Question Bank of Chemistry (Class XII)

Electrochemistry

Multiple choice questions

1	The correct cell to represent the following reaction is : $Zn + 2Ag^+ \rightarrow Zn^{2+} + 2Ag$ (a) $2Ag \mid Ag^+ \parallel Zn \mid Zn^{2+}$ (b) $Ag^+ \mid Ag \parallel Zn^{2+} \mid Zn$ (c) $Ag \mid Ag^+ \parallel Zn \mid Zn^{2+}$ (d) $Zn \mid Zn^{2+} \parallel Ag^+ \mid Ag$	
2	ΔG and Ecell for a spontaneous reaction will be : (a) positive, negative (b) negative, negative (c) negative, positive (d) positive, positive	
3	Which of the following is affected by catalyst ? (a) ΔH (b) ΔG (c) Ea (d) ΔS	
4	**Which of the following statement is correct?** **(A) ECell and $\Delta_r G$ of cell reaction both are extensive properties.** **(b) ECell and $\Delta_r G$ of cell reaction both are intensive properties.** **(c) ECell is an intensive property while $\Delta_r G$ of cell reaction is an extensive property.** **(d) ECell is an extensive property while $\Delta_r G$ of cell reaction is an intensive property.**	
5	**An electrochemical cell can behave like an electrolytic cell when _____.** **(a) Ecell = 0 (b) Ecell > Eext (c) Eext > Ecell (d) Ecell = Eext**	
6	Which of the following solutions of KCl will have the highest value of molar conductivity ? (a) 0.01 M (b) 1 M (c) 0.5 M (d) 0.1 M	
7	**The cell constant of a conductivity cell _____.** **(a) changes with the change of electrolyte.**	

	(b) changes with the change of concentration of electrolyte. **(c) changes with the temperature of the electrolyte.** **(d) remains constant for a cell.**	
8	**$\wedge^0_{m(NH4OH)}$ is equal to _____.** **(a)** $\wedge^0_{m(NH4OH)} + \wedge^0_{m(NH4Cl)} - \wedge^0_{(HCl)}$ **(b)** $\wedge^0_{m(NH4Cl)} + \wedge^0_{m(NaOH)} - \wedge^0_{(NaCl)}$ **(c)** $\wedge^0_{m(NH4Cl)} + \wedge^0_{m(NaCl)} - \wedge^0_{(NaOH)}$ **(d)** $\wedge^0_{m(NaOH)} + \wedge^0_{m(NaCl)} - \wedge^0_{(NH4Cl)}$	
9	**Using the data given below to find out the strongest reducing agent.** **$E^oCr_2O_7^{2-}/Cr^{3+}$ = 1.33V** **$E^oMnO_4^-/Mn^{2+}$ = 1.51V** **E^oCl_2/Cl^- = 1.36V** **E^oCr^{3+}/Cr = -0.74V** **(a) Cl–** **(b) Cr** **(c) Cr3+** **(d) Mn**	
10	Which of the following relations is incorrect ? (a) $R = \frac{1}{k}\left(\frac{l}{a}\right)$ (b) $G = k\left(\frac{a}{l}\right)$ (c) $G = k\left(\frac{l}{a}\right)$ (d) $\wedge_m = \frac{k}{c}$	
11	Kohlrausch gave the following relation for strong electrolyte : $\wedge = \wedge_o - A\sqrt{C}$ Which of the following equality holds true ? (a) $\wedge = \wedge_o$ as $C \longrightarrow \sqrt{A}$ (b) $\wedge = \wedge_o$ as $C \longrightarrow 0$ (c) $\wedge = \wedge_o$ as $C \longrightarrow \infty$ (d) $\wedge = \wedge_o$ as $C \longrightarrow 1$	

12	The cathode reaction during the charging of a lead storage battery leads to the : (a) formation of PbSO4 (b) reduction of Pb2+ to Pb4+ (c) formation of PbO2 and Pb (d) deposition of Pb at the anode	
13	The number of faradays passed through a solution of CuSO4 to produce 1 mol of Cu and O2 will be : (a) 1.0 (b) 4. 0 (c) 8 .0 (d) 2.0	
14	Corrosion of iron is : (a) a decomposition process (b) a photochemical process (c) an electrochemical process (d) a reduction process	
15	Four half reactions I to IV are shown below : 1 I. $2Cl^- \rightarrow Cl2 + 2e–$ II. $4OH^- \rightarrow O2 + 2H2O + 2e–$ III. $Na^+ + e– \rightarrow Na$ IV. $2H^+ + 2e– \rightarrow H2$ Which two of these reactions are most likely to occur when concentrated brine is electrolysed ? (a) I and III (b) I and IV (c) II and III (d) II and IV	
16	A voltaic cell is made by connecting two half cells represented by half equations below : $Sn^{2+}(aq) + 2e– \rightarrow Sn(s)\ E^O = – 0.14$ V $Fe^{3+}(aq) + e– \rightarrow Fe^{2+}(aq)\ E^O = + 0.77$ V Which statement is correct about this voltaic cell ? (a) Fe2+ is oxidised and the voltage of the cell is –0.91 V (b) Sn is oxidised and the voltage of the cell is 0.91 V (c) Fe2+ is oxidised and the voltage of the cell is 0.91 V (d) Sn is oxidised and the voltage of the cell is 0.63 V	
17	Which of the following cell was used in Apollo space programme ? (a) Mercury cell (b) Daniel cell (c) H2–O2 Fuel cell (d) Dry cell	
18	Consider the following standard electrode potential values : 1 $Fe^{3+}(aq) + e– \rightarrow Fe^{2+}(aq)\ E^O = + 0.77$ V $MnO_4^-(aq) + 8H^+ + 5e^- \rightarrow Mn^{2+}(aq) + 4\ H_2O(l)\ E^O = + 1.51$ V What is the cell potential for the redox reaction ? (a) – 2.28 V (b) – 0.74 V (c) + 0.74 V (d) + 2.28 V	
19	The unit of molar conductivity is (a) S cm–2 mol–1 (b) S cm2 mol–1 (c) S–1 cm2 mol–1 (d) S cm2 mol	
20	The difference between the electrode potentials of two electrodes when no current is drawn through the cell is called _____.	

