Sample Paper

1

Time : 90 Minutes **Max. Marks : 35**

General Instructions

1. *The Question Paper contains three sections.*
2. *Section A has **25** questions. Attempt any **20** questions.*
3. *Section B has **24** questions. Attempt any **20** questions.*
4. *Section C has **6** questions. Attempt any **5** questions.*
5. *All questions carry equal marks.*
6. *There is no negative marking.*

SECTION-A

*This section consists of 25 multiple choice questions with overall choice to attempt **any 20** questions. In case more than desirable number of questions are attempted, ONLY first 20 will be considered for evaluation.*

1. Which of the following exists as covalent crystals in the solid state?
(a) Iodine (b) Silicon (c) Sulphur (d) Phosphorus

2. In graphite electrons are :
(a) localised on each carbon atom (b) spread out between the sheets
(c) localised on every third carbon atom (d) present in antibonding orbital.

3. A fluorine atom (F) affects pair of an electron in a covalent bond which is
(a) Weakest (b) Strongest (c) Neutral (d) Constant

4. A crystalline solid
(a) changes abruptly from solid to liquid when heated (b) has no definite melting point
(c) undergoes deformation of its geometry easily (d) has an irregular 3-dimensional arrangements

5. An ideal solution is formed when its components
(a) have no volume change on mixing (b) have no enthalpy change on mixing
(c) have both the above characteristics (d) have high solubility.

6. Schottky defect defines imperfection in the lattice structure of
(a) solid (b) gas (c) liquid (d) plasma

7. IUPAC name of $CH_3CH_2C(Br) = CH - Cl$ is
(a) 2-bromo-1-chlorobutene (b) 1-chloro-2-bromobutene
(c) 3-chloro-2-bromobutene (d) None of the above

8. Proteins are condensation polymers of
(a) α-amino acids (b) β-amino acids (c) α-hydroxy acids (d) β-hydroxy acids

9. When two halogen atoms are attached to same carbon atom then it is :
(a) *vic*-dihalide (b) *gem*-dihalide (c) α, ω-halide (d) α, β-halide

10. Which of the following noble gases react with fluorine to form compound?
(a) Krypton (b) Xenon (c) Radon (d) All of the above

11. An ether is more volatile than an alcohol having the same molecular formula. This is due to
(a) dipolar character of ethers (b) alcohols having resonance structures
(c) inter-molecular hydrogen bonding in ethers (d) inter-molecular hydrogen bonding in alcohols

12. The space lattice of graphite is
(a) cubic (b) tetragonal (c) rhombic (d) hexagonal

13. The process of converting alkyl halides into alcohols involves ..... .
(a) addition reaction (b) substitution reaction (c) dehydrohalogenation (d) rearrangement reaction

14. Which of the following factor do not affect solubility of solid solute in liquid?
(a) Temperature (b) Pressure (c) Nature of solute (d) All of these

15. Which of the following has strongest hydrogen bonding?
(a) Ethyl amine (b) Ethanal (c) Ethyl alcohol (d) Diethyl ether

16. What is hybridization of P in PCl_5 ?
(a) sp^3 (b) sp^3d^2 (c) sp^3d (d) sp^2

17. Which of the following is correct about H-bonding in nucleotide?
(a) A --- A and T --- T (b) G --- T and A --- C (c) A --- G and T --- C (d) A --- T and G --- C

18. Ethylene dichloride can be prepared by adding HCl to
(a) ethane (b) ethylene (c) acetylene (d) ethylene glycol

19. Haloarenes are ortho and para directing due to
(a) Resonance in aryl halide (b) –I effect of halogen atom
(c) +I effect of halogen atom (d) Both (a) and (b)

20. On heating lead nitrate forms oxides of nitrogen and lead. The oxides formed are ..... .
(a) N_2O, PbO (b) NO_2, PbO (c) NO, PbO (d) NO, PbO_2

21. Which one of the following is non-ideal solution
(a) Benzene + toluene (b) *n*-hexane + *n*-heptane
(c) Ethyl bromide + ethyl iodide (d) $CCl_4 + CHCl_3$

22. Collectively the elements of group 15 are called –
(a) pnicogens (b) pnicopens (c) nicopen (d) None of these

23. Insulin production and its action in human body are responsible for the level of diabetes. This compound belongs to which of the following categories?
(a) A carbohydrate (b) A hormone (c) A co-enzyme (d) An antibiotic

