



केन्द्रीय विद्यालय संगठन

चंडीगढ़ संभाग

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SUPPORT MATERIAL

CHEMISTRY (TERM – I)

CLASS XII

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CHAPTER 1 SOLID STATE

Paragraph based questions

Q 1. Read the passage given below and answers the following question:

In stoichiometric Crystals, Generally two types of defects are observed: Schottky defect and Frankel defect. Schottky defect arises when some of the ions or atom are missing from their normal lattice sites. Due to the Schottky defect, density of ionic crystals decreases markedly. For example NaCl, KCl, CsCl have Schottky defect. It has been observed that in NaCl, there are about 10^6 Schottky pairs in room temperature. Frankel defect arises when an ion is missing from its normal site and occupies interstitial site between the lattice points. It does not affect the density of the crystal. In non-stoichiometric crystal, two types of defects are there: Metal excess defect and metal deficient defects. In metal excess defect positive ions are in excess. Whereas in metal deficient defect number of positive ions is less than number of negative ions. Impurity defect arises due to the impurity at lattice sites.

In these questions (1-4) a statement of assertion is followed by a statement of reason. Choose the correct answer out of the following choices:

- a) Assertion and reason are both correct statements and reason is the correct explanation of assertion.
- b) Assertion and reason both are correct statements but reason is not correct explanation of assertion.
- c) Assertion is correct statement but reason is wrong statement.
- d) Assertion is wrong statement but reason is correct statement.

i) Assertion : In an ionic solid(MX) with Schottky defect, the number of positive and negative ions are same.

Reason: Equal number of anion and cation vacancies are present.

ii) Assertion: Due to Frankel defect there is no effect on density of the crystalline solids.

Reason: In Frankel defect no cation and anion leaves the crystal.

iii) Assertion: No compound has both Schottky and Frankel defects.

Reason: Schottky defect change the density of the solid.

iv) Assertion: NaCl and KCl shows metal excess defect.

Reason: ZnO is white in color at room temperature and on heating It loses oxygen and turn yellow due to metal excess defect.

Q 2. Read the passage given below and answer the following questions:

In hexagonal system of crystals, a frequently encountered arrangement of atoms is described as a hexagonal prism. Here the top and bottom of the cell are regular hexagons and three atoms are sandwiched in between them. A space-filling model of this structure, called

hexagonal closed packed, is constituted of a sphere on a flat surface surrounded in the same plane by 6 identical spheres as closely as possible. three spheres are placed over the first layer so that they touch each other and touch the second layer. Each one of the three spheres touch the three spheres of the bottom layer. Finally the second layer is covered with a third layer identical to bottom layer in relative position.

I. the number of atoms in hcp unit cell?

- a) 4
- b) 6
- c) 12
- d) 7

II. The volume of this HCP unit cell is

- a) $24\sqrt{2}r^3$
- b) $16\sqrt{2}r^3$
- c) $12\sqrt{2}r^3$
- d) $(64r^3)/(3\sqrt{3})$

III. The empty space in this HCP unit cell is

- a) 74%
- b) 47.6%
- c) 32%
- d) 26%

OR

Which of the following statements is correct about the hexagonal close packaging

- a) In this arrangement, third layer is identical the first layer.
- b) The coordination number in this arrangement is 6
- c) It is as closely packed as body centred cubic packing
- d) It has 32% empty space

IV. In hexagonal close packing of spheres in three dimensions

- a) In one unit cell there are 12 octahedral voids and all are completely inside the unit cell.
- b) In one unit cell there are six octahedral voids and all are completely inside the unit cell
- c) In one unit cell there are six octahedral void and of which three are completely inside the unit cell and other three are partially inside the unit cell
- d) Co-ordination number of every sphere is 12 in hcp lattice.

CCT Questions

Q 3. Read the passage given below and answer the following questions;

Think of a diamond and some cotton candy. Do you think these substances are alike? They are different in every aspect, and yet they are both solids. What differentiates these, is the structure

(v) Which of the following is not a characteristic of a crystalline solid?

- a) Definite and characteristic heat of fusion.
- b) Isotropic nature.
- c) A regular periodically repeated pattern of arrangement of constituent particles in the entire crystal.
- d) A true solid

vi) Which of the following statement is not true about amorphous solids?

- a) On heating they may become crystalline at certain temperature.
- b) They may become crystalline on keeping for long time.
- c) Amorphous solids can be moulded by heating.
- d) They are anisotropic in nature

Q 4. Read the passage given below and answer the following questions;

In an assembly of atoms or molecules, a solid phase is formed whenever interatomic attractive forces significantly exceed the thermal forces thus restrict the mobility of atoms, forcing them into more or less fixed positions. From energy consideration, it is evident that in such solids atoms and molecules will always attempt to assume ordered structures. Depending on the nature of the active forces, all solids may be divided into following categories

Ionic solids : These solids consist of positively and negatively charged ions arranged in a regular fashion throughout the solid. These solids are very hard and brittle, have very high melting points and have high enthalpies of vaporization, e.g., NaCl, MgO, KCl, LiCl etc.

Covalent solids: In these solids, the constituent particles are atoms which are linked together by a continuous system of covalent bonds. These bonds are strong and directional in nature. The covalent crystals are hard, have high melting points and poor conductors of electricity.. Diamond is a typical example of covalent solids

Metallic solids: In these solids, the constituent particles are positive ions immersed in a sea of mobile electrons. Metallic solids may be hard as well as soft. They are good conductors of heat and electricity e.g. metals such as nickel, copper and alloys.

Molecular solids: In these the constituent particles are molecules. The molecules are held together by dispersion forces or London forces, dipole- dipole forces or hydrogen bonds (eg. Ice, iodine, HCl, etc.)

In these questions (Q.No. i-iv), 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 statement
- b) Assertion and reason both are correct statements but reason is not correct explanation for statement
- c) Assertion is correct statement but reason is wrong statement.
- d) Assertion is wrong statement but reason is correct statement.

- (i) Assertion : Network solids are also called giant molecules.
Reason : Graphite is soft in nature and conduct electricity.

- (ii) Assertion : Ionic solids e.g NaCl are characterized by high melting and boiling point.
Reason : Ionic solids have columbic forces of attraction between their ions.
- (iii) Assertion : Diamond is insulators of electricity.
Reason : Covalent solids are constituted by ions.
- (iv) Assertion : Diamond and graphite do not have the same covalent structure.
Reason : Silicon carbide is typical example of network solid."

Assertion Reason Questions

In this questions (5-15) a statement of assertion is followed by a statement of reason .Choose the correct answer out of the following choices:

- a) Assertion and reason are both correct statements and reason is the correct explanation of assertion .
- b) Assertion and reason both are correct statements but reason is not correct explanation of assertion.
- c) Assertion is correct statement but reason is wrong statement.
- d) Assertion is wrong statement but reason is correct statement

Q 5. Assertion : At low temperature , particles of matter occupy fixed positions and exist in solid states.

Reason : Under a given set of conditions of temperature and pressure, the state of a substance depends upon the net effect of thermal energy and intermolecular forces.

Q 6. Assertion : Quartz glass is an amorphous solid and quartz is crystalline solid.

Reason : Quartz glass has long range order.

Q 7. Assertion: Glass panes fixed to windows or doors of old buildings are slightly thicker at the bottom than as.

Reason: Glass is pseudo solid.

Q 8. Assertion: In crystalline solids , the value of resistance is different in different directions.

Reason: Crystalline solids are isotropic in nature.

Q 9. Assertion : Face centred cubic cell has 4 atoms per unit cell.

Reason : In *fcc* unit cell, there are 8 atoms at the corners and 6 atoms at face centres

Q 10. Assertion ; Molecular solids are characterized by low melting point.

Reason ; Molecular solids are made up of covalent molecules

Q 11. Assertion : A tetrahedral void is surrounded by four spheres and an octahedral void is surrounded by six sphere.

Reason :The number of tetrahedral voids is double the number of closed packed sphere and number of octahedral voids is equal to number of close packed spheres.

Q 12. Assertion: FeO is non-stoichiometric with $\text{Fe}_{0.95}\text{O}$

Reason: Some Fe^{2+} ions are replaced by Fe^{3+} as $3\text{Fe}^{2+} = 2\text{Fe}^{3+}$ to maintain electrical neutrality.

Q 13. Assertion : Packing efficiency of body centered cubic structure is 68%.

Reason : 68% is the maximum packing efficiency any crystal can have.

Q 14. Assertion :The total number of atoms present in simple cubic unit cell is one.

Reason : Simple cubic unit cell has atoms at its corners ,each of which is shared between eight adjacent unit cells.

Q 15. Assertion : Frenkel defect is also called dislocation defect.

Reason : Frenkel defect is shown by ionic substances in which cation and anion are of almost similar sizes.

Multiple choice questions

Q 16. Which of the following statement is not correct about molecular crystal ?

- (a) They are generally soft and compressible.
- (b) They are good conductor of electricity as electron are delocalized in the bonds .
- (c) They have low melting and boiling points .
- (d) They consist of polar and nonpolar molecules.

Q 17. In ABCABC packing If the number of atom in the unit cell is n, then the number of tetrahedral voids in unit cell is

- (a) n
- (b) n/2
- (c) n/4
- (d) 2n

Q 18. Which of the following statement is not correct about octahedral voids ?

- (a) Octahedral voids are formed at the center of the six spheres lie at the apices of octahedron .
- (b) There is one octahedral site for each sphere.
- (c) There are two tetrahedral sites for each sphere.
- (d) Octahedral voids are formed when the triangular voids in second layer of exactly overlap with similar voids in the first layer .

Q 19. A compound is formed by two elements Y and Z the element Z forms ccp and atoms Y occupy 1/3 of tetrahedral voids the formula of the compound is?

- a) Y_2Z_3
- b) Y_3Z_2
- c) YZ_3
- d) Y_2Z

Q 20. A cubic solid is made up of two elements P and Q. Atoms Q are present at the corners of the cube and atoms P at the body-centre. What is the formula of the compound? What are the coordination numbers of P and Q?

- a) PQ_2 6:6
- b) PQ 6:6
- c) P_2Q 6 : 8
- d) PQ 8:8

Q 21. The coordination number of metal crystallising in a hexagonal close packing is

- a) 12
- b) 4
- c) 8
- d) 6

Q 22. The edge lengths of the unit cells in terms of the radius of spheres constituting fcc, bcc and simple cubic unit cell are respectively_____.

- a. $2\sqrt{2}r, 4r/\sqrt{3}, 2r$
- b. $4r/\sqrt{3}, 2\sqrt{2}r, 2r$

Q 39. AgCl is crystallized from molten AgCl containing little CdCl₂. The solid obtained will have

a) cation vacancies equal to number of Cd²⁺ ions incorporated

b) Cation vacancies equal to double the number of Cd²⁺

c) Anion vacancies

d) Neither cationic nor anionic vacancies

Q 40. Experimentally it was found that a metal oxide has formula M_{0.98}O. Metal M is present as M²⁺ and M³⁺ in its oxide. Fraction of the metal which exist as M³⁺ would be

a) 5.08%

b) 4.08%

c) 7.01%

d) 6.05%

UNIT - SOLUTIONS

- The system that forms maximum boiling azeotrope is
 - Carbon disulphide – acetone
 - Benzene – toluene
 - Acetone – chloroform
 - n-Hexane – n-Heptane
- In osmosis
 - Solvent molecules move from higher concentration to lower concentration
 - Solvent molecules move from lower concentration to higher concentration
 - Solute molecules move from higher concentration to lower concentration
 - Solute molecules move from lower concentration to higher concentration
- Two solutions A and B are separated by semi-permeable membrane. If the liquid flows from A to B then
 - A is less concentrated than B
 - A is more concentrated than B
 - Both have the same concentration
 - None of these
- A liquid mixture boils without changing constituent is called
 - Binary liquid mixture
 - Zeotropic mixture
 - Azeotropic mixture
 - Stable structure complex
- Osmotic pressure is measured quickly and accurately by
 - Berkeley and Hatley's method
 - Morse's method
 - Pleffer's method
 - De Vries method
- A solution of acetone in ethanol
 - behaves like a near ideal solution
 - Obeys Raoult's law
 - Shows a negative deviation from Raoult's Law
 - Shows a positive deviation from Raoult's Law
- Liquids A and B form an ideal solution
 - The enthalpy of mixing is zero
 - The entropy of mixing is zero
 - The free energy of mixing is zero
 - The free energy as well as the entropy of mixing is zero
- When a substance is dissolved in a solvent, the vapour pressure of the solvent is decreased. This result in
 - An increase in the boiling point of the solution
 - A decrease in the boiling point of the solvent
 - The solution having a higher freezing point than the solvent
 - The solution having a lower osmotic pressure than the solvent

9. The density of 3 M solution of NaCl is 1.25 g L^{-1} . The molality of the solution is
(a) 1.79 (b) 2.79
(c) 0.79 (d) 2.98

10. Which colligative property is more useful to determine the molecular mass of the proteins and polymers?

- (a) Lowering in vapour pressure (b) Elevation in boiling point
(c) Depression in freezing point (d) Osmotic pressure

11. Value of Henry's constant K_H is

- (a) Increases with increase in temperature
(b) Decreases with increase in temperature
(c) Remains constant
(d) First increases then decreases

12. If two liquids A and B form minimum boiling azeotrope at some specific composition then

- (a) A – B interactions are stronger than those between A – A or B – B
(b) Vapour pressure of solution increase because more number of molecules of liquids A and B can escape
(c) Vapour pressure of solution decreases because less number of molecules of only one of the liquids escapes from the solution
(d) A – B interactions are weaker than those between A – A or B – B.