	(a) Cell potential (b) Cell emf (c) Potential difference (d) Cell voltage	

Short answer type questions (2 marks)

1	On diluting two electrolytes 'A' and 'B', the $\wedge_m$ of 'A' increases 25 times while that of 'B' increases by 1·5 times. Which of the two electrolytes is strong ? Justify your answer graphically.	
2	The electrical resistance of a column of **0.05** mol / L NaOH solution of diameter 1 cm and length 50 cm is **5.55 10^3** ohm. Calculate the conductivity.	
3	State Kohlrausch law of independent migration of ions. Write an expression for the molar conductivity of acetic acid at infinite dilution according to Kohlrausch law.	
4	State Faraday's first law of electrolysis. How much charge, in terms of Faraday, is required for the reduction of 1 mol Cu^{2+} to Cu ?	
5	(a) What is meant by 'limiting molar conductivity'? (b) What is the effect of catalyst on: (i) Gibbs energy (ΔG) and (ii) activation energy of a reaction?	
6	The molar conductivity of a 1.5 M solution of an electrolyte is found to be 138.9 S cm2 mol-1. Calculate the conductivity of this solution.	
7	The conductivity **of 0.20 M** solution of KCl at 298 K is **0.025 S cm^{-1}**. Calculate its molar conductivity.	
8	Why does the conductivity of a solution decrease with dilution?	
9	From the given cells: Lead storage cell, Mercury cell, Fuel cell and Dry cell Answer the following: (i) Which cell is used in hearing aids? (ii) Which cell was used in Apollo Space Programme? (iii) Which cell is used in automobiles and inverters? (iv) Which cell does not have long life?	
10	Calculate the degree of dissociation (a) of acetic acid if its molar conductivity (Λ_m) is **39.05 S cm^2 mol^{-1}.** Given: $\lambda°(H^+)$ = 349.6 S cm^2 mol^{-1} and $\lambda°(CH3COO^-)$ = 40.9 S cm^2 mol^{-1}	

11	Define fuel cell and write its two advantages.	
12	What type of a cell is the lead storage battery? Write the anode and the cathode reactions and the overall reaction occurring in a lead storage battery while operating.	
13	State Faraday's first law of electrolysis. How much charge in terms of Faraday is required for the reduction of 1 mol of Cu^{2+} to Cu.	
14	Calculate emf of the following cell at 298 K : Mg(s) | Mg^{2+} (0.1 M) || Cu^{2+} (0.01) | Cu (s) [Given E^0_{cell} = +2.71 V, 1 F = 96500 C mol^{-1}]	
15	With the help of a graph explain why it is not possible to determine m for a weak electrolyte by extrapolating the molar conductivity (m) versus C1/2 curve as for strong electrolyte	
16	Calculate the half-cell potential at 298 K for the reaction $Zn^{2+} + 2e^- \longrightarrow Zn$ if $[Zn^{2+}] = 0{\cdot}1$ M and $E^\circ_{Zn^{2+}/Zn} = -0{\cdot}76$ V.	
17	(a) What should be the signs (positive/negative) for E^oCell and ΔG^o for a spontaneous redox reaction occurring under standard conditions ? (b)Express the relation between conductivity and molar conductivity of a solution held in a cell	
18	Determine the values of equilibrium constant (K_c) and $\Delta G°$ for the following reaction : $Ni(s) + 2Ag^+(aq) \rightarrow Ni^{2+}(aq) + 2Ag(s)$, E° = 1.05 V (1F = 96500 C mol^{-1})	
19	The standard electrode potential for Daniell cell is **1.1 V**. Calculate the standard Gibbs energy for the cell reaction. (F = 96,500 C mol^{-1})	
20	What is corrosion? Explain the electrochemical theory of rusting of iron and write the reactions involved in the rusting of iron.	
	Short answer type questions (3 marks)	

1	Calculate the maximum work and log K_c for the given reaction at 298 K : $Ni\ (s) + 2Ag^+\ (aq) \rightleftharpoons Ni^{2+}\ (aq) + 2Ag\ (s)$ Given : $E^\circ_{Ni^{2+}/Ni} = -0{\cdot}25$ V, $E^\circ_{Ag^+/Ag} = +0{\cdot}80$ V $1\ F = 96500\ C\ mol^{-1}$ 2·	
2	Calculate emf of the following cell at 298 K for $Mg\ (s) \mid Mg^{2+}\ (0{\cdot}1\ M) \parallel Cu^{2+}\ (0{\cdot}01\ M) \mid Cu\ (s)$ $[E^\circ_{cell} = +2{\cdot}71$ V, $1\ F = 96500\ C\ mol^{-1}$, $\log 10 = 1]$	
3	Calculate the emf of the following cell at 298 K : $Al\ (s) \mid Al^{3+}\ (0{\cdot}001\ M) \parallel Ni^{2+}\ (0{\cdot}1\ M) \mid Ni\ (s)$ [Given : $E^\circ_{Al^{3+}/Al} = -1{\cdot}66$ V, $E^\circ_{Ni^{2+}/Ni} = -0{\cdot}25$ V, $\log 10 = 1$]	
4	The molar conductivities of NH_4^+ and Cl^- ion are $73{\cdot}8\ S\ cm^2\ mol^{-1}$ and $76{\cdot}2\ S\ cm^2\ mol^{-1}$ respectively. The conductivity of 0·1 M NH_4Cl is $1{\cdot}29 \times 10^{-2}\ S\ cm^{-1}$. Calculate its molar conductivity and degree of dissociation.	
5	(a) Write Nernst equation for the reaction at 25 ^OC : $2Al\ (s) + 3Cu^{2+}\ (aq) \rightarrow 2Al^{3+}\ (aq) + 3\ Cu\ (s)$ (b) What are secondary batteries? Give an example.	
6	(a) For an electrochemical cell $Mg\ (s) + Ag^+\ (aq) \rightarrow Ag\ (s) + Mg^{2+}\ (aq)$, give the cell representation. Also write the Nernst equation for the above cell at 25°C. (b) Write the product obtained at cathode on electrolysis of aqueous solution of NaCl.	
7	Define conductivity and molar conductivity for the solution of an electrolyte. Discuss their variation with concentration.	
8	Predict the products of electrolysis in each of the following. (i) An aqueous solution of $AgNO_3$ with silver electrodes. (ii) An aqueous solution of $AgNO_3$ with platinum electrodes.	

