressure, when 1 mole of mixture has been vaporized ?
(A) 800 torr (B) 500 torr
(C) 300 torr (D) None of these

12. For a binary ideal liquid solution, the total pressure of the solution is given as :
(A) $P_{total} = P^o_A + (P^o_A - P^o_B) X_B$
(B) $P_{total} = P^o_B + (P^o_A - P^o_B) X_A$
(C) $P_{total} = P^o_B + (P^o_B - P^o_A) X_A$
(D) $P_{total} = P^o_B + (P^o_B - P^o_A) X_B$

13. Given at 350 K $p_A^\circ = 300$ torr and $p_B^\circ = 800$ torr, the composition of the mixture having a normal boiling point of 350 K is
(A) $X_A = 0.08$ (B) $X_A = 0.06$
(C) $X_A = 0.04$ (D) $X_A = 0.02$

Exercise # 3 PART - 1 MATRIX MATCH COLUMN

1. Assuming all the solutes are non volatile and all solutions are ideal and neglect the hydrolysis of cation and anion.

Column – I	Column – II
(A) 10 ml 0.1 M NaOH aqueous solution is added to 10 ml 0.1 M HCl aqueous solution	**(p)** Osmotic pressure of solution increases
(B) 10 ml 0.1 M NaOH aqueous solution is added to 10 ml 0.1 M CH_3COOH aqueous solution	**(q)** Vapour pressure of solution increases
(C) 10 ml 0.1 M HCl aqueous solution is added to 10 ml 0.1 M NH_3 aqueous solution	**(r)** Boiling point of solution increases
(D) 10 ml 0.1 M HCl aqueous solution is added to 10 ml 0.1 M KOH aqueous solution	**(s)** Freezing point of solution increases

2.

Column I	Column II
(A) Acetone + $CHCl_3$	**(p)** $\Delta S_{mix.} > 0$
(B) Ethanol + Water	**(q)** $\Delta V_{mix.} > 0$
(C) $C_2H_5Br + C_2H_5I$	**(r)** $\Delta H_{mix.} < 0$
(D) Acetone + Benzene	**(s)** Maximum boiling azeotropes
	(t) Minimum boiling azeotropes

3.

Column-I (Properties)	Column-II (Affecting factors)
(A) Relative lowering of vapour pressure	**(p)** Directly proportional to van't Hoff factor, i
(B) Elevation in boiling point	**(q)** Directly proportional to molality
(C) Freezing point	**(r)** Directly proportional to molarity
(D) Osmotic pressure	**(s)** Indirectly proportional to lowering of vapour pressure

4. Match the entries listed in Column I with appropriate entries listed in Column II.

Column-I	Column-II
(A) 0.1 M $BaCl_2$ solution	**(p)** 271 K
(B) 0.1 M NaCl solution	**(q)** 270 K
(C) 0.1 M $K_3[Fe(CN)_6]$	**(r)** 268 K
(D) 0.1 M $Al_2(SO_4)_3$ solution	**(s)** 269 K

Given : Freezing point of 0.1 M sucrose solution = 272 K

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Exercise # 4 PART - 1 PREVIOUS YEAR (NEET/AIPMT)

1. Which of the following colligative property can provide molar mass of proteins (or polymers or colloids) with greatest precision? [CBSE AIPMT 2000]
(A) Osmotic pressure
(B) Elevation in boiling point
(C) Depression in freezing point
(D) Relative lowering of vapour pressure

2. Molarity of liquid HCl, if density of solution is 1.17 g/cc is [CBSE AIPMT 2001]
(A) 36.5 (B) 18.25
(C) 32.05 (D) 42.10

3. Pure water can be obtained from sea water by [CBSE AIPMT 2001]
(A) centrifugation (B) plasmolysis
(C) reverse osmosis (D) sedimentation

4. 1 M and 2.5 L NaOH solution is mixed with another 0.5 M and 3 L NaOH solution. Then, find out the molarity of resultant solution. [CBSE AIPMT 2002]
(A) 0.80 M (B) 1.0 M
(C) 0.73 M (D) 0.50 M