13. Molal depression constant depends upon:

- (a) nature of the solute (b) nature of the solvent
(c) vapour pressure of the solution (d) heat of solution

14. Ethylene glycol is used as antifreeze in a cold climate. Mass of ethylene glycol which should be added to 4 kg of water to prevent it from freezing at -6°C will be: (K_f for water = $1.86 \text{ K kg mol}^{-1}$ and molar mass of ethylene glycol = 62 g mol^{-1})

- (a) 204.30 g (b) 804.32 g
(c) 400.00 g (d) 304.60 g

15. Normal human blood sugar range from $65 - 105 \text{ mg / dL}$.

Considering density of human blood is 1.06 kg / L , if a patient's sugar level reads 720 ppm, his/her blood sugar at that time is

- (a) Low (b) High
(c) Normal (d) Cannot say

16. When a particular solution has a higher osmotic pressure than the given standard solution, it is most appropriately called as with respect to the standard solution.

- (a) Hypotonic (b) Hypertonic
(c) Isotonic (d) Pertonic

17. Which of the following statements is correct?

- (a) Solutes that dissociate in water experience a decrease in colligative properties
- (b) Colligative properties are independent of the number of particles of the solute in the solution
- (c) Solutes that dissociate in water have molar mass higher than the molar mass of the solute calculated theoretically
- (d) Solutes that associate in water have molar mass higher than the molar mass of the solute calculated theoretically.

18. Which relationship is not correct?

(a) $\Delta T_b = \frac{K_b \cdot 1000 \cdot W_2}{M_2 \cdot W_1}$ (b) $M_2 = \frac{K_f \cdot W_1 \cdot 1000}{W_2 \cdot \Delta T_b}$

(c) $\pi = \frac{n_2}{V} RT$ (d) $\frac{p^0 - p_s}{p^0} = \frac{W_2}{M_2} \times \frac{M_1}{W_1}$

19. Water – HCl mixture

- I. shows positive deviations II. Forms minimum boiling azeotrope
- III. shows negative deviations IV. Forms maximum boiling azeotrope

- (a) I and II (b) II and III
- (c) I and IV (d) III and IV

20. Which of the following is true for an aqueous solution of the solute in terms of concentration?

- (a) 1 M = 1 m (b) 1 M > 1 m
- (c) 1 M < 1 m (d) cannot be predicted

21. Two liquids P and Q have vapour pressures 450 and 200 torr respectively at certain temperature. In an ideal solution of the two, the mole fraction of P at which two liquids have equal partial pressures is

- (a) 0.80 (b) 0.308
- (c) 0.444 (d) 0.154

22. When 1 mole of benzene is mixed with 1 mole of toluene, the vapour will contain:

(Given: vapour pressure of benzene = 12.8 kPa and vapour pressure of toluene = 3.85 kPa)

- (a) equal amount of benzene and toluene as it forms an ideal solution.
- (b) unequal amount of benzene and toluene as it forms a non ideal solution
- (c) higher percentage of benzene
- (d) higher percentage of toluene

23. A set of solutions is prepared using 180 g of water as a solvent and 10 g of different non-electrolyte and non-volatile solutes A, B and C. The relative lowering of vapour pressure in the presence of these solutes are in the order (given: Molar mass of A = 100 g mol⁻¹, B = 200 g mol⁻¹, C = 10,000 g mol⁻¹)

- (a) A > B > C (b) B > C > A

- (a) Dalton's law of partial pressure (b) Graham's law
(c) Raoult's law (d) Henry's law

33. Which of the following characteristics is not possessed by an ideal solution?

- (a) Obeys Raoult's law
(b) Volume change on mixing is not equal to zero
(c) There should be no chemical reaction between solute and solvent
(d) Only very dilute solutions behave as ideal solutions

34. The phenomenon of lowering of vapour pressure is defined as:

- (a) Decrease in vapour pressure of a solvent on addition of a volatile non electrolyte solute in it.
(b) Decrease in vapour pressure of a solvent on addition of a non-volatile non electrolyte solute in it.
(c) Decrease in vapour pressure of a solvent on addition of a volatile electrolyte solute in it.
(d) Decrease in vapour pressure of a solvent on addition of a non-volatile solute in it.

35. During depression of freezing point in a solution the following are in equilibrium

- (a) liquid solvent, solid solvent (b) liquid solvent, solid solute
(c) liquid solute, solid solute (d) liquid solute, solid solvent

36. 1 molar aqueous solution is more concentrated than 1 molal aqueous solution of the same solute because:

- (a) mass of the solute present in 1 molar solution is more
(b) volume of solvent in 1 molar aqueous solution is less
(c) volume of solvent in 1 molar aqueous solution is more
(d) All the above statements are correct

37. Which one of the following statements regarding Henry's law is not correct?

- (a) Different gases have different K_H (Henry's law constant) values at the same temperature
(b) Higher the value of K_H at a given pressure, higher is the solubility of the gas in the liquids
(c) The value of K_H increases with increase of temperature and K_H is function of the nature of the gas
(d) The partial pressure of the gas in vapour phase is proportional to the mole fraction of the gas in the solution.

38. 1 g of a non-volatile, non-electrolyte solute is dissolved in 100 g of two different solvents A and B, whose ebullioscopic constants are in the ratio of 1: 5. The ratio of the

elevation in their boiling points, $\frac{\Delta T_b (A)}{\Delta T_b (B)}$, is

- (a) 5 : 1 (b) 10 : 1
(c) 1 : 5 (d) 1 : 0.2

ASSERTION REASONING TYPE QUESTIONS

In these questions (Q.No. 39 – 48), 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 the correct explanation for assertion.
- (b) Assertion and reason both are correct statements but reason is not the correct explanation for assertion.
- (c) Assertion is correct statement but reason is wrong statement.
- (d) Assertion is wrong statement but reason is correct statement.

39. Assertion : Reverse osmosis is used in the desalination of sea water.

Reason: When pressure more than osmotic pressure is applied, pure water is squeezed out of the sea water through the membrane.

40. Asssertion: The freezing point is the temperature at which solid crystallizes from solution.

Reason: The freezing point depression is the difference between that temperature freezing point of pure solvent.

41. Assertion: Isotonic solution does not show the phenomenon of osmosis.

Reason: Isotonic solutions have equal osmotic pressure.

42. Assertion: Molecular mass of polymers cannot be calculated using boiling point or freezing point method.

Reason: Polymer solutions do not possess a constant boiling point or freezing point.

43. Assertion: On placing RBC's in 0.5 % NaCl solution, they will shrink due to plasmolysis.

Reason: RBC's are isotonic with 0.91 % NaCl solution.

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

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

45. Assertion: ΔH_{mix} and ΔV_{mix} are positive for an ideal solution.

Reason: The interactions between the particles of the components of an ideal solution almost identical as between particles in the liquids.

46. Assertion: The pressure exerted by the vapour in equilibrium with a liquid at a given temperature is called its vapour pressure.

Reason: If a non-volatile solute is added to a solvent to give a solution, the vapour pressure of the solution is found to be greater than the vapour pressure of the pure solvent.

47. Assertion: One molal aqueous solution of urea contains 60 g of urea in 1 kg of water.
Reason: Solution containing one mole of solute in 1000 g solvent is called one molal solution.

48. Assertion: If a liquid solute, more volatile than the solvent, is added to the solvent, the vapour pressure of the solution may increase i.e. $p_s > p^\circ$.

Reason: In the presence of a more volatile liquid solute, only the solute will form the vapours and solvent will not.

COMPREHENSION BASED QUESTIONS

49. Read the passage below and answer the following questions :

The solubility of gases increases with increase of pressure. William Henry made a systematic investigation of the solubility of a gas in a liquid. According to Henry's law "the mass of a gas dissolved per unit volume of the solvent at constant temperature is directly proportional to the pressure of the gas in equilibrium with the solution."

Dalton during the same period also concluded independently that the solubility of a gas in a liquid solution depends upon the partial pressure of a gas. If we use the mole fraction of gas in the solution as a measure of its solubility, then Henry's law can be modified as "the partial pressure of the gas in the vapour phase is directly proportional to the mole fraction of the gas in the solution."

(i) Henry's law constant for the solubility of methane in benzene at 298 K is 4.27×10^5 mm Hg. The solubility of methane in benzene at 298 K under 760 mm Hg is

- (a) 4.27×10^{-5} (b) 1.78×10^{-3}
(c) 4.27×10^{-3} (d) 1.78×10^{-5}

(ii) The partial pressure of ethane over a saturated solution containing 6.56×10^{-2} g of ethane is 1 bar. If the solution contains 5.00×10^{-2} g of ethane then what will be the partial pressure (in bar) of the gas?

- (a) 0.762 (b) 1.312
(c) 3.81 (d) 5.0

(iii) K_H (kbar) values for Ar (g), CO₂ (g), HCHO (g) and CH₄ (g) are 40.39, 1.67, 1.83×10^{-5} and 0.413 respectively. Arrange these gases in the order of their increasing solubility.

- (a) HCHO < CH₄ < CO₂ < Ar
(b) HCHO < CO₂ < CH₄ < Ar
(c) Ar < CO₂ < CH₄ < HCHO
(d) Ar < CH₄ < CO₂ < HCHO

(iv) When a gas is bubbled through water at 298 K, a very dilute solution of the gas is obtained. Henry's law constant for the gas at 298 K is 150 kbar. If the gas exerts a partial pressure of 2 bar, the number of millimoles of the gas dissolved in 1 L of water is

- (a) 0.55 (b) 0.87
(c) 0.37 (d) 0.66

50. Read the passage given below and answer the questions:

At the freezing point of a solvent, the solid and the liquid are in equilibrium. Therefore, a solution will freeze when its vapour pressure becomes equal to the vapour pressure of the pure solid solvent. It has been observed that when a non-volatile solute is added to the solvent, the freezing point of the solution is always lower than that of the pure solvent.

Depression in freezing point can be given as, $\Delta T_f = K_f m$

Where, K_f = Molal freezing point depression constant

or we can write, $\Delta T_f = \frac{K_f \times 1000 \times W_B}{M_B \times W_A}$

In these questions (Q.No. i – iv), 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 the correct explanation for assertion.
- (b) Assertion and reason both are correct statements but reason is not the correct explanation for assertion.
- (c) Assertion is correct statement but reason is wrong statement.
- (d) Assertion is wrong statement but reason is correct statement.

(i) Assertion: 0.1 M solution of glucose has same depression in the freezing point as 0.1 M solution of urea.

Reason: K_f for both has same value.