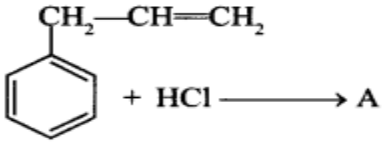
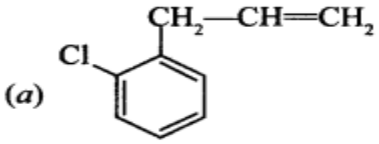
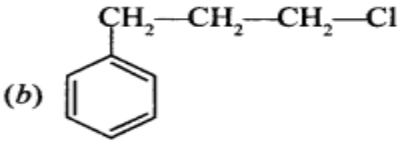
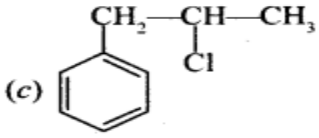
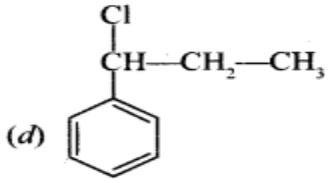
	(iii) A dilute solution of H_2S0_4 with platinum electrodes. (iv) An aqueous solution of $CuCl_2$ with platinum electrodes.	
9	How much charge is required for the following reductions: (i) 1 mol of Al^{3+} to Al? (ii) 1 mol of Cu^{2+} to Cu ? (iii) 1 mol of Mn04- to Mn^{2+}?	
10	A zinc rod is dipped in **0.1 M** solution of $ZnSO_4$. The salt is **95%** dissociated at this dilution at 298 K. Calculate the electrode potential. **[$E°_{Zn^{2+}}$ /Zn = – 0.76 V]**	
11	Write the name of the cell which is generally used in hearing aids. Write the reactions taking place at the anode and the cathode of this cell.	
12	Following reactions can occur at cathode during the electrolysis of aqueous silver nitrate solution using Pt electrodes : $Ag^+_{(aq)} + e^- \longrightarrow Ag_{(s)}$; $E^0 = 0.80$ V $H^+_{(aq)} + e^- \longrightarrow \frac{1}{2}H_{2(s)}$; $E^0 = 0.00$ V On the basis of their standard electrode potential values, which reaction is feasible at cathode and why?	
13	The cell in which the following reaction occurs: $2Fe^{3+}(aq) + 2I^-(aq) \rightarrow 2Fe^{2+}(aq) + I_2(s)$ has E^o Cell = 0.236 V at 298 K. Calculate the standard Gibbs energy of the cell reaction. (Given: 1F = 96,500 C mol^{-1})	
14	How many electrons flow through a metallic wire if a current of 0.5 A is passed for 2 hours? (Given: 1F = 96,500 C mol^{-1})	
15	Estimate the minimum potential difference needed to reduce Al_2O_3 at 500°C. The Gibbs energy change for the decomposition reaction $2\ Al_2O_3 \rightarrow 4\ Al + 3O_2$ is 960 kJ (F = 96500 C mol^{-1})	

Haloalkanes and Haloarenes

Multiple choice questions

1.	**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	
2	**The best method for the conversion of an alcohol into an alkyl chloride is by treating the alcohol with**	

	(a) PCl_5 (b) dry HCl in the presence of anhydrous $ZnCl_2$ (c) $SOCl_2$ in presence of pyridine (d) None of these	
3	S_N1 reaction of alkyl halides leads to (a) retention of configuration (b) racemisation (c) inversion of configuration (d) none of these.	
4	**Which is the correct increasing order of boiling points of the following compounds?** **1-Iodobutane, 1-Bromobutane, 1-Chlorobutane, Butane** **(a) Butane < 1-Chlorobutane < 1-Bromobutane < 1 -Iodobutane** **(b) 1-Iodobutane < 1-Bromobutane < 1-Chlorobutane < Butane** **(c) Butane < 1-Iodobutane < 1-Bromobutane < 1-Chlorobutane** **(d) Butane < 1-Chlorobutane < 1-Iodobutane < 1-Bromobutane**	
5	**Reaction of $C_6H_5CH_2Br$ with aqueous sodium hydroxide follows** **(a) S_N^1 mechanism (b) S_N^2 mechanism** **(c) any of the above two depending upon the temperature of reaction** **(d) Saytzeff rule**	
6	**Which of the following alkyl halides will undergo S_N^1 reaction most rapidly?** **(a) $(CH_3)_3C$-F (b) $(CH_3)_3C$ – Cl (c) $(CH_3)_3C$ – Br (d) $(CH_3)_3C$-I**	
7	Aryl halides are less reactive towards nucleophilic substitution reactions as compared to alkyl halides due to (a) formation of a less stable carbonium ion in aryl halides (b) resonance stabilization in aryl halides (c) presence of double bonds in alkyl halides (d) inductive effect in aryl halides	
8	Chlorobenzene on reaction with NaOH at 300K followed by acidic hydrolysis produces (a) Phenol (b) Sodium phenoxide (c) Benzaldehyde (d) Benzoic acid	
9	**Which of the following possesses highest melting point?** (a) Chlorobenzene (b) m-dichlorobenzene (c) o-dichlorobenzene (d) p-dichlorobenzene	
10	The synthesis of alkyl fluoride is best accomplished by (a) Finkelstein reaction (b) Swartz reaction (c) Free radical fluorination (d) Sandmeyers reaction	
11	Fitting reaction can be used to prepare (a) Toluene (b) Acetophenone (c) Diphenyl (d) Chlorobenzene	
12	p-djchlorobenzene has higher melting point than its o- and m- isomers because (a) p-dichlorobenzene is more polar than o- and m- isomer. (b) p-isomer has a symmetrical crystalline structure.	

	(c) boiling point of p-isomer is more than o- and m-isomer. (d) All of these are correct reasons.	
13	$CH_3CH_2CH_2Cl \xrightarrow{\text{alc. KOH}} B \xrightarrow{HBr} C \xrightarrow{Na/ether} D$ In the above reaction, the product D is (a) Propane (b) 2, 3-Dimethylbutane (c) Hexane (d) Allyl bromide	
14	**In which of the following conversions, phosphorus pentachloride is used as the reagent?** (a) $H_2C = CH_2 \rightarrow CH_3CH_2Cl$ (b) $CH_3CH_2OH \rightarrow CH_3CH_2Cl$ (c) $H_3C\text{-}O\text{-}CH3 \rightarrow CH_3Cl$ (d) $CH \equiv CH \rightarrow CH_2 = CHCl$	
15	What is 'A' in the following reaction?  (a)  (b)  (c)  (d) 	

short answer (SA) type questions (2 marks)

1.

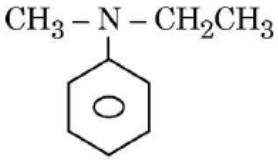
(a) $CH_3 - \underset{\underset{OH}{|}}{CH} - CH_3 \xrightarrow{PCl_5}$ 'A' $\xrightarrow{AgCN}$ 'B'

(b) $CH_3CH_2CH_2Cl + KOH \xrightarrow{ethanol}$ 'A' $\xrightarrow{HBr}$ 'B'

Identify 'A' and 'B' in the above reactions.