5. A solution contains non-volatile solute of molecular mass, M_2. Which of the following can be used to calculate the molecular mass of solute in terms of osmotic pressure? [CBSE AIPMT 2002]
(A) $M_2 = \left[\frac{m_2}{\pi}\right]VRT$ (B) $M_2 = \left[\frac{m_2}{V}\right]\frac{RT}{\pi}$
(C) $M_2 = \left[\frac{m_2}{V}\right]\pi RT$ (D) $M_2 = \left[\frac{m_2}{V}\right]\frac{\pi}{RT}$

6. A solution containing components A and B follows Raoult's law, when [CBSE AIPMT 2002]
(A) A - B attraction force is greater than A-A and B-B
(B) A - B attraction force is less than A - A and B - B
(C) A - B attraction force remains same as A - A and B - B
(D) volume of solution is different from sum of volumes of solute and solvent

7. Formation of a solution from two components can be considered as [CBSE AIPMT 2003]
I. pure solvent → separated solvent molecules, ΔH_1
II. pure solute → separated solute molecules, ΔH_2
III. separated solvent and solute molecules → solution, ΔH_3
Solution so formed will be ideal, if
(A) $\Delta H_{sol.} = \Delta H_1 - \Delta H_2 - \Delta H_3$
(A) $\Delta H_{sol.} = \Delta H_1 - \Delta H_2 - \Delta H_3$
(A) $\Delta H_{sol.} = \Delta H_1 + \Delta H_2 + \Delta H_3$
(A) $\Delta H_{sol.} = \Delta H_1 + \Delta H_2 - \Delta H_3$

8. The vapour pressure of two liquids P and Q are 80 and 60 torr, respectively, The total vapour pressure of solution obtained by mixing 3 moles of P and 2 moles of Q would be [CBSE AIPMT 2005]
(A) 140 torr (B) 20 torr
(C) 68 torr (D) 72 torr

9. A solution of urea (mol. mass 56 g mol^{-1}) boils at 100.18°C at the atmospheric pressure. If k_f and k_b for water are 1.86 and 0.512 K kg mol^{-1} respectively, the above solution will freeze at [CBSE AIPMT 2005]
(A) – 6.54°C (B) 6.54°C
(C) 0.654°C (D) – 0.654°C

10. A solution has 1 : 4 mole ratio of pentane to hexane. The vapour pressure of the pure hydrocarbons at 20°C are 440 mm of Hg for pentane and 120 mm of Hg for hexane. The mole fraction of pentane in the vapour phase would be [CBSE AIPMT 2005]
(A) 0.549 (B) 0.200
(C) 0.786 (D) 0.478

11. The mole fraction of the solute in one molal aqueous solution is [CBSE AIPMT 2005]
(A) 0.027 (B) 0.036
(C) 0.018 (D) 0.009

12. A solution containing 10 g per dm^3 of urea (molecular mass = 60 g mol^{-1})is isotonic with a 5 % solution of a non-volatile solute. The molecular mass of this non-volatile solute is [CBSE AIPMT 2006]
(A) 250 g mol^{-1} (B) 300 g mol^{-1}
(C) 350 g mol^{-1} (D) 200 g mol^{-1}

MOCK TEST

STRAIGHT OBJECTIVE TYPE

1. When ethanol mixes in cyclohexane; cyclohexane reduces the intermolecular forces between ethanol molecule. In this, liquid pair shows
(A) Positive deviation by Raoult's law (B) Negative deviation by Raoult's law
(C) No deviation by Raoult's law (D) Decrease in volume

2. Liquids A and B form an ideal solution
(A) The enthalpy of mixing is zero
(B) The entropy of mixing is zero
(C) The free energy of mixing is zero
(D) The free energy as well as the entropy of mixing are each zero

3. As a result of osmosis the volume of solution
(A) Increases (B) Decreases (C) Remains constant (D) Increases or decreases