24. Which one of the following elements is most metallic ?
(a) P (b) As (c) Sb (d) Bi

25. Which of the following elements does not show allotropy?
(a) Nitrogen (b) Bismuth (c) Antimony (d) Arsenic

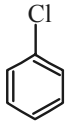
SECTION-B

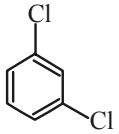
*This section consists of 24 multiple choice questions with overall choice to attempt **any 20** questions. In case more than desirable number of questions are attempted, ONLY first 20 will be considered for evaluation.*

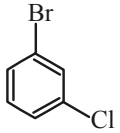
26. Which of the following liquid pairs shows a positive deviation from Raoult's law ?
(a) Water - Nitric acid (b) Benzene - Methanol
(c) Water - Hydrochloric acid (d) Acetone - Chloroform

27. The vapour pressure of two liquids '*P*' and '*Q*' are 80 and 60 torr, respectively. The total vapour pressure of solution obtained by mixing 3 mole of *P* and 2 mole of *Q* would be
(a) 72 torr (b) 140 torr (c) 68 torr (d) 20 torr

28. Arrange the following compounds in the increasing order of their densities.

(i)  (ii) 

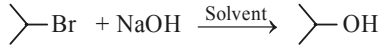
(iii) 

(iv) 

(a) (i) < (ii) < (iii) < (iv) (b) (i) < (iii) < (iv) < (ii) (c) (iv) < (iii) < (ii) < (i) (d) (ii) < (iv) < (iii) < (i)

29. Which of the following is not tetrahedral in shape?
(a) NH_4^+ (b) $SiCl_4$ (c) SF_4 (d) SO_4^{2-}

30. Primary structure of a protein is
(a) sequence in which α-amino acids are linked to one another
(b) sequence in which amino acids of one polypeptide chain are joined to other chain
(c) the folding patterns of polypeptide chains
(d) the pattern in which the polypeptide chains are arranged

31. 
For which solvent rate of S_N2 will be maximum?
(a) Benzene (b) 100% H_2O
(c) 100% acetone (d) 75% H_2O + 25% acetone

32. S – S bond is not present in
(a) $S_2O_4^{2-}$ (b) $S_2O_5^{2-}$ (c) $S_2O_3^{2-}$ (d) $S_2O_7^{2-}$

33. Which of the following is not a crystalline solid?
(a) KCl (b) CsCl (c) Glass (d) Rhombic S

34. For the compounds
CH_3Cl, CH_3Br, CH_3I and CH_3F,
the correct order of increasing C-halogen bond length is:
(a) $CH_3F < CH_3Cl < CH_3Br < CH_3I$ (b) $CH_3F < CH_3Br < CH_3Cl < CH_3I$
(c) $CH_3F < CH_3I < CH_3Br < CH_3Cl$ (d) $CH_3Cl < CH_3Br < CH_3F < CH_3I$

35. XeF_6 dissolves in anhydrous HF to give a good conducting solution which contains:
(a) H^+ and XeF_7^- ion (b) HF_2^- and XeF_5^+ ions (c) $HXeF_6^+$ and F^- ions (d) None of these

36. Equal moles of water and urea are taken in a flask. What is mass percentage of urea in the solution ?
(a) 7.692% (b) 769.2% (c) 76.92% (d) 0.7692%

37. Which statement is not correct about alcohol?
(a) Molecular weight of alcohol is higher than water
(b) Alcohol of less no. of carbon atoms is less soluble in water than alcohol of more no. of carbon atoms
(c) Alcohol evaporates quickly
(d) All of the above

38. Strong reducing behaviour of H_3PO_2 is due to
(a) low oxidation state of phosphorus
(b) presence of two — OH groups and one P — H bond
(c) presence of one — OH group and two P — H bonds
(d) high electron gain enthalpy of phosphorus

39. What is the coordination number of sodium and oxygen in Na_2O in which oxide ions occupy ccp arrangement and sodium ions occupy all tetrahedral voids?
(a) 6, 4 (b) 4, 8 (c) 8, 4 (d) 2, 4

40. Which of the following group 15 element forms metallic bonds in elemental state ?
(a) As (b) P (c) Sb (d) Bi

41. Isopropyl alcohol is obtained by reacting which of the following alkenes with concentrated H_2SO_4 followed by boiling with H_2O?
(a) Ethylene (b) Propylene (c) 2-Methylpropene (d) Isoprene

42. Which of the following cannot be made by using Williamson's synthesis?
(a) Methoxybenzene (b) Benzyl *p*-nitrophenyl ether
(c) Methyl tertiary butyl ether (d) Di-tert-butyl ether

43. PCl_3 reacts with water to form
(a) PH_3 (b) H_3PO_4 and HCl (c) $POCl_3$ (d) H_3PO_4

44. Which of the following compounds is resistant to nucleophilic attack by hydroxyl ions?
(a) Methyl acetate (b) Acetonitrile (c) Acetamide (d) Diethyl ether

Given below are two statements labelled as Assertion (A) and Reason (R). Select the most appropriate answer from the options given below:

(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true but R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false and R is also false.