(ii) Assertion: Larger the value of cryoscopic constant of the solvent, lesser will be the freezing point of the solution.

Reason: Extent of depression in the freezing point depends on the nature of the solvent.

(iii) Assertion: The water pouch of instant cold pack for treating athletic injuries breaks when squeezed and NH_4NO_3 dissolves thus lowering the temperature.

Reason: Addition of non-volatile solute into solvent results into depression of freezing point of solvent.

(iv) Assertion: If a non-volatile solute is mixed in a solution then elevation in boiling point and depression in freezing point both will be same.

Reason: Elevation in boiling point and depression in freezing point both depend on number of particles of solute.

UNIT: p-block Elements

- Which of the following elements does not show allotropy?
 - Nitrogen
 - Bismuth
 - Antimony
 - Arsenic
- What is peroxomonosulphuric acid ?
 - H_2SO_4
 - H_2SO_5
 - $\text{H}_2\text{S}_2\text{O}_8$
 - H_2SO_3
- Phosphorous halides fume in moist air due to formation of
 - H_3PO_4
 - H_3PO_3
 - HCl
 - P_2O_3
- Ozone gas is used in cinema halls because
 - Germicide
 - Disinfectant
 - Bleaching action
 - Oxidising action
- Which of the following statements is wrong?
 - Single N–N bond is stronger than the single P–P bond.
 - PH_3 can act as a ligand in the formation of coordination compound with transition elements.
 - NO_2 is paramagnetic in nature.
 - Covalency of nitrogen in N_2O_5 is four.
- A brown ring is formed in the ring test for NO_3^- ion. It is due to the formation of
 - $[\text{Fe}(\text{H}_2\text{O})_5(\text{NO})]^{2+}$
 - $\text{FeSO}_4 \cdot \text{NO}_2$
 - $[\text{Fe}(\text{H}_2\text{O})_4(\text{NO})_2]^{2+}$
 - $\text{FeSO}_4 \cdot \text{HNO}_3$
- Elements of group-15 form compounds in +5 oxidation state. However, bismuth forms only one well characterised compound in +5 oxidation state. The compound is
 - Bi_2O_5
 - BiF_5
 - BiCl_5
 - Bi_2S_5
- Yellow crystals of sulphur when dissolved in fuming nitric acid form

- a) SO_2
 b) H_2SO_4
 c) Both A and B
 d) None of the above
9. The SO_2 gas when bubbled through Chlorine forms
 a) SO_2Cl
 b) SO_2Cl_2
 c) S_2Cl_2
 d) None of the above
10. The boiling points of hydrides of group 16 are in the order
 (a) $\text{H}_2\text{O} > \text{H}_2\text{Te} > \text{H}_2\text{S} > \text{H}_2\text{Se}$
 (b) $\text{H}_2\text{O} > \text{H}_2\text{S} > \text{H}_2\text{Se} > \text{H}_2\text{Te}$
 (c) $\text{H}_2\text{O} > \text{H}_2\text{Te} > \text{H}_2\text{Se} > \text{H}_2\text{S}$
 (d) None of these
11. The set with correct order of acidity is
 (a) $\text{HClO} < \text{HClO}_2 < \text{HClO}_3 < \text{HClO}_4$
 (b) $\text{HClO}_4 < \text{HClO}_3 < \text{HClO}_2 < \text{HClO}$
 (c) $\text{HClO} < \text{HClO}_4 < \text{HClO}_3 < \text{HClO}_2$
 (d) $\text{HClO}_4 < \text{HClO}_2 < \text{HClO}_3 < \text{HClO}$
12. On heating ammonium dichromate and barium azide separately we get
 a) N_2 in both cases
 b) N_2 with ammonium dichromate and NO with barium azide
 c) N_2O with ammonium dichromate and N_2 with barium azide
 d) N_2O with ammonium dichromate and NO_2 with barium azide
13. H_2S is more acidic than H_2O because
 (a) oxygen is more electronegative than sulphur.
 (b) atomic number of sulphur is higher than oxygen.
 (c) $\text{H} - \text{S}$ bond dissociation energy is less as compared to $\text{H} - \text{O}$ bond.
 (d) $\text{H} - \text{O}$ bond dissociation energy is less also compared to $\text{H} - \text{S}$ bond.
14. Which of the following is isoelectronic pair?
 a) ICl_2 , ClO_2
 b) BrO_2^- , BrF_2^+
 c) ClO_2 , BrF
 d) CN^- , O_3
15. When chlorine reacts with cold and dilute solution of sodium hydroxide, it forms
 (a) Cl^- and ClO^-
 (b) Cl^- and ClO_2^-
 (c) Cl^- and ClO_3^-
 (d) Cl^- and ClO_4^-

16. The formation of $O_2^+ [PtF_6]^-$ is the basis for the formation of first xenon compound. This is because
- O_2 and Xe have different sizes.
 - both O_2 and Xe are gases.
 - O_2 and Xe have comparable electro-negativities.
 - O_2 and Xe have comparable ionisation enthalpies.
17. A black compound of manganese reacts with a halogen acid to give greenish yellow gas. When excess of this gas reacts with NH_3 an unstable trihalide is formed. In this process the oxidation state of nitrogen changes from _____.
- 3 to +3
 - 3 to 0
 - 3 to +5
 - 0 to - 3
18. Which of the following shows allotropy?
- P
 - Sb
 - Both a and b
 - None of the above
19. In solid state PCl_5 is a _____.
- covalent solid
 - octahedral structure
 - ionic solid with $[PCl_6]^+$ octahedral and $[PCl_4]^-$ tetrahedra
 - ionic solid with $[PCl_4]^+$ tetrahedral and $[PCl_6]^-$ octahedra
20. The Royal water is mixture of
- HCl and HNO_3
 - H_2SO_4 and HCl
 - HNO_3 and H_2SO_4
 - HNO_3 and HCl
21. Which one of the following is an exothermic compound?
- NCl_3
 - NBr_3
 - NI_3
 - NF_3
22. Which of the following oxides is anhydride of nitrous acid ?
- N_2O_3
 - NO_2
 - NO
 - N_2O_4
23. Arrange the following in decreasing Lewis acid strength - PF_3 , PCl_3 , PBr_3 , PI_3
- $PI_3 > PBr_3 > PCl_3 > PF_3$

- (b) $\text{PF}_3 > \text{PCl}_3 > \text{PBr}_3 > \text{PI}_3$
 (c) $\text{PCl}_3 > \text{PBr}_3 > \text{PI}_3 > \text{PF}_3$
 (d) $\text{PBr}_3 > \text{PI}_3 > \text{PF}_3 > \text{PCl}_3$
24. Barium azide is used in:
 (a) car safety bags
 (b) cleaning
 (c) Fertilizer industry
 (d) Manufacture of ammonia
25. Nitrolim is a mixture of:
 (a) Coke and calcium cyanide
 (b) Coke and calcium nitrate
 (c) Coke with calcium cyanamide
 (d) none of the above
26. Arrange the following hydrides of group 16 elements in order of increasing stability
 (a) $\text{H}_2\text{S} < \text{H}_2\text{O} < \text{H}_2\text{Te} > \text{H}_2\text{Se}$
 (b) $\text{H}_2\text{O} < \text{H}_2\text{Te} < \text{H}_2\text{Se} < \text{H}_2\text{S}$
 (c) $\text{H}_2\text{O} < \text{H}_2\text{S} < \text{H}_2\text{Se} < \text{H}_2\text{Te}$
 (d) $\text{H}_2\text{Te} < \text{H}_2\text{Se} < \text{H}_2\text{S} < \text{H}_2\text{O}$
27. NO_2 and SO_2 have few properties in common. Predict the property uncommon to both
 a) Acid rain
 b) Soluble in water
 c) Act as RA
 d) Food preservative
28. Charring of Sucrose in king of chemicals is an example of
 a) Oxidising action
 b) Reducing action
 c) Dehydrating action
 d) Disproportionation action
29. The excess ammonia gas combines with HCl giving dense white fumes due to formation of
 a) NH_4Cl
 b) NCl_3
 c) Both a and b
 d) None of the above
30. Sulphur powder dissolves in concentrated H_2SO_4 to liberate
 a) SO_3 gas
 b) SO_2 gas
 c) SO_2 and H_2O
 d) All of the above
31. What happens when ammonium chloride is added to sodium nitrite
 a) Salt and water
 b) Ammonia is liberated

- c) Nitrogen is evolved
 - d) All of the above
32. Gas which cannot be collected over water
- a) N_2
 - b) SO_2
 - c) O_2
 - d) PH_3
33. The Pale yellowish brown coloured solution changes to pale green when Sulphur dioxide is bubbled through ferric ions due to formation of
- a) H_2SO_4
 - b) Ferric Sulphate
 - c) Fe^{2+} , H^+ and Sulphate ions
 - d) Fe^{3+} and Sulphate and Water
34. Give the name of the compound formed when sulphur is added to conc. HNO_3
- a) NO_2
 - b) H_2SO_4
 - c) NO_2 and H_2O
 - d) Both a and b
35. The brown ring test for nitrates depends on
- a) reduction of ferrous sulphate to iron
 - b) oxidation of nitric oxide to nitrogen dioxide
 - c) the reduction of nitrate to nitric oxide
 - d) oxidising action of sulphuric acid
36. Which of the following statements regarding ozone is not correct?
- a) The oxygen-oxygen bond length in ozone is identical with that of molecular oxygen
 - b) The ozone is resonance hybrid of two structures
 - c) The ozone molecule is angular in shape
 - d) Ozone is used as a germicide and disinfectant for the purification of air.
37. Which of the following has S-S bond
- a) $H_2S_2O_6$
 - b) $H_2S_2O_5$
 - c) $H_2S_2O_7$
 - d) $H_2S_2O_8$
38. One mole of magnesium nitride on the reaction with an excess of water gives:
- a) One mole of ammonia
 - b) one mole of nitric acid
 - c) two moles of ammonia
 - d) two moles of nitric acid
39. Out of the following which is not inert
- a) SF_4
 - b) SF_6
 - c) N_2
 - d) All of the above
40. Nitrous acid disproportionates to:
- (a) Nitrous oxide and nitric oxide

- (b) Nitric acid and nitric acid
- (c) Nitric oxide and nitric acid
- (d) Dinitrogen oxide and nitric oxide

41. Which of the following statement is not true for halogens:
- (a) All are oxidizing agents
 - (b) All but fluorine shows positive oxidation states
 - (c) All form monobasic oxoacids
 - (d) Chlorine has the highest electron gain enthalpy
42. The number of lone pairs on central Cl in ClF_3 is:
- (a) 1
 - (b) 2
 - (c) 3
 - (d) 4
43. Which of the following statement regarding Sulphur is incorrect:
- (a) S_2 molecule is paramagnetic
 - (b) Vapour at 200°C consists mostly of S_8 rings
 - (c) Vapour at 600°C consists mostly of S_2 molecules
 - (d) The oxidation state of sulphur is never less than +4 in its compounds
44. Which among the following is the most reactive?
- (a) I_2
 - (b) Cl_2
 - (c) Br_2
 - (d) ICl
45. When concentrated sulphuric acid was added to an unknown salt present in a test tube a brown gas (A) was evolved. This gas intensified when copper turnings were added to this test tube. On cooling the gas (A) changed into a colourless solid (B). Identify (A) and (B).
- a) A: Nitrogen dioxide (NO_2) B : Dinitrogen tetraoxide (N_2O_4)
 - b) A : Dinitrogen tetraoxide (N_2O_4) B: Nitrogen dioxide (NO_2)
 - c) A: Dinitrogen tetraoxide (N_2O_4) B: Dinitrogen (N_2)
 - d) A: Dinitrogen (N_2) B : Dinitrogen tetraoxide (N_2O_4)
46. On heating compound (A) gives a gas (B) which is a constituent of air. This gas when treated with 3 mol of hydrogen (H_2) in the presence of a catalyst gives another gas (C) which is basic in nature. Gas C on further oxidation in moist condition gives a compound (D) which is a part of acid rain. Identify compounds (A) to (D) and also give necessary equations of all the steps involved.
- i) $\text{A} = \text{NH}_4\text{NO}_2$ $\text{B} = \text{N}_2$ $\text{C} = \text{NH}_3$ $\text{D} = \text{HNO}_3$

- ii) A= NH_4NO_2 B= N_2 C= HNO_3 D= NH_3
 iii) A= HNO_3 B= N_2 C= NH_3 D= NH_4NO_2
 iv) A= N_2 B= NH_4NO_2 C= NH_3 D= HNO_3

Case based Questions :

47. Up till the early 1900s, ammonia was mostly produced via the dry distillation of animal waste products along with certain vegetable waste that was rich in nitrogen. The distillation of these waste products resulted in the reduction of nitrites and nitrous acids along with hydrogen. Eventually, ammonia was obtained as a product. Today, ammonia is produced industrially via the Haber-Bosch process, which involves a reaction in the gaseous phase between molecular nitrogen and molecular hydrogen. It is important to note that this reaction takes place at relatively high temperatures and high pressure (in the order of 450 degrees celsius and over 10000 kilopascals). Liquid ammonia is the most commonly studied, and best known, non-aqueous ionizing solvent. The most notable property of this compound is its ability to dissolve alkali metals to form strongly coloured, electrically conductive solutions that contain solvated electrons. Besides these notable solutions, much of the chemistry of liquid ammonia can be described with the help of aqueous solutions by comparison with similar reactions.