2.

(a) Write the IUPAC name for the following organic compounds : $2 \times 1 = 2$



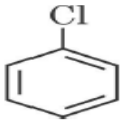
(b) Complete the following :

$C_6H_5NO_2 \xrightarrow{Sn / HCl}$ A $\xrightarrow{Br_2 / H_2O}$ B

3.

Write the structure of the major products in each of the following reactions : $2 \times 1 = 2$

(1) $CH_3 - \underset{\underset{Br}{|}}{CH} - CH_3 + KOH \xrightarrow[heat]{Ethanol}$

(2)  $+ CH_3COCl \xrightarrow{Anhyd.\ AlCl_3}$

4.

Answer the following questions :

(i) What happens when bromobenzene is treated with Mg in the presence of dry ether ? *1*

(ii) Which compound in each of the following pairs will react faster in S_N1 reaction with OH^- ? *1*

(1) $CH_2 = CH - CH_2 - Cl$ or $CH_3 - CH_2 - CH_2 - Cl$

(2) $(CH_3)_3C - Cl$ or CH_3Cl

5.

Write the equations for the preparation of 1-iodobutane from

(1) 1-chlorobutane

(2) but-1-ene. *2 ×1=2*

6. An alkyl halide (A) of molecular formula C6H13Cl on treatment with alcoholic KOH gives two isomeric alkenes (B) and (C) of molecular formula C6H12. Both alkenes on hydrogenation give 2,3-dimethylbutane. Write the structures of (A), (B) and (C).

7. Why is boiling point of o-dichlorobenzene higher than p-dichlorobenzene but melting point of para isomer is higher than ortho isomer ?

8. What are ambident nucleophiles? Explain giving an example.

9. Suggest a possible reason for the following observations:
(i) The order of reactivity of haloalkanes is RI > RCl > RBr.
(ii) Neopentyl chloride $(CH_3)_3CCH_2Cl$ does not follow SN_2 mechanism.

10. Define the following terms :
(i) Enantiomers (ii) Racemic mixture

Short answer (SA) type questions (3 marks)

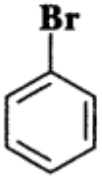
1. Write main product formed when :
(a) Methyl chloride is treated with NaI/Acetone.
(b) 2,4,6-trinitrochlorobenzene is subjected to hydrolysis.
(c) n-Butyl chloride is treated with alcoholic KOH.

2

Write the structures of the major product in each of the following reactions:

(*i*) $CH_3—CH=\underset{\displaystyle CH_3}{\overset{\displaystyle |}{C}}—CH_3 + HBr \longrightarrow$

(*ii*) $CH_3—CH_2—CH_2—\underset{\displaystyle Br}{\overset{\displaystyle |}{CH}}—CH_3 + KOH \xrightarrow{\text{ethanol/heat}}$

(*iii*)  $+ CH_3Cl \xrightarrow{\text{anhyd. } AlCl_3}$ **[AI Patna]**

3.

(*a*) Which alkyl halide from the following pairs would you expect to react more rapidly by an S_N2 mechanism and why? **[Foreign]**

$CH_3—CH_2—\underset{\displaystyle Br}{\overset{\displaystyle |}{CH}}—CH_3$; $CH_3—CH_2—CH_2—CH_2—Br$

(*b*) Racemisation occurs in S_N1 reactions. Why?

4.

Answer any 3 of the following : 3×1

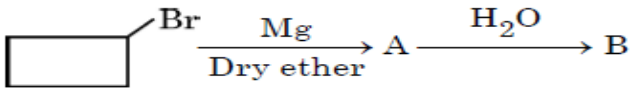
(a) Which isomer of C_5H_{10} gives a single monochloro compound C_5H_9Cl in bright sunlight ?

(b) Arrange the following compounds in increasing order of reactivity towards S_N2 reaction :

2-Bromopentane, 1-Bromopentane, 2-Bromo-2-methylbutane

(c) Why p-dichlorobenzene has higher melting point than those of ortho- and meta-isomers ?

(d) Identify A and B in the following :



5. Account for the following :
(a) Benzyl chloride is highly reactive towards SN1 reaction.
(b) ( )-Butan-2-ol is optically inactive, though it contains a chiral carbon atom.
(c) Chloroform is stored in closed dark coloured bottles.

6. (a) Why are alkyl halides insoluble in water?
(b) Why is Butan-l-ol optically inactive but Butan-2-ol is optically active?
(c) Although chlorine is an electron withdrawing group, yet it is ortho-, Para- directing in electrophilic aromatic substitution reaction. Why?

7. Explain as to why
(i) the dipole moment in chlorobenzene is lower than that of cyclohexyl chloride.
(ii) Grignard's reagent should be prepared under anhydrous conditions.
(iii) haloalkanes are only slightly soluble in water but dissolve easily in organic solvents.

8. Answer the following questions:
(i) What is meant by chirality of a compound? Give an example.
(ii) Which one of the following compounds is more easily hydrolysed, $CH_3CHClCH_2CH_3$ or $CH_3CH_2CH_2Cl$?
(iii) Which one undergoes SN2 substitution reaction faster and why?

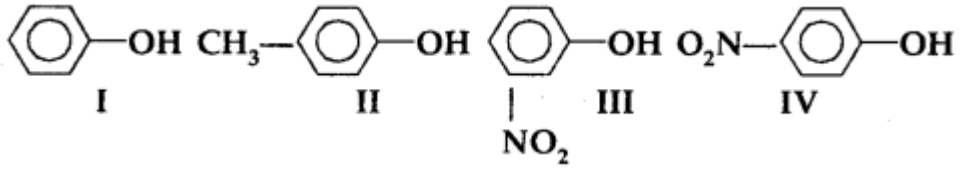
9. Among all the isomers of molecular formula C4H9Br, identify
(a) the one isomer which is optically active.
(b) the one isomer which is highly reactive towards SN2.
(c) the two isomers which give same product on dehydrohalogenation with alcoholic KOH.