45. **Assertion :** $PhC(=O)CH_2Cl$ is more reactive than $PhCH_2Cl$.
Reason : Conjugation with carbonyl group much more effective than with simple alkene or benzene ring.

46. **Assertion :** Bond angle of H_2S is smaller than H_2O.
Reason : Electronegativity of the central atom increases, bond angle decreases.

47. **Assertion :** Alkyl fluorides are prepared by heating AgF with alkyl chloride.
Reason : Because direct fluorination of alkanes occurs very slowly with rupture of C = C bonds.

48. **Assertion :** Molarity of a solution in liquid state changes with temperature.
Reason : The volume of a solution changes with change in temperature.

49. **Assertion :** Dinitrogen is inert at room temperature.
Reason : Dinitrogen directly combines with lithium to form ionic nitrides.

SECTION-C

*This section consists of 6 multiple choice questions with an overall choice to attempt **any 5**. In case more than desirable number of questions are attempted, ONLY first 5 will be considered for evaluation.*

50. Match the columns

Column -I	**Column-II**
(A) Mass percentage	(p) Medicine and pharmacy
(B) Mass by volume	(q) Concentration of pollutants in water
(C) ppm	(r) Industrial chemical application
(D) Volume percentage	(s) Liquid solutions

(a) A – (q), B – (p), C – (s), D – (r) (b) A – (s), B – (r), C – (p), D – (q)
(c) A – (r), B – (q), C – (s), D – (p) (d) A – (r), B – (p), C – (q), D – (s)

51. Which of the following analogy is incorrect?
(a) Optically inactive amino acid : Glycine : : Optically active protein : Lysine
(b) Essential amino acid : Lysine : : Non essential amino acid : Glycine
(c) Basic amino acid : Aspartate : : Acidic amino acid : Histidine
(d) Glucose : Pyranose : : Fructose : Furanose

52. XeF_6 —(+Excess H_2O)→ 'X' + HF ; —(+$2H_2O$)→ 'Y' + HF

Correct analogy for X : : Y

(a) $X : XeO_3 : : Y : XeOF_4$ (b) $X : Xe : : Y : XeO_3$
(c) $X : XeO_2F_2 : : Y : Xe$ (d) $X : XeO_3 : : Y : XeO_2F_2$

Case Study : *Read the following paragraph and answers the questions.*

Alkyl halides are insoluble in water but soluble in organic solvents. The insolubility in water is due to their inability to form hydrogen bonds with water. Alkyl bromides and iodides are denser than water whereas alkyl chlorides and fluorides are lighter than water. Alkyl halides have higher boiling points than alkanes of comparable molecular weight. For a given halogen atom, the boiling points of alkyl halides increase with the increase in the size of the alkyl group.

53. Which of the following is liquid at room temperature (b.p. is shown against it)?
(a) CH_3I (42 °C) (b) CH_3Br (3 °C) (c) C_2H_5Cl (12 °C) (d) CH_3F (–78 °C)

54. Which of the following possesses highest melting point?
(a) Chlorobenzene (b) *m*-dichlorobenzene (c) *o*-dichlorobenzene (d) *p*-dichlorobenzene

55. 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

Sample Paper 1

ANSWER KEYS																			
1	(b)	**7**	(a)	**13**	(b)	**19**	(d)	**25**	(a)	**31**	(c)	**37**	(b)	**43**	(b)	**49**	(c)	**55**	(c)
2	(b)	**8**	(a)	**14**	(b)	**20**	(b)	**26**	(b)	**32**	(d)	**38**	(c)	**44**	(d)	**50**	(d)		
3	(b)	**9**	(b)	**15**	(c)	**21**	(d)	**27**	(a)	**33**	(c)	**39**	(b)	**45**	(a)	**51**	(c)		
4	(a)	**10**	(d)	**16**	(c)	**22**	(a)	**28**	(a)	**34**	(a)	**40**	(d)	**46**	(c)	**52**	(b)		
5	(c)	**11**	(d)	**17**	(d)	**23**	(b)	**29**	(c)	**35**	(b)	**41**	(b)	**47**	(c)	**53**	(a)		
6	(a)	**12**	(d)	**18**	(d)	**24**	(d)	**30**	(a)	**36**	(c)	**42**	(d)	**48**	(a)	**54**	(d)		

SOLUTIONS

1. **(b)** Among the given crystals, only silicon exists as a covalent solid. It has diamond like structure.