Ammonia is known to naturally occur in many parts of the environment such as the soil, the air, and in vegetation. It can also be noted that the human body naturally creates ammonia while breaking down protein-containing food items into amino acids. This ammonia is then converted into urea. It is important to note that ammonia and, by extension, the ammonium ion are important components of many vital metabolic processes in human beings.

- I) In qualitative analysis when H_2S is passed through an aqueous solution of salt acidified with dil. HCl , a black precipitate is obtained. On boiling the precipitate with dil. HNO_3 , it forms a solution of blue colour. Addition of excess of aqueous solution of ammonia to this solution gives _____.
- deep blue precipitate of $\text{Cu}(\text{OH})_2$
 - deep blue solution of $[\text{Cu}(\text{NH}_3)_4]^{2+}$
 - deep blue solution of $\text{Cu}(\text{NO}_3)_2$
 - deep blue solution of $\text{Cu}(\text{OH})_2 \cdot \text{Cu}(\text{NO}_3)_2$
- II) On heating with concentrated NaOH solution in an inert atmosphere of CO_2 , white phosphorus gives a gas. Which of the following statement is incorrect about the gas?
- It is highly poisonous and has smell like rotten fish.
 - It's solution in water decomposes in the presence of light.
 - It is more basic than NH_3 .
 - It is less basic than NH_3 .
- III) Silver Chloride combines with liquor ammonia to form
- Silver hydroxide
 - Silver
 - Diamminesilver(I) Chloride
 - Diamminesilver (II) Chloride

IV) Bond dissociation enthalpy of E—H (E = element) bonds is given below. Which of the compounds will act as strongest reducing agent?

Compound	NH ₃	PH ₃	AsH ₃	SbH ₃
$\Delta_{\text{diss}}(\text{E—H})/\text{kJ mol}^{-1}$	389	322	297	255

- a) NH₃
- b) PH₃
- c) AsH₃
- d) SbH₃

48. Hydrofluoric acid was used in glass etching from 1720 onwards. Andreas Sigismund Marggraf first characterized it in 1764 when he heated fluorite with sulfuric acid, and the resulting solution corroded its glass container. Swedish chemist Carl Wilhelm Scheele repeated the experiment in 1771, and named the acidic product fluorspar acid. In 1810, the French physicist André-Marie Ampère suggested that hydrogen and an element analogous to chlorine constituted hydrofluoric acid. He also proposed in a letter to Sir Humphry Davy dated August 26, 1812 that this then-unknown substance may be named *fluorine* from fluoric acid.

Initial studies on fluorine were so dangerous that several 19th-century experimenters were deemed "fluorine martyrs" after misfortunes with hydrofluoric acid. Isolation of elemental fluorine was hindered by the extreme corrosiveness of both elemental fluorine itself and hydrogen fluoride, as well as the lack of a simple and suitable electrolyte. Edmond Frémy postulated that electrolysis of pure hydrogen fluoride to generate fluorine was feasible and devised a method to produce anhydrous samples from acidified potassium bifluoride; instead, he discovered that the resulting (dry) hydrogen fluoride did not conduct electricity. Frémy's former student Henri Moissan persevered, and after much trial and error found that a mixture of potassium bifluoride and dry hydrogen fluoride was a conductor, enabling electrolysis. To prevent rapid corrosion of the platinum in his electrochemical cells, he cooled the reaction to extremely low temperatures in a special bath and forged cells from a more resistant mixture of platinum and iridium, and used fluorite stoppers. In 1886, after 74 years of effort by many chemists, Moissan isolated elemental fluorine.

- I) Which of the halogen acids should have highest bond dissociation enthalpy?
 - a. HF
 - b. HCl
 - c. HBr
 - d. HI
- II) The increasing order of reducing power of the halogen acids is
 - (a) HF < HCl < HBr < HI
 - (b) HI < HBr < HCl < HF
 - (c) HBr < HCl < HF < HI
 - (d) HCl < HBr < HF < HI
- III) Which one of the following does not form hydrogen bonding?
 - (a) NH₃
 - (b) H₂O
 - (c) HCl
 - (d) HF

49. Halogens are highly reactive, and as such can be harmful or lethal to biological organisms in sufficient quantities. This high reactivity is due to the high electronegativity of the atoms due to their high effective nuclear charge. Because the halogens have seven valence electrons in their outermost energy level, they can gain an electron by reacting with atoms of other elements to satisfy the octet rule. Fluorine is the most reactive of all elements; it is the only element more electronegative than oxygen, it attacks otherwise-inert materials such as glass, and it forms compounds with the usually inert noble gases. It is a corrosive and highly toxic gas. The reactivity of fluorine is such that, if used or stored in laboratory glassware, it can react with glass in the presence of small amounts of water to form silicon tetrafluoride (SiF_4). Thus, fluorine must be handled with substances such as Teflon (which is itself an organofluorine compound), extremely dry glass, or metals such as copper or steel, which form a protective layer of fluoride on their surface.

The high reactivity of fluorine allows some of the strongest bonds possible, especially to carbon. For example, Teflon is fluorine bonded with carbon and is extremely resistant to thermal and chemical attacks and has a high melting point. Fluorine (F_2), composed of two fluorine atoms, combines with all other elements except helium and neon to form ionic or covalent fluorides. Some metals, such as nickel, are quickly covered by a fluoride layer, which prevents further attack of the metal by the element. Certain dry metals, such as mild steel, copper, aluminum, or Monel (a 66 percent nickel, 31.5 percent copper alloy), are not attacked by fluorine at ordinary temperatures. Fluorine reacts violently with organic matter (such as rubber, wood, and cloth), and controlled fluorination of organic compounds by the action of elemental fluorine is only possible if special precautions are taken. Fluorspar is the most important source of fluorine.

- I) .Fluorine differs from rest of the halogens in some of its properties. This is due to
- (a) its smaller size and high electronegativity.
 - (b) lack of d-orbitals.
 - (c) low bond dissociation energy.
 - (d) All of the these.

- II) Which of the following is the strongest oxidising agent?
- (a) F_2
 - (b) Cl_2
 - (c) I_2
 - (d) Br_2

- III) Fluorine is a versatile oxidizing agent
- a) Low bond dissociation enthalpy
 - b) Maximum hydration enthalpy
 - c) Both a and b
 - d) None of the above

50. Sulfuric acid is a very important commodity chemical, and a nation's sulfuric acid production is a good indicator of its industrial strength. It is widely produced with different methods, such as contact process, wet sulfuric acid process, lead chamber process and some other methods. Sulfuric acid is also a key substance in the chemical industry. It is most commonly used in fertilizer manufacture, but is also important in mineral processing, oil refining,

wastewater processing, and chemical synthesis. It has a wide range of end applications including in domestic acidic drain cleaners, as an electrolyte in lead-acid batteries, in dehydrating a compound, and in various cleaning agents. Sulfuric acid can be obtained by dissolving sulfur trioxide in water.

- I) On addition of conc. H_2SO_4 to a chloride salt, colourless fumes are evolved but in case of iodide salt, violet fumes come out. This is because
- a) H_2SO_4 reduces HI to I_2
 - b) HI is of violet colour
 - c) HI gets oxidised to I_2
 - d) HI changes to HIO_3
- II) Hot conc. H_2SO_4 acts as moderately strong oxidising agent. It oxidises both metals and nonmetals. Which of the following element is oxidised by conc. H_2SO_4 into two gaseous products?
- a) Cu
 - b) S
 - c) C
 - d) Zn
- III) H_2SO_4 is also known as
- (a) oil of Vitriol
 - (b) cream of Vitriol
 - (c) blue Vitriol
 - (d) green Vitriol

51. In recent years many chemists have begun to gain a better understanding of p-block reactivity, particularly the behaviour of those elements not typically found in biological ('organic') system.

Many studies concerning heavier p-block element reactivity have been brought about by variously making comparisons to, or contrasting with, well-established carbon chemistry. Through creating conceptual bridges between inorganic and organic chemistry, a deeper understanding of electronic structure and the ability to predict chemical reactivity can be gained. This includes the structure and bonding in cluster compounds, p-block polymers, and multiple bonded systems. Indeed, one area of focus has been the synthesis of new p-block reagents such as $[\text{O}-\text{C}\equiv\text{P}]^-$. For example, white phosphorus (P_4) is a common industrial reagent for the synthesis of value-added phosphorus-containing compounds. Yet the synthesis of these compounds, which involves the reaction of P_4 with chlorine gas, is both energy intensive and hazardous. The search for safer, cheaper, and more environmentally friendly alternative reagents has prompted the development of the bis(trichlorosilyl)phosphide anion, $[\text{P}(\text{SiCl}_3)_2]^-$, which can be used in the synthesis of a variety of phosphorus-containing compounds. Other reagents for incorporating p-block elements into compounds have included phosphinonitrenes.

The strength of multiple bonding is a common theme of organic chemistry and is facilitated by efficient orbital overlap associated with smaller 2p orbitals. In these systems, the strength of π

bonding is comparable to that of σ bonding. On descending the p-block, the more radially expanded nature of the p-orbitals leads to a reduced overlap integral and weaker bonds, and σ bonds become substantially favored over π bonds. The isolation of heavier main-group compounds containing multiple bonds has therefore been of fundamental interest. These compounds are expected to have much-enhanced reactivity (relative to their carbon analogs) arising from the inherent weakness of these multiple bonds.

I) Which of the following elements can be involved in $p\pi-d\pi$ bonding?

- a) Carbon
- b) Nitrogen
- c) Phosphorus
- d) Boron

II) The shape of XeF_4 is

- (a) tetrahedral
- (b) square planar
- (c) pyramidal
- (d) linear

III) The hybridisation of sulphur in sulphur hexafluoride is

- (a) sp^3d
- (b) sp^3d^2
- (c) sp^3d^3
- (d) sp^3

IV) Which of the following is not correctly matched?

- (a) PCl_5 - sp^3d hybridisation
- (b) PCl_3 - sp^3 hybridisation
- (c) PCl_5 (solid)- $[\text{PtCl}_4]^-$ $[\text{PtCl}_3]^-$
- (d) H_3PO_3 -tribasic

V). Partial hydrolysis of XeF_4 gives

- (a) XeO_3
- (b) XeOF_2
- (c) XeOF_4
- (d) XeF_2

Matching Type

Note : Match the items of Column I and Column II in the following questions.