10. How do you convert:
(i) Chlorobenzene to biphenyl
(ii) Propene to 1-iodopropane

(iii) 2-bromobutane to but-2-ene

Alcohols, Phenols and Ethers

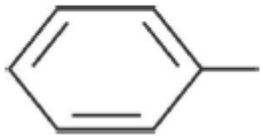
MULTIPLE CHOICE QUESTIONS

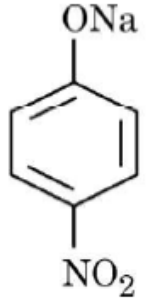
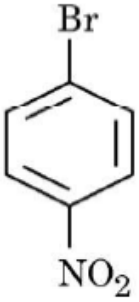
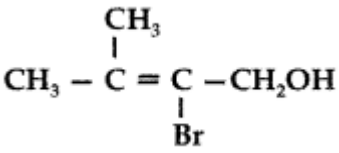
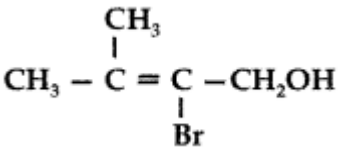
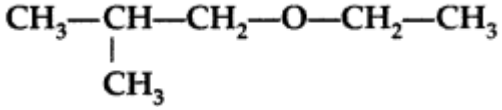
1	Which of the following reagents may be used to distinguish between phenol and benzoic acid? (a) Neutral $FeCl_3$ (b) Aqueous NaOH (c) Tollen's reagent (d) Molisch reagent	
2.	Rate of dehydration of alcohols follows the order: (a) $2° > 1° > CH_3OH > 3°$ (b) $3° > 2° > 1° > CH_3OH$ (c) $2° > 3° > 1° > CH_3OH$ (d) $CH_3OH > 1° > 2° > 3°$	
3	Phenol on heating with CHCl3 and NaOH gives salicylaldehyde. The reaction is called: (a) Reimer-Tiemann reaction (b) Gatterman-Koch reaction (c) Cannizzaro's reaction (d) Hell-Volhard-Zelinsky reaction	
4.	**HBr reacts fastest with** (a) 2-Methylpropan-1-ol (b) 2-Methylpropane-2-ol (c) propan-2-ol (d) propan-1-ol	
5	**Lucas reagent is** (a) Conc. HCl and anhydrous $ZnCl_2$ (b) Conc. HNO_3 and hydrous $ZnCl_2$ (c) Conc. HCl and hydrous $ZnCl_2$ (d) Conc. HNO_3 and anhydrous $ZnCl_2$	
6	**The compound which reacts fastest with Lucas reagent at room temperature is** (a) Butan-1-ol (b) Butan-2-ol (c) 2-Methyl propan-1-ol (d) 2-Methylpropan-2-ol	
7	In the following compounds:  I II III IV NO_2 The order of acidity is (a) III > IV > I > II (b) I > IV > III > II (c) II > I > III > IV (d) IV > III > I > II	
8	During dehydration of alcohols to alkenes by heating with cone. H_2SO_4 the initial step is (a) formation of an ester (b) protonation of alcohol molecule	

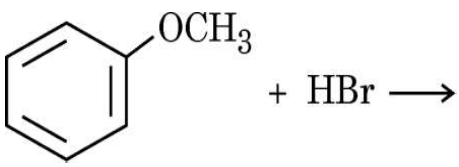
	(c) formation of carbocation (d) elimination of water	
9	Acetone reacts with Grignard reagent to form (a) 3° alcohol (b) 2° alcohol (c) ether (d) no reaction	
10	tert-Butyl methyl ether on heating with HI gives a mixture of (a) tert-Butyl alcohol and methyl iodide. (b) tert-Butyl iodide and methanol (c) Isobutylene and methyl iodide (d) Isobutylene and methanol.	
11	When Phenol is distilled with zinc dust, it gives (a) Benzene (b) Toluene (c) Benzaldehyde (d) Benzoic acid	
12	**CH_3CH_2OH can be converted into CH_3CHO by .** **(a) catalytic hydrogenation (b) treatment with $LiAlH_4$** **(c) treatment with pyridinium chlorochromate (d) treatment with $KMnO_4$**	
13	**Phenol is less acidic than.** **(a) ethanol (b) o-nitrophenol c) o-methylphenol (d) o-methoxyphenol**	
14	When phenol reacts with bromine water, what is the result? a) Brown liquid b) Colourless gas c) White precipitate d) No reaction	
15	Dehydration of alcohol to ethers is catalysed by (a) cone. H_2SO_4 at 413 K (b) Hot NaOH (c) Hot HBr (d) Hot HNO_3	
16	Which of the following alcohols will not undergo oxidation? (a) Butanol (b) Butan- 2- ol (c) 2-Methylbutan-2-ol (d) 3-Methylbutan-2-ol	
17	The C-O-H bond angle in alcohol is (a) Slightly greater than $109^o28'$ (b) Slightly less than $109^o28'$ (c) Slightly greater than 120^o (d) Slightly less than 120^o	
18	Which of the acid reacts with acetic anhydride to form a compound Aspirin ? (a) Benzoic acid (b) Salicylic acid (c) Phthalic acid (d) Acetic acid	
19	**When Phenol is treated with Excess Bromine Water it gives___** (a) m-bromophenol (b) o- and p-bromophenol (c) 2,4-dibromophenol (d) 2,4,6-tribromophenol	

20	**Dehydration of Alcohol is an example of___** (a) addition reaction (b) elimination reaction (c) substitution reaction (d) redox reaction	

Short Answer type question (2 marks)

1	(a) Account for the following : (i) Phenol is a stronger acid than an alcohol(Ethanol) (ii) The boiling point of alcohols decreases with increase in branching of alkyl chain.	
2	(a) Write the mechanism of the following reaction : $CH_3CH_2OH \xrightarrow{443\ K,\ H^+} CH_2 = CH_2 + H_2O$ (b) Write the equation involved in Friedel-Craft's acetylation of anisole.	
3	Write the chemical equation involved in the following reactions : (a) Reimer-Tiemann reaction (b) Acetylation of Salicylic acid	
4	(a) Write the structures of the products obtained by heating  OCH_3 with conc. HI. (b) Give the structures and IUPAC name of the products expected from the following reaction : Reaction of phenol with Br_2 (aq).	
5	(a) Write the equation of the reaction for the preparation of phenol from cumene. (b)Draw the structure of hex-1-en-3-ol compound.	