2. **(b)** In graphite, the electrons are spread out between the sheets.

3. **(b)** It is the most electronegative element. Hence, it strongly attract the electron pair in a covalent bond.

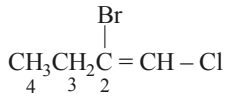
4. **(a)** In crystalline solid, there is perfect arrangement of the constituent particles only at 0 K. As the temperature increases the chance that a lattice site may be unoccupied by an ion increases. As the number of defects increases with temperature, solid changes into liquid.

5. **(c)** For ideal solution,

$\Delta V_{mixing} = 0$ and $\Delta H_{mixing} = 0$.

6. **(a)** Schottky defect is found in ionic solids.

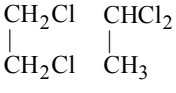
7. **(a)**



2-Bromo-1-chloro but-1-ene

8. **(a)**

9. **(b)**



(*vic*-dihalide) (*gem*-dihalide)

10. **(d)**

11. **(d)** Due to inter-molecular hydrogen bonding in alcohols boiling point of alcohols is much higher than ether.

12. **(d)** In graphite, the carbon atoms are arranged in regular hexagons in flat parallel layers.

13. **(b)** The process of conversion of alkyl halides into alcohols involves substitution reaction.

$$R-X \xrightarrow{OH^-} R-OH$$

Alkyl halide Alcohol

14. **(b)** An increase in temperature of the solution increases the solubility of a solid solute.
The amount of solute that dissolve depends on what type of solute it is.
For solids and liquid solutes, changes in pressure have practically no effect on solubility.

15. **(c)** Ethyl alcohol has strongest hydrogen bonding due to large electronegativity difference.

16. **(c)** Hybridisation in $PCl_5 = \frac{1}{2}(5+5+0-0) = 5$; sp^3d

17. **(d)**

18. **(d)** Ethylene dichloride can be prepared by adding HCl to ethylene glycol ($CH_2OH.\ CH_2OH$).

19. **(d)** Due to resonance, the electron density increases more at ortho- and para-positions than at meta-positions. Further, the halogen atom because of its – I effect has some tendency to withdraw electrons from the benzene ring. As a result, the ring gets somewhat deactivated as compared to benzene and hence the electrophilic substitution reactions in haloarenes occur slowly and require more drastic conditions as compared to those in benzene.

20. **(b)** On heating, lead nitrate produces brown coloured nitrogen dioxide (NO_2) and lead (II) oxide.

$$2Pb(NO_3)_2 \xrightarrow{\Delta} 4NO_2 + 2PbO + O_2$$

21. **(d)** CCl_4 is non-polar and $CHCl_3$ is polar.

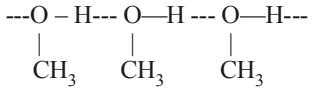
22. **(a)** Collectively these elements are called pnicogens and their compound pniconides.

23. **(b)** Insulin is a biochemically active peptide hormone secreted by pancreas.

24. **(d)** Metallic character increases down the group, Bi is most metallic

25. **(a)** Nitrogen does not show allotropy due to its small size and high electronegativity. The N–N bond is weak due to high inter–electronic repulsions among non-bonding electrons due to the small bond distance. Hence, it does not show allotropy.

26. **(b)** Positive deviations are shown by such solutions in which solvent-solvent and solute-solute interactions are stronger than the solute-solvent interactions. In such solution, the interactions among molecules becomes weaker. Therefore their escaping tendency increases which results in the increase in their partial vapour pressures.
In pure methanol, there exists intermolecular H–bonding.



On adding benzene, its molecules come between ethanol molecules, thereby breaking H-bonds which weaken intermolecular forces. This results in increase in vapour pressure.

27. **(a)** Given $P_P = 80$ torr

$P_Q = 60$ torr

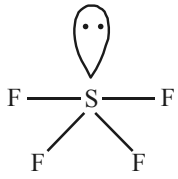
$P_{total} = P_P \times x_p + P_q \times x_q$

$= \left[80 \times \frac{3}{5} + 60 \times \frac{2}{5}\right] = 16 \times 3 + 12 \times 2$

$P_{total} = 48 + 24 = 72$ torr

28. **(a)** Density is directly related to molecular mass. Higher the molecular mass, higher will be the density of the compound. The order of molecular mass is
benzene < chlorobenzene < dichlorobenzene < bromochlorobenzene

29. **(c)** SF_4 has sea-saw shape as shown below:

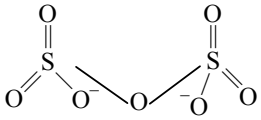


It has trigonal bipyramidal geometry having sp^3d hybridisation.