52. Match the items of Columns I and II and mark the correct option.

Column I	Column II
(A) H_2SO_4	(1) Highest electron gain enthalpy
(B) CCl_3NO_2	(2) Chalcogen

(C) Cl ₂	(3) Tear gas
(D) Sulphur	(4) Storage batteries

Code:

- (a) A (4) B (3) C (1) D (2)
 (b) A (3) B (4) C (1) D (2)
 (c) A (4) B (1) C (2) D (3)
 (d) A (2) B (1) C (3) D (4)

53. Match the items of Columns I and II and mark the correct option.

Column I	Column II
(A) Its partial hydrolysis does not change oxidation state of central atom	(1) He
(B) It is used in modern diving apparatus	(2) XeF ₆
(C) It is used to provide inert atmosphere for filling electrical bulbs	(3) XeF ₄
(D) Its central atom is in sp ³ d ² hybridisation	(4) Ar

Code:

- (a) A (1) B (4) C (2) D (3)
 (b) A (1) B (2) C (3) D (4)
 (c) A (2) B (1) C (4) D (3)
 (d) A (1) B (3) C (2) D (4)

Assertion and Reason Type Questions

Note: In the following questions a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

- (i) Both assertion and reason are correct statements, and reason is the correct explanation of the assertion.
- (ii) Both assertion and reason are correct statements, but reason is not the correct explanation of the assertion.
- (iii) Assertion is correct, but reason is wrong statement.
- (iv) Assertion is wrong but reason is correct statement.
- (v) Both assertion and reason are wrong statements.

54. Assertion: Chlorine water loses its yellow colour on standing.

Reason: HClO is unstable and decomposes to HCl which is colourless.

55. Assertion: Bleaching by SO_2 is temporary.

Reason: SO_2 bleaches by oxidizing action.

56. Assertion: Reaction of SO_2 and H_2S in the presence of Fe_2O_3 catalyst gives elemental sulphur.

Reason: SO_2 is a reducing agent.

57. Assertion: F-F bond in F_2 molecule is strong.

Reason: F atom is small in size.

58. Assertion: H_3PO_3 is dibasic acid.

Reason: There are 2H atoms directly bonded to P.

59. Assertion: F_2 has low reactivity.

Reason: F-F bond has low bond dissociation enthalpy.

60. Assertion: Ozone is a powerful oxidizing agent in comparison to Oxygen.

Reason: Ozone is diamagnetic but O_2 is Paramagnetic.

61. Assertion: Xenon forms fluorides.

Reason: Because 5d orbitals are available for valence shell expansion.

62. Assertion: HClO_4 is less acidic than HBrO_4 .

Reason: HClO_4 ionises less in water than HBrO_4

63. Assertion: HClO_4 is a stronger acid than HClO_3

Reason: Oxidation state of Cl in HClO_4 is +7 and in HClO_3 is +5.

64. Assertion: Iodine dissolves in aqueous solution of Potassium Iodide.

Reason: Potassium Iodide behaves as an organic solvent and thus dissolves non polar iodine.

65. Assertion: N_2 is less reactive than P_4 .

Reason: Nitrogen has more electron gain enthalpy than phosphorus.

66. Assertion: HNO_3 makes iron passive.

Reason: HNO_3 forms a protective layer of ferric nitrate on the surface of iron.

67. Assertion: HI cannot be prepared by the reaction of KI with concentrated H_2SO_4

Reason: HI has lowest H–X bond strength among halogen acids.

68. Assertion: Both rhombic and monoclinic sulphur exist as S_8 but oxygen exists as O_2 .

Reason: Oxygen forms $p\pi-p\pi$ multiple bond due to small size and small bond length but $p\pi-p\pi$ bonding is not possible in sulphur.

69. Assertion: NaCl reacts with concentrated H_2SO_4 to give colourless fumes with pungent smell. But on adding MnO_2 the fumes become greenish yellow.

Reason: MnO_2 oxidises HCl to chlorine gas which is greenish yellow.

70. Assertion: SF_6 cannot be hydrolysed but SF_4 can be.

Reason: Six F atoms in SF_6 prevent the attack of H_2O on sulphur atom of SF_6 .

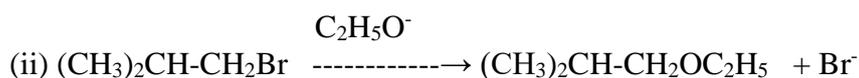
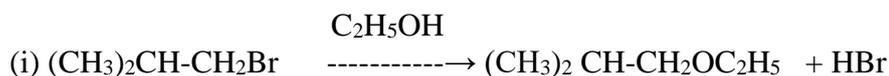
Unit: Haloalkanes and Haloarenes

Section -I

Multiple choice questions (Question number 1 to 20)

1. C – X bond is strongest in
 - (a) CH₃Cl
 - (b) CH₃Br
 - (c) CH₃F
 - (d) CH₃I
2. Which of the following will have the maximum dipole moment?
 - (a) CH₃F
 - (b) CH₃Cl
 - (c) CH₃Br
 - (d) CH₃I
3. The total number of isomers having the molecular formula C₆H₁₄ is –
 - (a) 3
 - (b) 4
 - (c) 5
 - (d) 6

4. Consider the reactions :



The mechanisms of reactions (i) and (ii) are respectively:

- (a) SN₁ and SN₂
 - (b) SN₁ and SN₁
 - (c) SN₂ and SN₂
 - (d) SN₂ and SN₁
5. The replacement of chlorine of chlorobenzene to give phenol requires drastic conditions, but the chlorine of 2,4-dinitrochlorobenzene is readily replaced since,
 - (a) nitro groups make the aromatic ring electron rich at ortho/Para positions
 - (b) Nitro groups withdraw electrons from the Meta position of the aromatic ring
 - (c) Nitro groups donate electrons at Meta position
 - (d) Nitro groups withdraw electrons from ortho/Para positions of the aromatic ring.

6. Finkelstein reaction results in the preparation of
- RF
 - RCl
 - RBr
 - RI
7. Which of the following represents correct set of ambident nucleophiles?
- CN^- and NH_3
 - CN^- , NO_2^-
 - OH^- , RO^-
 - CN^- , OH^-
8. Which of the following statements is correct?
- $\text{S}_{\text{N}}2$ reactions of optically active halides are accompanied by inversion of configuration.
 - $\text{S}_{\text{N}}1$ reactions of optically active halides are accompanied by racemisation.
 - Carbocation formed in $\text{S}_{\text{N}}1$ reaction is sp^2 hybridized.
 - All of the above.
9. Which will undergo $\text{S}_{\text{N}}2$ reaction fastest among the following halogen compounds?
- $\text{CH}_3\text{CH}_2\text{F}$
 - $\text{CH}_3\text{CH}_2\text{Cl}$
 - $\text{CH}_3\text{CH}_2\text{Br}$
 - $\text{CH}_3\text{CH}_2\text{I}$
10. Aryl halides are extremely less reactive towards nucleophilic substitution than alkyl halides. Which of the following statements true for above?
- Due to resonance in aryl halides.
 - In alkyl halides carbon atom in C–X bond is sp^2 hybridised whereas in aryl halides carbon atom in C–X bond is sp^3 hybridized.
 - Due to stability of phenyl cation.
 - Due to possible repulsion, there are less chances of nucleophile to approach electron rich arenes.
- (i), (iii) and (iv)
 - (i), (ii) and (iii)
 - (i), (ii) and (iv)
 - (ii), (iii) and (iv)
11. The correct order of reactivity of the halides, ethyl chloride (I) iso-propyl chloride (II) and benzyl chloride (III) in $\text{S}_{\text{N}}1$ reaction is
- $\text{I} > \text{II} > \text{III}$
 - $\text{III} > \text{II} > \text{I}$
 - $\text{II} > \text{I} > \text{III}$
 - $\text{I} > \text{III} > \text{II}$

12. The catalyst used in the preparation of an alkyl chloride by the action of dry HCl on an alcohol is
- Anhydrous AlCl_3
 - FeCl_3
 - Anhydrous ZnCl_2
 - Cu
13. Dehydrohalogenation of an alkyl halide is a/an :
- Nucleophilic substitution reaction
 - Elimination reaction
 - Both nucleophilic and elimination reaction
 - Rearrangement
14. Isocyanide can be prepared from alkyl halide on treatment with :
- KCN
 - AgNC
 - KNC
 - AgCN
15. The major product formed when 2-Bromo-2methyl butane is refluxed with ethanoic KOH is
- 2-Methyl but-2-ene.
 - 2-Methyl butan-1-ol
 - 3-Methyl butan -2-ol
 - 2-Methyl but-1-ene.
16. IUPAC name of $(\text{CH}_3)_3\text{CCl}$
- 3-Chlorobutane
 - 2-Chloro-2-methylpropane
 - t-butyl chloride
 - n-butyl chloride
17. Which of the following is the example of Friedel Craft reaction?
- $\text{C}_6\text{H}_6 + \text{CH}_3\text{CH}_2\text{Cl} \xrightarrow{\text{AlCl}_3} \text{C}_6\text{H}_5\text{C}_2\text{H}_5 + \text{HCl}$
 - $\text{C}_6\text{H}_5\text{OH} + \text{CH}_3\text{CH}_2\text{Cl} \xrightarrow{\text{AlCl}_3} \text{C}_6\text{H}_5\text{C}_2\text{H}_5 + \text{HOCl}$
 - $\text{C}_6\text{H}_5\text{Cl} + \text{CH}_3\text{CH}_2\text{Cl} \xrightarrow{\text{AlCl}_3} \text{C}_6\text{H}_5\text{C}_2\text{H}_5 + \text{Cl}_2$
 - $\text{C}_6\text{H}_5\text{CH}_3 + \text{CH}_3\text{CH}_2\text{Cl} \xrightarrow{\text{AlCl}_3} \text{C}_6\text{H}_5\text{C}_2\text{H}_5 + \text{CH}_3\text{Cl}$

18. An alkyl halide reacts with metallic sodium in dry ether. The reaction is known as :
- Gattermann's reaction
 - Sandmeyer's reaction
 - Wurtz reaction
 - Kolbe's reaction
19. Tertiary alkyl halides are practically inert to substitution by S_N2 mechanism because of
- Steric hindrance
 - Inductive effect
 - Instability
 - Insolubility
20. The order of reactivities of the following alkyl halides for a S_N2 reaction is
- $RF > RCl > RBr > RI$
 - $RF > RBr > RCl > RI$
 - $RCl > RBr > RF > RI$
 - $RI > RBr > RCl > RF$

Section- II

Assertion reason type question (question number 21 to 30)

Note: In the following questions, a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

- Both assertion and reason are true and the reason is the correct explanation of _____ assertion.*
- Both assertion and reason are true but the reason is not the correct explanation _____ of _____ assertion.*
- Assertion is true but reason is false.*
- Assertion is false but reason is true.*

21. **Assertion:** Thionyl chloride is preferred over Phosphorus chlorides (tri and penta) for the preparation of alkyl chlorides from alcohols.

Reason: Phosphorus chlorides give pure alkyl halides.

22. **Assertion:** Reactivities of alkyl halide in S_N2 substitution is governed by steric factors.

Reason: The bulkier the group, that less reactive it will be.

23. **Assertion:** KCl reacts with CH_3Cl to give methyl isocyanide.

Reason: CN^- is an ambidentate nucleophile.

24. **Assertion:** Presence of a nitro group at ortho or para position increases the reactivity of haloarenes towards nucleophilic substitution.
Reason: Nitro group, being an electron-releasing group increases the electron density over the benzene ring.
25. **Assertion:** Nitration of chlorobenzene leads to the formation of meta nitro chloro benzene.
Reason: Nitro group is a meta directing group.
26. **Assertion:** S_N2 reaction of an optically active aryl halide with an aqueous solution of KOH always gives an alcohol with opposite sign of rotation.
Reason: S_N2 reactions always proceed with inversion of configuration.
27. **Assertion:** It is difficult to replace Cl by OH group in chlorobenzene in comparison to that in chloroethane.
Reason: CCl bond in chlorobenzene has partial double bond character due to resonance.
28. **Assertion:** Hydrolysis of two bromo octane proceeds with inversion of configuration.
Reason: the reaction proceeds through the formation of a carbocation.
29. **Assertion:** In monohaloarenes further electrophilic substitution occurs at ortho & para directions.
Reason: halogen atom is ring deactivated.
30. **Assertion:** S_N1 reactions are carried out through formation of carbocation as an intermediate.
Reason: S_N1 reactions are two step reactions in which step 1 is fast and irreversible
31. **Assertion:** Optically active alkyl halide gives enantiomeric pair in S_N1 reaction.
Reason: Alkyl carbocation has planar geometry
32. **Assertion:** Neopentyl chloride always gives S_N2 reaction.
Reason: Neopentyl chloride is primary alkyl halide
33. **Assertion:** S_N1 reaction is carried out in the presence of polar protic solvents.
Reason: Polar protic solvents increases stability of carbocation due to solvation.
34. **Assertion:** S_N2 reaction is carried out in the presence of polar aprotic solvents.
Reason: A polar aprotic solvent does not contain acidic hydrogen.
35. **Assertion:** *Tert* butyl bromide and sodium ethoxide will react to form only ether.
Reason: Ethers are prepared from sodium alkoxide and alkyl halide.