4. A solution of urea contain 8.6 gm/litre (mol. wt. 60.0). It is isotonic with a 5% solution of a non-volatile solute. The molecular weight of the solute will be
(A) 348.9 (B) 34.89 (C) 3489 (D) 861.2

5. One mole each of urea, glucose and sodium chloride were dissolved in one litre of water Equal osmotic pressure will be produced by solutions of
(A) Glucose and sodium chloride (B) Urea and glucose
(C) Sodium chloride and urea (D) None of these

6. A solution of 1 molal concentration of a solute will have maximum boiling point elevation when the solvent is
(A) Ethyl alcohol (B) Acetone (C) Benzene (D) Chloroform

7. Mark the correct relationship between the boiling points of very dilute solutions of $BaCl_2\,(t_1)$ and $KCl\,(t_2)$, having the same molarity
(A) $t_1 = t_2$ (B) $t_1 > t_2$ (C) $t_2 > t_1$ (D) t_2 is approximately equal to t_1

8. What should be the freezing point of aqueous solution containing 17 gm of C_2H_5OH in 1000 gm of water (water $K_f = 1.86\ deg - kg\ mol^{-1}$)
(A) -0.69^oC (B) -0.34^oC (C) 0.0^oC (D) 0.34^oC

9. For 0.1 M solution, the colligative property will follow the order
(A) $NaCl > Na_2SO_4 > Na_3PO_4$ (B) $NaCl < Na_2SO_4 < Na_3PO_4$
(C) $NaCl > Na_2SO_4 \approx Na_3PO_4$ (D) $NaCl < Na_2SO_4 = Na_3PO_4$

10. Which of the following will have the lowest vapour pressure
(A) 0.1M KCl solution (B) 0.1 M urea solution
(C) 0.1M Na_2SO_4 solution (D) 0.1M $K_4Fe(CN)_6$ solution

11. The Van't Hoff factor for sodium phosphate would be
(A) 1 (B) 2 (C) 3 (D) 4

12. The molecular weight of benzoic acid in benzene as determined by depression in freezing point method corresponds to
(A) Ionization of benzoic acid (B) Dimerization of benzoic acid
(C) Trimerization of benzoic acid (D) Solvation of benzoic acid

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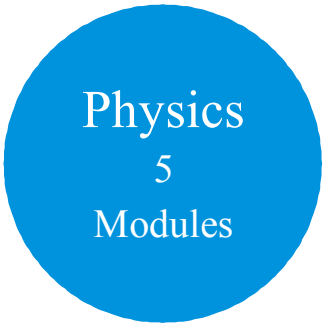
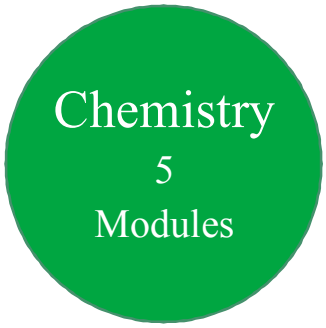
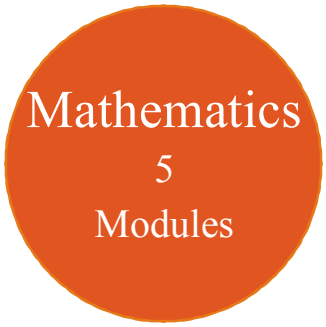
11th Class Modules Chapter Details