30. **(a)** The sequence in which the α-amino acids are linked to one another in a protein molecule is called its primary structure.

31. **(c)** For S_N2 reaction polar aprotic solvent is needed.

32. **(d)**



33. **(c)** Glass is amorphous solid.

34. **(a)** The correct order of increasing bond length is

$CH_3F < CH_3Cl < CH_3Br < CH_3I$

35. **(b)** $HF + XeF_6 \longrightarrow XeF_5^+ + HF_2^-$

36. **(c)** If $H_2O = x$ mole

Mass of x mole of $H_2O = 18x$ g

Then urea = x mole

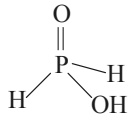
Mass of x mole of $NH_2 - \overset{\overset{O}{\|}}{C} - NH_2 = 60x$ g

Total mass of the solution $= 18x + 60x = 78x$ g

Mass % of urea $= \frac{60x}{78x} \times 100 = 76.92\%$

37. **(b)** The solubility of alcohols depend on number of C-atoms of alcohols. The solubility of alcohols in water decreases with the increase in number of C-atoms of alcohol. As resulting molecular weight increases, the polar nature of – OH bond decreases and hence strength of hydrogen bond decreases.

38. **(c)** The acids which contain P–H bond have strong reducing properties. Thus, H_3PO_2 is a strong reducing agent due to the presence of two P–H bonds and one – OH group



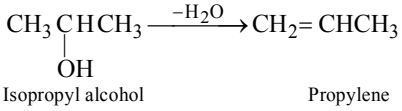
Hypophosphorus acid

39. **(b)** In Na_2O, negative ions form the *ccp* arrangement so that each positive ion is surrounded by 4 negative ions and each negative ion is surrounded by 8 positive ions.

$\therefore$ coordination no. of Na^+ is 4 and that of O^{2-} is 8.

40. **(d)** Bismuth forms metallic bonds in elemental state.

41. **(b)** Since the compound is formed by hydration of an alkene, to get the structure of alkene remove a molecule of water from the alcohol.



Isopropyl alcohol Propylene

42. **(d)** The two components should be $(CH_3)_3CONa$ + $(CH_3)_3CBr$. However, tert-alkyl halides tend to undergo elimination reaction rather than substitution leading to the formation of an alkene, $Me_2C = CH_2$

43. **(b)** $PCl_3 + H_2O \longrightarrow POCl_3 + 2HCl$

$POCl_3 + 3H_2O \longrightarrow H_3PO_4 + 3HCl$

44. **(d)** Diethyl ether, being a Lewis base, is not attacked by nucleophiles, while all others contain electrophilic carbon, hence attacked by nucleophiles like OH^- ions.

45. **(a)** α-halo carbonyl compounds (such as $C_6H_5COCH_2Cl$) are more reactive because conjugation with carbonyl group is more effective than simple alkene or benzene ring.

46. **(c)** Bond angle of H_2S (92°) < H_2O (104°31). As the electronegativity of the central atom decreases, bond angle decreases. In the present case, S is less electronegative than oxygen. Thus, bond pairs in H_2S are more away from the central atom than in H_2O and thus repulsive forces between bond pairs are smaller, producing smaller bond angle.

47. **(c)** alkyl fluorides are obtained by heating alkyl chloride or bromide in the presence of metallic fluorides like AgF or SbF_3. the reaction is known as Swartz reaction.

$$R - X + AgF/Hg_2F_2 \rightarrow R - F + AgX/Hg_2X_2$$

48. **(a)**

49. **(c)** At higher temperatures, dinitrogen combines with metals to form ionic nitrides.

50. **(d)**

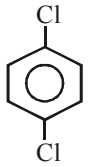
51. **(c)** Histidine is basic amino acid while aspartate is acidic amino acid.

52. **(b)** XeF_6 → (+Excess H_2O) → XeO_3 + HF (X); (XeF_6 + $2H_2O$) → XeO_2F_2 + HF (Y)

Y is not an oxyacid of xenon.

53. **(a)** Boiling point of CH_3I is 42°C which indicates that it is liquid at room temperature. CH_3I is larger molecule so it has stronger vander Waal's force of attraction than others.

54. **(d)** Para-dichlorobenzene has most symmetrical structure than others. It is found as crystalline lattice form, therefore, it has highest melting point (52°C) due to symmetrical structure.



55. **(c)** For the same alkyl group, the boiling points of alkyl halides decrease in the order :

RI > RBr > RCl > RF

This is because with the increase in size and mass of halogen atom, the magnitude of van der Waal's forces increases.