Section –III

CCT / Case study based question (Q:36 to Q:40)

36. **Case I: Read the passage given below and answer the following questions from:**

Markovnikov's rule predicted the regioselectivity of electrophilic addition reactions of alkenes. This rule was an important milestone in the development of the structural theory in organic chemistry. The chemical basis for Markovnikov's Rule is the formation of the most stable carbocation during the addition process. In 1933 **Kharasch** described the addition of hydrogen bromide in the presence of peroxides to unsymmetrically substituted alkenes and the formation of a product called as Anti-Markovnikov product. Hydroboration reaction also forms the Anti-Markovnikov products.

In all these reactions the electrophiles (H^+ , Br, and BH_3) attack the carbon atom with the greater number of hydrogen substituents forming the most stable intermediate. However, the students are getting ignored. They assume that the anti-Markovnikov addition results in the formation of the least stable intermediate. Therefore, I assume, that this formulation of Anti-Markovnikov addition for radical addition and hydroboration should be changed.

(Source: Metin Balci Emeritus Professor (2019). Org. Commun. 12:3 (2019) 120-120.)

(i) The following reaction is



- a) Nucleophilic addition
- b) Electrophilic Addition
- c) Electrophilic substitution
- d) Free Radical addition

(ii) The **Markovnikov's rule** is used in connection with

- a) Stereochemistry of elimination reaction
- b) Stability of free radical
- c) Activity of enzymes
- d) Addition of acids to double bond

(iii) The catalyst used in Kharasch effect is –

- a) Only halogenated compounds
- b) peroxide
- c) $\text{Al}_2(\text{SO}_4)_3$
- d) TiCl_4

(iv) In the following reaction, The alkene would be



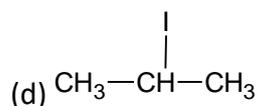
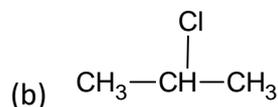
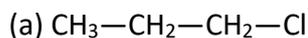
The alkene would be

- a) $\text{CH}_3 - \text{CH} = \text{CH}_2$
- b) $\text{CH}_3\text{CH}_2 - \text{CH} = \text{CH}_2$
- c) $(\text{CH}_3)_2\text{C} = \text{CH}_2$
- d) $\text{CH}_3 - \text{CH} = \text{CH} - \text{CH}_3$

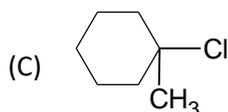
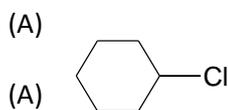
37. Case II: Read the passage given below and answer the following questions.

A nucleophilic substitution reaction that occurs by an SN_1 mechanism proceeds in two steps. In the first step, the bond between the carbon atom and the leaving group breaks to produce a carbocation and most commonly, an anionic leaving group. In the second step, the carbocation reacts with the nucleophile to form the substitution product. The formation of a carbocation is the slow or rate determining step. The rate of SN_1 reactions decrease in the order $3^\circ > 2^\circ > 1^\circ$, which is the reverse order observed in SN_2 reactions. In contrast to SN_2 reactions at stereogenic centers, which occur with inversion of configuration, an SN_1 reaction gives a racemic mixture of enantiomers that has no optical rotation. The polarity of carbon-halogen bond of alkyl halides is responsible for their nucleophilic substitution, elimination and their reaction with metal atoms to form organometallic compounds.

(i) Predict the compound which will undergo SN_2 reaction faster:



(ii) Which of the following compounds will be most reactive for S_N1 reaction:



(iii) Which of the following has highest nucleophilicity:

- (a) F^-
- (b) CH_3^-
- (c) OH^-
- (d) NH_2^-

(iv) Aryl halides are less reactive towards S_N reactions as compared to alkyl halides due to:

- (a) The formation of more stable carbocation
- (b) No Resonance stabilization
- (c) Long carbon-halogen bond
- (d) sp^2 -hybrid carbon attached to Cl having lone pairs

38. Case III: Read the passage given below and answer the following questions from.

When haloalkanes with β -hydrogen atom are boiled with alcoholic solution of KOH, they undergo elimination of hydrogen halide resulting in the formation of alkenes. These

reactions are called β -elimination reactions or dehydrohalogenation reactions. These reactions follow Saytzeff's rule. Substitution and elimination reactions often compete with each other. Mostly bases behave as nucleophiles: The polarity of carbon-halogen bond of alkyl halides is responsible for their nucleophilic substitution, elimination and their reaction with metal atoms to form organometallic compounds. Nucleophilic substitution reactions are categorised into S_N1 and S_N2 on the basis of their kinetic properties. Chirality has a profound role in understanding the reaction mechanisms of S_N1 and S_N2 reactions. S_N2 reactions of chiral alkyl halides are characterised by the inversion of configuration while S_N1 reactions are characterised by racemisation.

(i) Two isomeric halo alkenes (A) and (B) have molecular formula C_5H_9Cl . (A) gives optically inactive compound while (B) gives optically active compound in hydrogenation. The two isomers respectively are:

- (a) 3-chloro-1-pentene and 4-chloro-2-pentene
- (b) 4-chloro-1-pentene and 2-chloro-2-pentene
- (c) 3-chloro-2-pentene and 1-chloro-2-pentene
- (d) 1-chloro-1-pentene and 5-chloro-1-pentene

(ii) HCl does not form Anti-Markownikov's product with propene, because –

- a) HCl is a polar covalent molecule
- b) Dipole-Dipole attraction exist between HCl molecules
- c) Formation of Cl^\ominus is energetically unfavorable
- d) Chlorine has highest electron affinity

(iii) IUPAC name of $CH_3CH_2C(Br)=CH-Cl$ is

- (a) 2-bromo-1-chloro but-1-ene
- (b) 1-chloro-2-bromo but-1-ene
- (c) 3-chloro-2-bromo but-1-ene
- (d) None of the above

(iv) Possible major product formed in the reaction of neopentyl alcohol with HCl is

- (a) 2-chloro-2-methylbutane
- (b) 2,2-dimethyl 1-chloropropane
- (c) 2-chloro-3-methylbutane
- (d) 3-chloro-3-methylbutane

39. Case IV: Read the passage given below and answer the following questions from.

Haloalkanes are colorless (when pure), sweet smelling liquids. CH_3Cl , CH_3Br and C_2H_5Cl and freons are gases. Boiling point increases with increase in molecular weight and increase in carbon chain and decreases with branching. They are insoluble in water due to inability to form H-bonds with water. Dipole moment increases with polarity, density increases with increase in molar mass. They are non-inflammable, therefore, CCl_4 is used as fire extinguisher under the name pyrene. p-dichloro benzene has zero dipole moment, higher melting point than o-dichloro benzene due to symmetry, fits into crystal lattice readily. Haloalkanes undergo nucleophilic substitution reaction by SN_2 mechanism, $1^\circ > 2^\circ > 3^\circ$, SN_1 if carbocation formed is stable. They also undergo nucleophilic elimination reactions with alcoholic KOH. Haloarenes are less reactive than haloalkanes towards nucleophilic substitution due to resonance. Haloarenes undergo electrophilic substitution reaction like nitration, sulphonation, Friedel Crafts

alkylation, acylation. Chloroform is used as solvent, Freon is used as refrigerant, dichloromethane is used as paint.

(i) The order of reactivity of the given haloalkanes towards nucleophile is :

- (a) $RI > RBr > RCl$
- (b) $RCl > RBr > RI$
- (c) $RBr > RCl > RI$
- (d) $RBr > RI > RCl$

(ii) The decreasing order of boiling points of alkyl halides is

- (a) $RF > RCl > RBr > RI$
- (b) $RBr > RCl > RI > RF$
- (c) $RI > RBr > RCl > RF$
- (d) $RCl > RF > RI > RBr$

(iii) Which of the following has highest boiling point :

- a) CH_3Cl
- b) CH_3I
- c) CH_3Br
- d) CH_3F

iv) Which reagents is used for elimination reaction :

- a) Alc.KOH
- b) Aq.KOH
- c) Na/Dry Ether
- d) NaI & Dry Acetone

40. Case V: Read the passage given below and answer the following questions from.

A chemical reaction is the result of competition; it is a race that is won by the fastest runner. A collection of molecules tend to do, by and large, what is easiest for them. Nucleophilic substitution reaction is given by those compounds which has nucleophilic group as a good leaving group. The leaving group is a electron withdrawing group, it should be stable after leaving with bonding pair of electrons and it should have high polarisability. An alkyl halide with α -hydrogen atoms when reacted with a base or a nucleophile has two competing routes: substitution (SN_1 and SN_2) and elimination. Which route will be taken up depends upon the nature of alkyl halide, strength and size of base/nucleophile and reaction conditions. Thus, a bulkier nucleophile will prefer to act as a base and abstracts a proton rather than approach a tetravalent carbon atom (steric reasons) and vice versa. Similarly, a primary alkyl halide will prefer a SN_2 reaction, a secondary halide- SN_2 or elimination depending upon the strength of

base/nucleophile and a tertiary halide- SN_1 or elimination depending upon the stability of carbocation or the more substituted alkene.

(i) Which of the following compound will give nucleophile substitution reactions?

- (a) $\text{R}-\text{Br}$ (b) $\text{R}-\text{NH}_2$ (c) $\text{R}-\overset{\oplus}{\text{O}}\text{H}_2$ (d) all of these

(ii) Which of the following will give fast SN_2 mechanism?

- (a) CH_3-Br (b) $\text{CH}_2=\text{CH}-\text{CH}_2-\text{Br}$
(c) $\text{C}_6\text{H}_5-\text{CH}_2-\text{Br}$ (d) $(\text{CH}_3)_3\text{C}-\text{Br}$

(iii) Which of the following compounds will give SN_1 reaction?

- (a) $\text{CH}_3-\text{CH}=\text{CH}-\text{CH}_2-\text{Cl}$ (b) $\text{CH}_3-\text{C}_6\text{H}_4-\text{CH}_2-\text{Cl}$
(c) $\text{CH}_3\text{O}-\text{C}_6\text{H}_4-\text{CH}_2-\text{Cl}$ (d) All of these

(iv) Which of the following undergoes nucleophilic substitution exclusively by SN_1 mechanism:

- (a) Ethyl chloride (b) Isopropyl chloride
(c) Chlorobenzene (d) Benzyl chloride

Unit: ALCOHOLS, PHENOLS & ETHERS

Q-1 Arrange the following compounds in increasing order of boiling point.

Propan-1-ol, butan-1-ol, butan-2-ol, pentan-1-ol:

- (i) Propan-1-ol, butan-1-ol, butan-2-ol, pentan-1-ol
- (ii) Pentan-1-ol, butan-2-ol, butan-1-ol, propan-1-ol
- (iii) Pentan-1-ol, butan-1-ol, butan-2-ol, propan-1-ol
- (iv) Propan-1-ol, butan-2-ol, butan-1-ol, pentan-1-ol

Q-2 Phenol is less acidic than _____.

- (i) Methanol
- (ii) p-methylphenol
- (iii) o-nitrophenol
- (iv) o-methoxyphenol

Q-3 Which of the following is most acidic?

- (i) Benzyl alcohol
- (ii) Ethanol
- (iii) Phenol
- (iv) m-Chlorophenol

Q-4 Which of the following compounds will react with sodium hydroxide solution in water?