6	Which of the following is an appropriate set of reactants for the preparation of 1-methoxy-4-nitrobenzene and why ? (a)  + CH_3Br (b)  + CH_3ONa	
7	For the pair phenol and cyclohexanol, answer the following : (a) Why is phenol more acidic than cyclohexanol ? (b) Give one chemical test to distinguish between the two.	
8	Explain the following chemical reactions giving a chemical equation for each (a) Williamson's ether synthesis (b) Kolbe's reaction.	
9	Write the mechanism of hydration of ethene to yield ethanol.	
10	(a) Rearrange the following compounds in the increasing order of their boiling points: $CH_3—CHO$, $CH_3—CH_2—OH$, $CH_3—CH_2—CH_3$ (b) Arrange the following compounds in the increasing order of their acid strengths: 4-Nitrophenol, Phenol, 2,4,6-Trinitrophenol.	
11	(a) Give simple chemical tests to distinguish between the following pairs of compounds: Benzoic acid and Phenol (b) Write the IUPAC name of the following : 	
12	(a) Ortho nitrophenol has lower boiling point than p-nitrophenol. Why ? (b) Give a chemical test to distinguish between 2-Pentanol and 3-Pentanol.	
13	(a) The C-O bond is much shorter in phenol than in ethanol. Give reason (b) Write the IUPAC name of the following : 	
14	(a) Write the IUPAC name of given compound:  (b) Which of the following isomers is more volatile : o-nitrophenol or p-nitrophenol?	
15	(a) Arrange the following compounds in the increasing order of their acid strength:	

	p-cresol, p-nitrophenol, phenol (b) Arrange the following compound groups in the increasing order of their property indicated: (i) p-nitrophenol, ethanol, phenol (acidic character) (ii) Propanol, Propane, Propanal (boiling point)	
Short Answer type question (3 marks)		
1	How do you convert the following : (Any three) (a) Phenol to picric acid (b) Propanone to 2-Methylpropan-2-ol (c) Phenol to anisole (d) Propene to Propan-1-ol	
2	(i) Write the mechanism of the following reaction : $2CH_3CH_2OH \xrightarrow[413\ K]{H^+} CH_3 - CH_2 - O - CH_2 - CH_3 + H_2O$ (ii) Why ortho-nitrophenol is steam volatile while para-nitrophenol is not ?	
3	What happens when (i) Anisole is treated with CH_3Cl/anhydrous $AlCl_3$? (ii) Phenol is oxidised with $Na_2Cr_2O_7/H^+$? (iii) $(CH_3)_3C - OH$ is heated with Cu/573 K ? Write chemical equation in support of your answer.	
4	(i) Write hydroboration-oxidation reaction with an example. (ii) Write the products of the following reaction :  (iii) Why is p-nitrophenol more acidic than phenol ?	
5	(i) What happens when phenol reacts with (1) Conc. HNO_3, and (2) $CHCl_3$ in presence of aqueous NaOH followed by acidification ? Write equations only. (ii) Why does the reaction of CH_3ONa with $(CH_3)_3C$ Br give 2-methylpropene and not $(CH_3)_3C$ OCH_3 ?	
6	(i) Why is the C – O bond length in phenols less than that in methanol ? (ii) Arrange the following in order of increasing boiling point : Ethoxyethane, Butanal, Butanol, n-butane (iii) How can phenol be prepared from anisole ? Give reaction.	
7	How do you convert the following: (i) Aniline to phenol (ii) Prop-l-ene to Propan- l-ol (iii) Anisole to 2-methoxytoluene	

8	Predict the products of the following reaction: (i) $CH_3—CH=CH_2 \xrightarrow[(ii)\ 3H_2O_2/OH^-]{(i)\ B_2H_6} ?$ (ii) $C_6H_5—OH \xrightarrow{Br_2(aq)} ?$ (iii) $CH_3CH_2OH \xrightarrow{Cu/573\ K} ?$	
9	Name the reagents used in the following reactions: (i) Nitration of phenol to 2, 4, 6-trinitrophenol (ii) Butanal to Butanol . (iii) Friedel – Crafts acetylation of anisole (iv) Oxidation of primary alcohol to aldehyde	
10	How would you convert the following : (i) Phenol to benzoquinone (ii) Propanone to 2-methylpropan-2-ol (iii) Propene to propan-2-ol	

CHEMICAL KINETICS

Q1. How will the rate of the reaction be affected when

(a) Surface area of the reactant is reduced,

(b) Catalyst is added in a reversible reaction, and

(c) Temperature of the reaction is increased?

Q2. Calculate the overall order of the reaction whose rate law expression was predicted as :

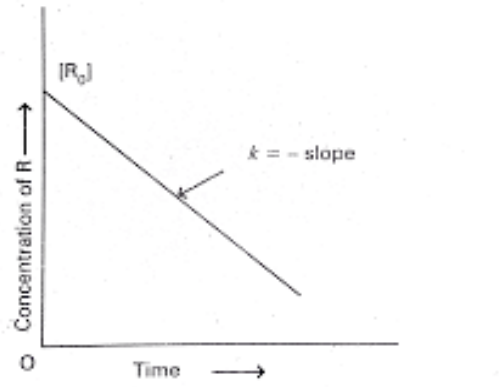
Rate $=k[NO]^{3/2}[O]^{1/2}$

Q3. Give one point of difference between average rate and instantaneous rate

Q4. Write the slope value obtained in the plot of ln[R] vs. time for a first order reaction

Q5. A first order reaction is 40% complete in 80 minutes. Calculate the value of rate constant (k). In what time will the reaction be 90% completed? [Given: log 2 = 0·3010, log 3 = 0·4771, log 4 = 0·6021, log 5 = 0·6771, log 6 = 0·7782]

Q6. (a) Visha plotted a graph between concentration of R and time for a reaction R P. On the basis of this graph, answer the following questions :



Variation in the concentration vs time plot for a zero order reaction

(i) What does the slope of the line indicate?
(ii) What are the units of rate constant?

Q 7. A first order reaction takes 25 minutes for 25% decomposition. Calculate t1/2. [Given : log 2 = 0·3010, log 3 = 0·4771, log 4 = 0·6021]

Q8. The rate constant for a first order reaction is 60 s–1 . How much time will it take to reduce the initial concentration of the reactant to its 1/16th value?

(b) Write two factors that affect the rate of a chemical reaction.

Q9. (a) Define order of reaction. How does order of a reaction differ from molecularity for a complex reaction?

(b) A first order reaction is 50% complete in 25 minutes. Calculate the time for 80% completion of the reaction?

Q10. For the reaction 2N2O5 (g) 4NO2 (g) + O2 (g), the rate of formation of NO2 (g) is $2{\cdot}8 \times 10^{-3}$ M s–1 . Calculate the rate of disappearance of N2O5 (g).

Q10. (a) A reaction is second order in A and first order in B.