PHYSICS	CHEMISTRY	BIOLOGY
Module-1 1. Physical World & Measurements 2. Basic Maths & Vector 3. Kinematics **Module-2** 1. Law of Motion & Friction 2. Work, Energy & Power **Module-3** 1. Motion of system of particles & Rigid Body 2. Gravitation **Module-4** 1. Mechanical Properties of Matter 2. Thermal Properties of Matter **Module-5** 1. Oscillations 2. Waves	**Module-1(PC)** 1. Some Basic Conceps of Chemistry 2. Atomic Structure 3. Chemical Equilibrium 4. Ionic Equilibrium **Module-2(PC)** 1. Thermodynamics & Thermochemistry 2. Redox Reaction 3. States Of Matter (Gaseous & Liquid) **Module-3(IC)** 1. Periodic Table 2. Chemical Bonding 3. Hydrogen & Its Compounds 4. S-Block **Module-4(OC)** 1. Nomenclature of Organic Compounds 2. Isomerism 3. General Organic Chemistry **Module-5(OC)** 1. Reaction Mechanism 2. Hydrocarbon 3. Aromatic Hydrocarbon 4. Environmental Chemistry & Analysis Of Organic Compounds	**Module-1** 1. Diversity in the Living World 2. Plant Kingdom 3. Animal Kingdom **Module-2** 1. Morphology in Flowering Plants 2. Anatomy of Flowering Plants 3. Structural Organization in Animals **Module-3** 1. Cell: The Unit of Life 2. Biomolecules 3. Cell Cycle & Cell Division 4. Transport in Plants 5. Mineral Nutrition **Module-4** 1. Photosynthesis in Higher Plants 2. Respiration in Plants 3. Plant Growth and Development 4. Digestion & Absorption 5. Breathing & Exchange of Gases **Module-5** 1. Body Fluids & Its Circulation 2. Excretory Products & Their Elimination 3. Locomotion & Its Movement 4. Neural Control & Coordination 5. Chemical Coordination and Integration

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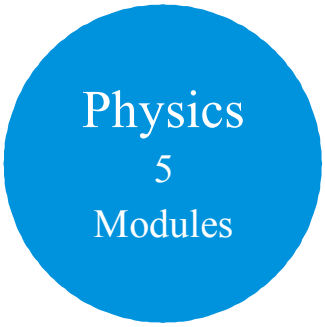
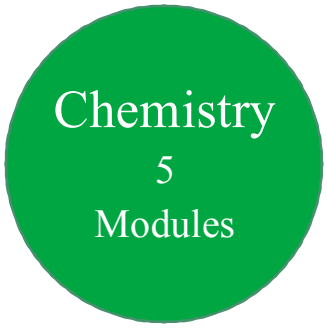
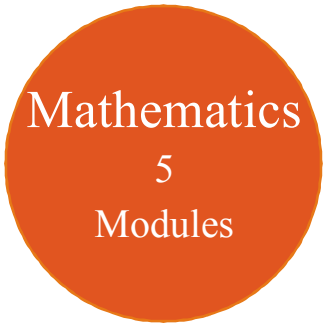
12th Class Modules Chapter Details







PHYSICS

Module-1

1. Electrostatics
2. Capacitance

Module-2

1. Current Electricity
2. Magnetic Effect of Current and Magnetism

Module-3

1. Electromagnetic Induction
2. Alternating Current

Module-4

1. Geometrical Optics
2. Wave Optics

Module-5

1. Modern Physics
2. Nuclear Physics
3. Solids & Semiconductor Devices
4. Electromagnetic Waves

CHEMISTRY

Module-1(PC)

1. Solid State
2. Chemical Kinetics
3. Solutions and Colligative Properties

Module-2(PC)

1. Electrochemistry
2. Surface Chemistry

Module-3(IC)

1. P-Block Elements
2. Transition Elements (d & f block)
3. Co-ordination Compound
4. Metallurgy

Module-4(OC)

1. HaloAlkanes & HaloArenes
2. Alcohol, Phenol & Ether
3. Aldehyde, Ketone & Carboxylic Acid

Module-5(OC)

1. Nitrogen & Its Derivatives
2. Biomolecules & Polymers
3. Chemistry in Everyday Life

BIOLOGY

Module-1

1. Reproduction in Organisms
2. Sexual Reproduction in Flowering Plants
3. Human Reproduction
4. Reproductive Health

Module-2

1. Principles of Inheritance and Variation
2. Molecular Basis of Inheritance
3. Evolution

Module-3

1. Human Health and Disease
2. Strategies for Enhancement in Food Production
3. Microbes in Human Welfare

Module-4

1. Biotechnology: Principles and Processes
2. Biotechnology and Its Applications
3. Organisms and Populations

Module-5

1. Ecosystem
2. Biodiversity and Conservation
3. Environmental Issues

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