- (i) C_6H_5OH
- (ii) $C_6H_5CH_2OH$
- (iii) $(CH_3)_3COH$
- (iv) C_2H_5OH

Q-5 IUPAC name of m-cresol is _____.

- (i) 3-methylphenol
- (ii) 3-chlorophenol
- (iii) 3-methoxyphenol
- (iv) benzene-1,3-diol

Q-6 The process of converting alkyl halides into alcohols involves_____.

- (i) addition reaction
- (ii) substitution reaction
- (iii) dehydrohalogenation reaction
- (iv) rearrangement reaction

Q-7 $\text{CH}_3\text{CH}_2\text{OH}$ can be converted into CH_3CHO by _____.

- (i) treatment with $\text{K}_2\text{Cr}_2\text{O}_7$
- (ii) treatment with LiAlH_4
- (iii) treatment with pyridinium chlorochromate
- (iv) treatment with KMnO_4

Q-8 Monochlorination of toluene in sunlight followed by hydrolysis with aq. NaOH yields.

- (i) o-Cresol
- (ii) m-Cresol
- (iii) Benzyl alcohol
- (iv) 2, 4-Dihydroxytoluene

Q-9 Order of esterification of alcohols are

- (i) $1^\circ > 2^\circ > 3^\circ$
- (ii) $3^\circ > 1^\circ > 2^\circ$
- (iii) $2^\circ > 3^\circ > 1^\circ$
- (iv) None of these

Q-10 What happens when tertiary butyl alcohol is passed over heated copper at 573K?

- (i) Acetone & methanal are formed
- (ii) 2-methylpropene is formed
- (iii) 1-butene is formed
- (iv) Butanol is formed

Q-11 Which of the following alcohols reacts most readily with Lucas reagent?

- (i) 3° alcohol
- (ii) 2° alcohol
- (iii) 1° alcohol
- (iv) Methyl alcohol

Q-12 Chemical name of Picric acid is

- (i) 2,4,6-nitrobenzoic acid
- (ii) 2, 4, 6-tribromophenol

- (iii) 2, 4, 6-trinitrophenol
- (iv) p-nitrophenol

Q-13 The reaction between phenol and chloroform in the presence of aqueous NaOH is known as

- (i) Etard reaction
- (ii) Kolbe's reaction
- (iii) Reimer Tiemann reaction
- (iv) None of above

Q-14 Conversion of phenol to salicylic acid is known as

- (i) Reimer-Tiemann reaction
- (ii) Hydroboration-oxidation
- (iii) Williamson's synthesis
- (iv) Kolbe's reaction

Q-15 Benzyl alcohol is obtained from benzaldehyde

- (i) Wurtz reaction
- (ii) Etard reaction
- (iii) Williamson's synthesis
- (iv) Cannizzaro's reaction

Q-16 Phenol reacts with Br₂ in CS₂ at low temperature to give

- (i) o-Bromophenol
- (ii) o-and p-Bromophenol
- (iii) p-Bromophenol
- (iv) 2,4,6-Tribromophenol

Q-17 Phenol on distillation with zinc dust gives

- (i) Benzoquinone
- (ii) Toluene
- (iii) Benzaldehyde
- (iv) Benzene

Q-18 Acetone reacts with Grignard reagent to form

- (i) 2° alcohol
- (ii) 3° alcohol
- (iii) Acetic acid
- (iv) no reaction

Q-19 Which of the following cannot be prepared by using Williamson Synthesis:

- (i) Ditert. butyl ether
- (ii) Methoxybenzene
- (iii) Benzyl p-nitrophenyl ether
- (iv) tert. butyl methyl ether

Q-20 Ethanol & Phenol can be distinguished by

- (i) Dye test
- (ii) NaHCO_3 test
- (iii) Carbylamine test
- (iv) Hinsberg's test

Q-21 During esterification water is removed as soon as it is formed:

- (i) To shift the equilibrium in forward reaction
- (ii) To purify the product
- (iii) To decrease the rate of reaction
- (iv) None of above

Q-22 The compound obtained by the reaction of propene with diborane followed by hydrolysis with alkaline H_2O_2 is

- (i) n-propyl alcohol
- (ii) ethanol
- (iii) triethyl bromide
- (iv) None of above

Q-23 which one of the following will not form yellow precipitate on heating with an alkaline solution of iodine?

- (i) CH_3OH
- (ii) $\text{CH}_3\text{CH}_2\text{OH}$
- (iii) $\text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{CH}_3$
- (iv) $\text{CH}_3\text{CH}(\text{OH})\text{CH}_3$

Q-24 Cumene hydroperoxide on hydrolysis with dilute H_2SO_4 gives

- (i) only phenol
- (ii) alcohol and phenol
- (iii) alcohol and acetone
- (iv) phenol and acetone

Q-25 Phenol is approximately how much times acidic than ethanol?

- (i) 10
- (ii) 50
- (iii) million
- (iv) 100

Q-26 Four compounds A, B, C and D having similar molecular masses were tested for their boiling points. It was found that compound C has the highest boiling point of all four. What is the compound C most likely to be?

- (i) Alcohol
- (ii) Haloalkane
- (iii) Hydrocarbon
- (iv) Ether

Q-27. If the boiling point of methoxymethane is 248K, predict the boiling point of ethanol.

- (i) 231K
- (ii) 351K
- (iii) 248K
- (iv) 455K

Note : In the following questions a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

- (i) Assertion and reason both are correct and reason is correct explanation of assertion.**
- (ii) Assertion and reason both are wrong statements.**
- (iii) Assertion is correct statement but reason is wrong statement.**
- (iv) Assertion is wrong statement but reason is correct statement.**
- (v) Both assertion and reason are correct statements but reason is not correct explanation of assertion.**

Q-28. Assertion : Addition reaction of water to but-1-ene in acidic medium yields butan-2-ol

Reason : Addition of water in acidic medium proceeds through the formation of primary carbocation.

Q-29. Assertion : p-nitrophenol is more acidic than phenol.

Reason : Nitro group helps in the stabilisation of the phenoxide ion by dispersal of negative charge due to resonance.

Q-30. Assertion : Bond angle in ethers is slightly greater than the tetrahedral angle.

Reason : There is a repulsion between the two bulky (—R) groups.

Q-31. Assertion : Boiling points of alcohols are higher than ethers with comparable molecular mass.

Reason : Alcohols can form intermolecular hydrogen-bonding.

Q-32. Assertion : o-Nitrophenol is less soluble in water than the m- and p-isomers.

Reason : o-Nitrophenol shows intramolecular Hydrogen bonding.

Read the passage given below and answer the following questions:

Williamson's synthesis is used for the preparation of symmetrical as well as unsymmetrical ether. It is S_N2 reaction mechanism. In Williamson's synthesis, 1° alkyl halide are used for preparation of ethers because 2° and 3° alkyl halide give alkene: Ethers are cleaved by hydrogen halides to alcohol and alkyl halide where alkyl halide is corresponding to that alkyl which has less number of carbon atom (it is because of less steric hindrance). In polar media unsymmetrical ether like tertiary butyl ethyl ether gives ethyl alcohol and tertiary butyl halide as reaction proceeds via carbocation.

Q-33. The Williamson ether synthesis produces ethers by reacting which of the following?

- (i) alkoxide with an alkyl halide
- (ii) alkoxide with a metal
- (iii) alcohol with a metal
- (iv) alkyl halide with an aldehyde

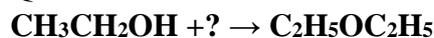
Q-34 In which case would a Williamson ether synthesis fail?

- (i) sodium ethoxide + iodomethane
- (ii) sodium ethoxide + iodoethane
- (iii) sodium ethoxide + 2-iodo-2-methylpropane
- (iv) sodium ethoxide + 2-iodopropane

Q-35. Which of the following reagents should be used to prepare tert-butyl ethyl ether?

- (i) tert-butyl bromide and sodium ethoxide
- (ii) potassium tert-butoxide and ethyl bromide
- (iii) tert-butyl alcohol and ethanol
- (iv) tert-butyl alcohol and ethyl bromide

Q-36. What will be the reactant and reaction condition required for the given reaction?



- (i) H_2SO_4 , 443K
- (ii) H_2SO_4 , 413K
- (iii) HNO_3 , 413K
- (iv) HNO_3 , 443K

Q-37. Williamson synthesis proceed via which of the following mechanism?

- a) S_N1
- b) S_N2
- c) E1
- d) E2

Read the passage given below and answer the following questions:

Alcohol Use is Common Among Women and Girls

Excessive alcohol use is associated with more than 27,000 deaths among women and girls each year.

1 Excessive alcohol use poses unique health and safety risks to females.

2 Alcohol Affects Women Differently than Men



Although men are more likely to drink alcohol and consume larger amounts, biological differences in body structure and chemistry lead most women to absorb more alcohol and take longer to metabolize it. After drinking the same amount of alcohol, women tend to have higher blood alcohol levels than men, and the immediate effects of alcohol usually occur more quickly and last longer in women than men. These differences make women more susceptible to the long-term negative health effects of alcohol compared with men.²

Alcohol is Associated with other Diseases, Injuries, and Harms

- **Liver Disease:** The risk of cirrhosis and other alcohol-related liver diseases is higher for women than for men.^{2,7}
- **Impact on the Brain:** Alcohol-related cognitive decline and shrinkage of the brain develop more quickly for women than for men.²
- **Impact on the Heart:** Women who drink excessively are at increased risk for damage to the heart muscle at lower levels of consumption and over fewer years of drinking than men.²
- **Breast and other Cancers:** Alcohol consumption increases the risk of cancers of the mouth, throat, esophagus, liver, and colon. In women, drinking is also associated with breast cancer, even at low levels of consumption.^{2,8}

Q-38 IUPAC name of alcohol used for drinking purpose is:

(i) Methanol

(ii) Ethanol

(iii) Propanol

(iv) None of above

Q-39 The enzyme which break down ethanol in the body

(i) Alcohol dehydrogenase (ADH),

(ii) Invertase

(iii) Trypsin

(iv) None of above

Q-40 which of the following is not correct

(i) The risk of cirrhosis and other alcohol-related liver diseases is higher for women than for men.

(ii) Alcohol Affects Women Differently than Men.

(iii) In the body ethanol is transformed into a toxic compound called acetaldehyde, a known carcinogen.

(iv) In women, drinking is not associated with breast cancer.

UNIT - BIOMOLECULES

SECTION A (ASSERTION-REASON)

For questions below, two statements are given one labeled Assertion(A) and the other labeled Reason(R). select the correct answer from the codes, A, B, C and D as given below.

- A. Both assertion and reason are correct statements and reason is the correct explanation of the assertion.
 - B. Both assertion and reason are correct statements and reason is not the correct explanation of the assertion
 - C. Assertion is correct but reason is wrong statement
 - D. Assertion is wrong but reason is correct statement
1. **Assertion(A):** The pentaacetate of glucose does not react with hydroxylamine
Reason(R): Glucose contains free aldehyde group
 2. **Assertion(A):** In zwitter ionic form, amino acids show amphoteric behavior.
Reason(R): Amino acids in zwitter ionic form react with acid and base both.
 3. **Assertion(A):** Glucose is a ketohexose
Reason(R): Glucose contains six carbon atoms and an aldehyde group
 4. **Assertion(A):** Glucose is monosaccharide
Reason(R): Glucose cannot be hydrolyzed further to give a simpler unit of polyhydroxy aldehyde or ketone.
 5. **Assertion(A):** DNA is responsible for maintaining the identity of different species of organisms over millions of years
Reason(R): DNA is the chemical basis of heredity and may be regarded as the reserve of genetic information.
 6. **Assertion(A):** Coagulation of egg white occurs on boiling
Reason(R): Denaturation of protein occurs when a native protein is subjected to a temperature change or a pH change.
 7. **Assertion(A):** When RNA is hydrolyzed, there is no relationship among the quantities of different bases obtained.
Reason(R): RNA molecules are of three types and they perform different functions.
 8. **Assertion(A):** Glucose pentaacetate does not form oxime.
Reason(R): Glucose pentaacetate does not have a free –OH group at C1 and so it can't be converted to the open chain form to give –CHO group and hence doesn't form the oxime.