(i). Write the differential rate equation.

(ii). How is the rate affected on increasing the concentrations of both A three times?

(iii). How is the rate affected when the concentrations of both A and B are doubled?

(b). A find order reaction takes 40 minutes for $\mathbf{30}$% decomposition. Calculate $\boldsymbol{t_{1/2}}$ for this reaction. (Given log 1.428 = 0.1548)

Q11. (a) List the factors on which the rate of a chemical reaction depends.

(b) The half-life for decay of radioactive $\mathbf{14}\boldsymbol{C}$ is 5730 years. An archaeological artifact containing wood has only 80% of the $\mathbf{14}\boldsymbol{C}$ activity as found in living trees.Calculate the age of the artifact?

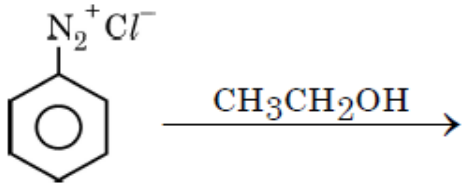
Amines

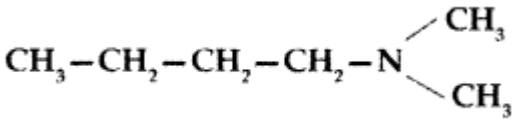
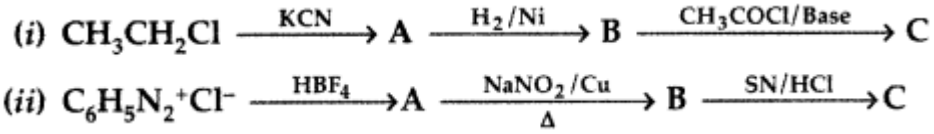
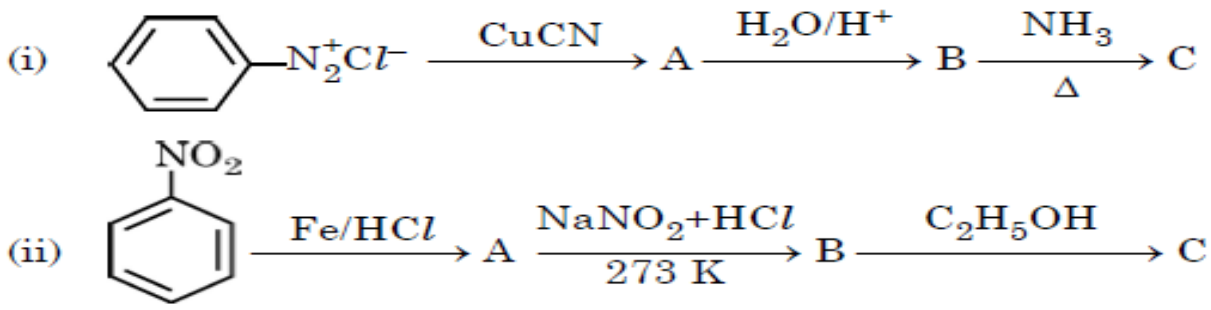
Multiple choice questions

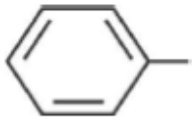
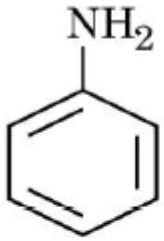
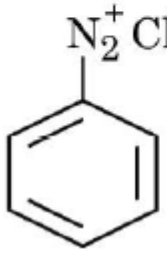
1	Which of the following reagents would not be a good choice for reducing Nitobenzene to Aniline ? (a) H_2 (excess)/Pt (b) $LiAlH_4$ in ether (c) Fe and HCl (d) Sn and HCl	
2	Hoffmann bromamide degradation is used for the preparation of (a) primary amines (b) secondary amines (c) tertiary amines (d) secondary aromatic amines	
3	**The correct IUPAC name for $CH_2 = CHCH_2NHCH_3$ is** **(a) allylmethylamine (b) 2-amino-4-pentene** **(c) 4-aminopent-l-ene . (d) N-methylprop-2-en-l-amine.**	
4	**The best reagent for converting-2-phenylpropanamide into 1-phenylethanamine is .** **(a) excess H_2/Pt (b) NaOH /Br_2 (c) $NaBH_4$/methanol (d) $LiAlH_4$/ether**	
5	**Hoffmann bromamide degradation reaction is shown by .** **(a) $ArNH_2$ (b) $ArCONH_2$ (c) $ArNO_2$ (d) $ArCH_2NH_2$**	
6	The source of nitrogen in Gabriel synthesis of amines is. (A) sodium azide, NaN3 (B) sodium nitrite, NaNO2 (C) potassium cyanide, KCN (D) potassium phthalimide, C6H4(CO2)N−K+	
7	Best method for preparing primary amines from alkyl halides without changing the number of carbon atoms in the chain is (A) Hoffmann bromamide reaction (B) Gabriel phthalimide reaction (C) Sandmeyer reaction (D) reaction with NH3	
8	Reduction of nitrobenzene by which of the following reagents give aniline? (A) Sn/HCl (B) Fe/HCl (C) H2−Pd (D) All of these	
9	**CH_3-CO-NH_2 on reduction with NaOH and Br_2 in alcoholic medium gives** (A) **CH_3-CH_2-NH_2** (B) **CH_3-CH_2-Br** (C) **CH_3-NH_2** (D) **CH_3COOH**	
10	**Out of the following, the stongest base in aqueous solution is**	

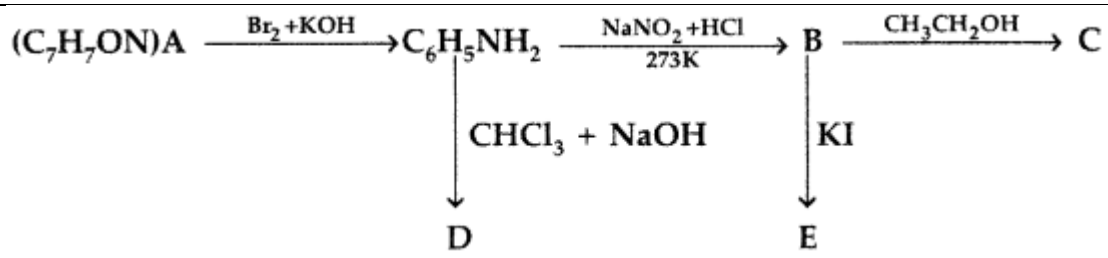
	(a) Methylamine (b) Dimethylamine (c) Trimethylamine (d) Aniline	
11	**The action of Nitrous acid on ethylamine gives mainly:** **(a) Ethylnitrite (b) Ethyl alcohol (c) Nitroethane (d) Ethane**	
12	**Which reagent will be requiredfor one step conversionof Benzenediazonium chloride to phenol** (A) **Cu_2Cl_2** (B) **NaOH(aq)** (C) **H_2O** (D) **Alcoholic KOH**	

SHORT ANSWER TYPE QUESTION (2 MARKS)

1	Explain briefly : (a) Carbylamine reaction (b) Gabriel phthalimide synthesis	
2	(a) Why aniline does not undergo Friedal-Crafts reaction ? (b) Arrange the following in increasing order of their boiling point : C_2H_5OH, $C_2H_5NH_2$, $(C_2H_5)_3N$	
3	(a) How can the activating effect of $-NH_2$ group in aniline be controlled ? (b) Primary amines have higher boiling point than tertiary amines	
4	(a) Complete the reaction with the main product formed :  (b) Convert Bromoethane to Propanamine.	
5	(a) Explain, why (CH3)2NH is more basic than (CH3)3N in aqueous solution. (b) pK_b value for aniline is more than that for methylamine.	
6	(a) Arrange the following in the decreasing order of their basic strength in aqueous solutions: CH_3NH_2, $(CH_3)_2$ NH, $(CH_3)_3N$ and NH_3 (b) Write the structure of prop-2-en-1-amine.	
7	(a) Arrange the following in increasing order of basic strength : $C_6H_5NH_2$, $C_6H_5NHCH_3$, $C_6H_5CH_2NH_2$ (b) Arrange the following in increasing order of basic strength Aniline, p-Nitroaniline and p-Toluidine	

8	(a) Write the IUPAC name of the following compound: $CH_3NHCH(CH_3)_2$ (b) Write IUPAC name of the following compound : 	
9	Give the chemical tests to distinguish between the following pairs of compounds : (a) Methylamine and Dimethylamine (b) Aniline and N-methylaniline	
10	How are the following conversions carried out : (a) Aniline to p-hydroxyazobenzene (b) Ethanoyl chloride to Ethanenitrile.	
	SHORT ANSWER TYPE QUESTION (3 MARKS)	
1.	Give reasons : (a) Aniline on nitration gives good amount of m-nitroaniline, though – NH_2 group is o/p directing in electrophilic substitution reactions. (b) Electrophilic substitution in aromatic amines takes place more readily than benzene. (c) Ammonolysis of alkyl halides is not a good method to prepare pure primary amines.	
2	Giving an example for each describe the following reactions : (i) Hofmann's bromamide reaction (ii) Gatterman reaction (iii) A coupling reaction	
3	Identify A, B and C in the following reactions : 	
4	Write the structures of A, B and C in the following reactions 	

5	Write the structures of A, B and C in the following reactions : (i)  $\xrightarrow[\Delta]{NH_3}$ A $\xrightarrow{Br_2 + NaOH}$ B $\xrightarrow[0°C]{NaNO_2 + HCl}$ C (ii) $CH_3CH_2Br \xrightarrow{KCN} A \xrightarrow{LiAlH_4} B \xrightarrow[0°C]{HNO_2} C$	
6	How will you convert the following : (a) Aniline to p-bromoaniline (b) Aniline to benzyl alcohol (c) Butanenitrile to 1-aminobutane	
7	Complete the following reactions giving main products : (1)  $+ Br_2\,(aq) \longrightarrow$ (2)  $\xrightarrow[(ii)\ NaNO_2/Cu,\ \Delta]{(i)\ HBF_4}$	
8	Give the structures of A, B and C in the following reactions : (Delhi 2014) (i) $CH_3Br \xrightarrow{KCN} A \xrightarrow{LiA/H_4} B \xrightarrow[273\ K]{HNO_2} C$ (ii) $CH_3COOH \xrightarrow[\Delta]{NH_3} A \xrightarrow{Br_2+KOH} B \xrightarrow{CHCl_3+NaOH} C$ (iii) $CH_3CN \xrightarrow{H_2O/H^+} A \xrightarrow[\Delta]{NH_3} B \xrightarrow{Br_2+KOH} C$	
9	An aromatic compound JA' of molecular formula $C_7H_{27}ON$ undergoes a series of reactions as shown below. Write the structures of A, B, C, D and E in the following reactions :	

		
10	How will you convert the following : (i) Nitrobenzene into aniline (ii) Ethanoic acid into methanamine (iii) Aniline into N-phenylethanamide (Write the chemical equations involved)	

BIOMOLECULES

VERY SHORT ANSWER TYPE QUESTIONS (1 Mark)

Q. 1. Name polysaccharides which is stored in the liver of animals.

Q. 2. What structural feature is required for a carbohydrate to behave as reducing sugar ?

Q. 3. Give the significance of (+) sign in the name D-(+)-glucose.

Q. 4. Glucose is an aldose sugar but it does not react with sodium hydrogen sulphite. Give reason.

Q. 5. Name the amino acid which is not optically active.

Q. 6. Give the Howarth projection of D-glucopyranose.

SHORT ANSWER-I TYPE QUESTIONS (2 Marks)

Q. 1. Define the following terms in relation to proteins : (i) Peptide linkage (ii) Denaturation

Q. 2. List the reactions of glucose which cannot be explained by its open chain structure.

Q. 3. Explain the following terms : (i) Invert sugar (ii) Polypeptides

Q. 4. What are anomers ? Give the structures of two anomers of glucose.

Q. 5. (i) Acetylation of glucose with acetic anhydride gives glucose penta-acetate. Write the structure of penta acetate.

(ii) Explain why glucose penta acetate does not react with hydroxylamine ?

Q. 6. What are vitamins ? How are they classified ?

Q. 7. Write the products of oxidation of glucose with : (i) Bromine water (ii) Nitric acid

Q. 8. State two main differences between globular and fibrous proteins.

Q. 9. What are essential and non-essential amino acid ? Give two examples of each type.

SHORT ANSWER-II TYPE QUESTIONS (3 Marks)

Q. 1. (i) Deficiency of which vitamin causes scurvy ?

(ii) What type of linkage is responsible for the formation of proteins ?

(iii) Write the product formed when glucose is treated with HI.

Q. 2. Differentiate between the following :

(i) Secondary and tertiary structure of protein

(ii) α-helix and β-pleated sheet structure of protein

(iii) Fibrous and globular protein