SECTION B(MCQS)

9. Which of the following reagents does not react with glucose?
a) NH_2OH b) HCN c) 2,4 –DNP reagent d) Br_2 water
10. The number of chiral carbons in β -D (+) glucose is
a) five b) two c) four d) Six
11. Which of the following nitrogenous bases is not present in RNA?
a) adenine b) cytosine c) guanine d) thymine

25. The presence or absence of hydroxyl group on which carbon atom of sugar differentiates RNA and DNA
 a) 1st b) 2nd c) 3rd d) 4th
26. Glucose when reacts with HI and red phosphorus gives
 a) n-hexane b) n-heptane c) n –pentane d) n-octane
27. Which one of the following is an essential amino acid?
 a) cysteine b) serine c) tyrosine d) isoleucine
28. Which of the following protein is globular:
 a) collagen b) albumin c) myosin d) fibroin
29. Proteins are condensation polymers of
 a) alpha amino acids b) beta amino acids
 c) alpha hydroxyl acids d) beta hydroxyl acids
30. Coagulation of proteins is known as
 a) dehydration b) decay c) deamination d) denaturation
31. In fibrous proteins, polypeptides chains are held together by
 a) Vander Waal forces b) electrostatic forces of attraction
 c) hydrogen bonds d) covalent bonds
32. Which of the following is not a function of proteins:
 a) formation of hair, wool, skin and nails
 b) as a biological catalysts in the form of enzymes
 c) as food in the form of meat, eggs
 d) as energy provider for metabolisms

SECTION C (CASE STUDY QUESTIONS)

- A) Carbohydrates are polyhydroxy aldehydes and ketones and those compounds which on hydrolysis give such compounds are also called carbohydrates. The carbohydrates which are not hydrolyzed are called monosaccharides. Monosaccharides with an aldehydic group are called aldose and those with free ketonic groups are called ketose. Carbohydrates are optically active. Number of optical isomers = 2^n (where n=number of asymmetric carbon)

Carbohydrates are mainly synthesized by plants during photosynthesis. The monosaccharides give the characteristic reactions of alcohols and carbonyl groups (aldehydes and ketones). It has been found that these monosaccharides exist in the form of cyclic structures. In cyclisation, the –OH group (generally C5 or C4 in aldohexoses and C5 or C6 in ketohexoses) combine with the aldehyde or keto group. As a result, cyclic structures of five or six membered rings containing one oxygen atom are formed e.g. glucose forms a ring structure. glucose contains one aldehyde group, one primary alcoholic group and four secondary alcoholic groups in open chain structure.

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

33. In $\text{CH}_2\text{OHCHOHCHOHCHOHCHOHCHO}$, the number of optical isomers will be:
 a) 16 b) 8 c) 32 d) 4
34. Which of the following properties of glucose can be explained only by its cyclic structure?
 a) glucose forms cyanohydrin with HCN
 b) glucose reacts with hydroxyl amine to form an oxime
 c) pentaacetate of glucose does not react with hydroxyl amine
 d) glucose is oxidized by nitric acid to gluconic acid
35. Some statements are given below:
 1. Glucose is aldohexose
 2. Naturally occurring glucose is dextrorotatory
 3. Glucose contains 3 chiral centers
 4. Glucose contains one primary alcoholic group and four secondary alcoholic groups
- Among the above, correct statements are
 a) 1 and 2 only b) 3 and 4 only c) 1,2 and 4 only d) 1,2,3 and 4
36. The first member of ketose sugar is
 a) ketotriose b) ketotetrose
 c) ketopentose d) ketohexose

B. The sequence of bases along the DNA and RNA chain establishes its primary structure which controls the specific properties of the nucleic acid. An RNA molecule is usually a single chain of ribose containing nucleotides. On the basis of X-ray analysis of DNA, J.D Watson and F.H.C Crick (shared Nobel prize in 1962) proposed a three-dimensional secondary structure for DNA. A DNA molecule is a long and highly complex, spirally twisted, double helix, ladder like structure. The two polynucleotide chains or strands are linked up by hydrogen bonding between the nitrogenous base molecules of their nucleotide monomers. Adenine (purine) always links with Thymine (pyrimidine) with the help of two hydrogen bonds and Guanine (purine) with cytosine (pyrimidine) with the help of three hydrogen bonds. Hence, the two strands extend in opposite directions i.e. are antiparallel and complementary.

In these questions a statement is followed by a statement of reason. Choose the correct answer out of the following choices.

- A. Both assertion and reason are correct statements and reason is the correct explanation of the assertion.
- B. Both assertion and reason are correct statements and reason is not the correct explanation of the assertion
- C. Assertion is correct but reason is wrong statement
- D. Assertion is wrong but reason is correct statement

37. **Assertion(A):** DNA and RNA molecules are found in nucleus of a cell

Reason(R): there are two types of nitrogenous bases, purines and pyrimidines. Adenine and Guanine are substituted purines, Cytosine, Thymine and Uracil are substituted pyrimidines

38. **Assertion(A):** in DNA, the complementary bases are adenine and guanine, thymine and cytosine
Reason(R): the phenomenon of mutation is chemical change in DNA molecule
39. **Assertion(A):** the two strands of RNA are complementary to each other
Reason(R): Adenine always forms Hydrogen bonds with Thymine and Guanine forms hydrogen bonds with Cytosine
40. **Assertion(A):** a unit formed by the attachment of a base to 1' position of sugar is known as nucleotide.
Reason(R): when nucleoside is linked to phosphoric acid at 5' position of sugar moiety, we get a nucleotide

ANSWER KEY

UNIT- SOLID STATE

- Q1) i)a ii)a iii)d iv)b
Q2} i)b ii)a iii)d Or (a) iv)b
Q3) i)c ii)a iii)a iv)b v) b vi) d
Q 4) i) b ii)a iii)c iv)b
5)a 6)c 7)a 8)a 9)a 10)b 11)b 12)a 13)c 14)a 15)c
16)b 17)d 18)d 19)a 20)d 21)a 22)a 23)c 24)b 25)b 26)c
27)c 28)a 29)a 30)d 31)d 32)a 33)a 34)a 35)c 36)b 37)b
38)c 39)a 40)b

UNIT- SOLUTIONS

- (c) Acetone – chloroform
- (b) Solvent molecules move from lower concentration to higher concentration
- (a) A is less concentrated than B
- (c) Azeotropic mixture
- (a) Berkeley and Hatley's method
- (d) Shows a positive deviation from Raoult's Law
- (a) The enthalpy of mixing is zero
- (a) An increase in the boiling point of the solution
- (b) 2.79
- (d) Osmotic pressure
- (a) Increases with increase in temperature
- (d) A – B interactions are weaker than those between A – A or B – B
- (b) nature of the solvent
- (b) 804.32 g
- (c) Normal
- (b) Hypertonic
- (d) Solutes that associate in water have molar mass higher than the molar mass of the solute calculated theoretically.
- $$M_2 = \frac{K_f \cdot W_1 \cdot 1000}{W_2 \cdot \Delta T_b}$$
- (a) I and II
- (b) $1\text{ M} > 1\text{ m}$
- (b) 0.308
- (c) higher percentage of benzene
- (a) $A > B > C$
- (b) $\pi_1 < \pi_2$
- (a) mole fraction
- (d) Powdered sugar in hot water

27. (b) 5 times
28. (c) the boiling point of water inside the cooker is elevated
29. (d) 20.2 % HCl
30. (a) Acetone and aniline
31. (d) $C_4H_8O_4$
32. (d) Henry's law
33. (b) Volume change on mixing is not equal to zero
34. (b) Decrease in vapour pressure of a solvent on addition of a non-volatile non electrolyte solute in it.
35. (a) liquid solvent, solid solvent
36. (b) volume of solvent in 1 molar aqueous solution is less
37. (b) Higher the value of K_H at a given pressure, higher is the solubility of the gas in the liquids
38. (c) 1 : 5

Assertion Reasoning Based Questions

39. (a) Assertion and reason both are correct statements and reason is the correct explanation for assertion.
40. (b) Assertion and reason both are correct statements but reason is not the correct explanation for assertion.
41. (b) Assertion and reason both are correct statements but reason is not the correct explanation for assertion.
42. (c) Assertion is correct statement but reason is wrong statement.
43. (d) Assertion is wrong statement but reason is correct statement.
44. (b) Assertion and reason both are correct statements but reason is not the correct explanation for assertion.
45. (d). Assertion is wrong statement but reason is correct statement
46. (c) Assertion is correct statement but reason is wrong statement.
47. (a) Assertion and reason both are correct statements and reason is the correct explanation for assertion.
48. (c) Assertion is correct statement but reason is wrong statement.

Passage based questions:

49. (i) (b) 1.78×10^{-3}
 (ii) (a) 0.762
 (iii) (c) $Ar < CO_2 < CH_4 < HCHO$
 (iv) (c) 0.37
50. (i) (b) Assertion and reason both are correct statements but reason is not the correct explanation for assertion.
 (ii) (a) Assertion and reason both are correct statements and reason is the correct explanation for assertion.
 (iii) (a) Assertion and reason both are correct statements and reason is the correct explanation for assertion.
 (iv) (d) Assertion is wrong statement but reason is correct statement.

UNIT- p BLOCK ELEMENTS

1	a	21	d	41	d	61	a
2	b	22	a	42	b	62	c
3	c	23	a	43	d	63	b
4	b	24	a	44	d	64	c
5	a	25	c	45	a	65	c
6	a	26	d	46	a	66	c
7	b	27	d	47	I) b II) c III) c IV) d	67	b
8	c	28	c	48	I)a II)a III)c	68	a
9	b	29	a	49	I)b II)a III)c	69	a
10	b	30	c	50	I)c II)c III)a	70	A
11	a	31	c	51	I)c II)b III)b IV)d V)b		
12	a	32	b	52	a		
13	b	33	c	53	c		
14	b	34	d	54	a		
15	a	35	c	55	c		
16	d	36	a	56	b		
17	a	37	a	57	d		
18	c	38	c	58	c		
19	d	39	a	59	d		
20	d	40	c	60	b		

UNIT – HALOALKANES AND HALOARENES

Que	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans	C	a	C	a	d	d	b	d	d	a	b	c	b	d	a	b	a	c	a	d
Que	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35					
Ans	C	a	D	c	d	d	a	c	b	c	a	d	a	d	d					

Q36	(i)	(ii)	(iii)	(iv)
Ans	b	d	b	d
Q37	(i)	(ii)	(iii)	(iv)
Ans	c	d	a	d
Q38	(i)	(ii)	(iii)	(iv)
Ans	a	c	a	b
Q39	(i)	(ii)	(iii)	(iv)
Ans	a	c	b	a
Q40	(i)	(ii)	(iii)	(iv)
Ans	d	a	d	d

UNIT - ALCOHOLS, PHENOLS & ETHERS

1. (iv)	2. (iii)	3. (iv)	4. (i)	5. (i)	6. (ii)
7.(iii)	8.(iii)	9. (i)	10. (ii)	11. (i)	12. (iii)
13. (iii)	14. (iv)	15. (iv)	16. (ii)	17. (iv)	18. (ii)
19. (i)	20. (i)	21. (i)	22. (i)	23. (i)	24. (iv)
25. (iii)	26. (i)	27. (ii)	28. (iii)	29. (i)	30. (i)
31. (i)	32. (i)	33. (i)	34. (iii)	35. (iii)	36. (ii)
37. (ii)	38. (ii)	39. (i)	40. (iv)		

UNIT – BIOMOLECULES

1	C	11	D	21	D	31	C
2	A	12	C	22	C	32	D
3	D	13	D	23	A	33	A
4	A	14	D	24	C	34	C
5	A	15	D	25	B	35	C
6	A	16	D	26	A	36	A
7	B	17	B	27	D	37	D
8	A	18	B	28	B	38	D
9	C	19	C	29	A	39	D
10	A	20	A	30	D	40	D