SAMPLE QUESTION PAPER

BLUE PRINT

Time Allowed : 3 hours **Maximum Marks :** 70

S. No.	Chapter	Passage based/ MCQs/A & R (1 mark)	SA-I (2 marks)	SA-II (3 marks)	LA (5 marks)	Total
1.	The Solid State	1(1)	–	1(3)	–	**12(23)**
2.	Solutions	1(1)	1(2)	–		
3.	Electrochemistry	1(1)	–	–	1(5)	
4.	Chemical Kinetics	2(2)	1(2)	1(3)	–	
5.	Surface Chemistry	1(1)	1(2)	–	–	
6.	The *p*-Block Elements	1(4)	1(2)	–	–	**8(19)**
7.	The *d*- and *f*-Block Elements	2(2)	1(2)	1(3)	–	
8.	Coordination Compounds	1(1)	–	–	1(5)	
9.	Haloalkanes and Haloarenes	1(4)	1(2)	–	–	**13(28)**
10.	Alcohols, Phenols and Ethers	1(1)	–	1(3)		
11.	Aldehydes, Ketones and Carboxylic Acids	2(2)	1(2)	–	1(5)	
12.	Amines	1(1)	1(2)	1(3)	–	
13.	Biomolecules	1(1)	1(2)	–	–	
	Total	**16(22)**	**9(18)**	**5(15)**	**3(15)**	**33(70)**

Subject Code : 043

CHEMISTRY

Time allowed : 3 hours ***Maximum marks : 70***

General Instructions : Read the following instructions carefully.

(a) There are 33 questions in this question paper. All questions are compulsory.

(b) Section A : Q. No. 1 to 16 are objective type questions. Q. No. 1 and 2 are passage based questions carrying 4 marks each while Q. No. 3 to 16 carry 1 mark each.

(c) Section B : Q. No. 17 to 25 are short answer questions and carry 2 marks each.

(d) Section C : Q. No. 26 to 30 are short answer questions and carry 3 marks each.

(e) Section D : Q. No. 31 to 33 are long answer questions carrying 5 marks each.

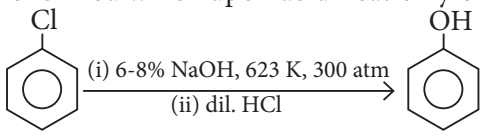
(f) There is no overall choice. However, internal choices have been provided.

(g) Use of calculators and log tables is not permitted.

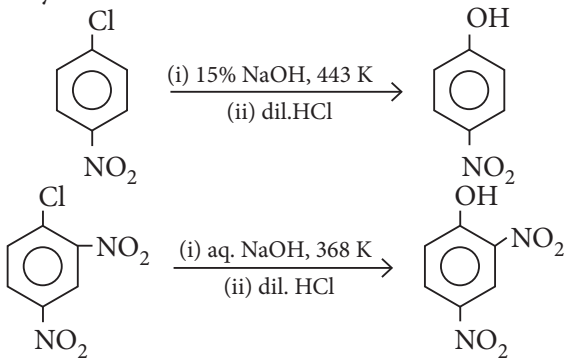
SECTION - A (OBJECTIVE TYPE)

1. Read the passage given below and answer the following questions :

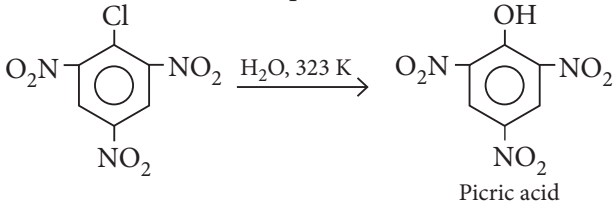
When haloarenes are heated with an aqueous solution of NaOH at 623 K and under 300 atmospheric pressure, sodium phenoxides are formed which upon acidification yield phenols.



This process is called Dow process. The presence of electron withdrawing group at *ortho* and *para* position increases the reactivity of haloarenes.



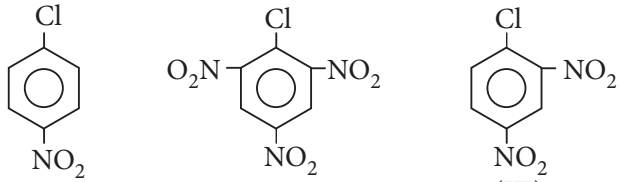
Only warm water is required in the formation of picric acid from 2, 4, 6 –trinitrochlorobenzene.



Picric acid

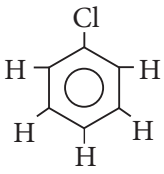
The following question are multiple choice questions. Choose the most appropriate answer :

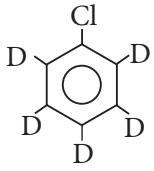
(i) The correct order of reactivity towards nucleophilic substitution reaction with CH_3ONa of the following compound is

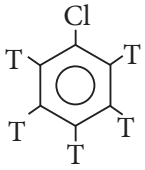


(a) I > II > III (b) III > II > I (c) I > III > II (d) II > III > I

(ii) The most reactive compound towards the Dow process is

(a) 

(b) 

(c) 

(d) all are equally reactive.

(iii) Dow's process is used for the preparation of which of the following:

(a) Esters (b) Phenols (c) Alcohols (d) Ethers.

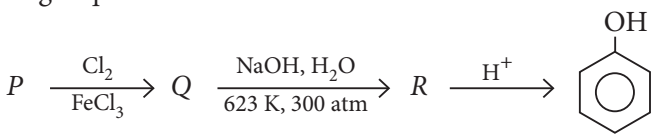
OR

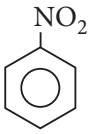
Dow's process involves

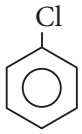
(a) electrophilic addition reaction (b) nucleophilic addition reaction

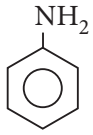
(c) electrophilic substitution reaction (d) nucleophilic substitution reaction.

(iv) Identity (*P*) in the following sequence of reactions :



(a) 

(b) 

(c) 

(d) 

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

In the gaseous state the hydrogen halides are essentially covalent but in aqueous solution they ionise.

$$HX + H_2O \rightarrow H_3O^+ + X^-$$

The aqueous solutions form azeotropic mixtures with maximum boiling points. Such solutions can be used as standards for volumetric analysis. In dilute aqueous solutions, HF is only slightly ionized, but HCl, HBr and HI are completely ionized. In poorer ionizing solvents such as methanol, ionisation is much less complete and HCl is less ionized than HI. The ΔH values for the dissociation of $HX_{(hydrated)}$ into $H^+_{(hydrated)}$ and $X^-_{(hydrated)}$ are negative. So the change is thermodynamically possible. HF is only slightly exothermic in aqueous solution whereas the others evolve a considerable amount of heat.

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 assertion.

(b) Assertion and reason both are correct statements but reason is not 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 :** HF is the strongest acid among the hydrogen halides.
Reason : HF has a greater electronegativity difference and more ionic character than the other hydrides.

(ii) **Assertion :** Reaction of conc. H_2SO_4 on NaBr and NaI does not give HBr and HI.
Reason : HBr and HI are oxidised by conc. H_2SO_4 to Br_2 and I_2.

(iii) **Assertion :** Heat of neutralisation of $HF_{(aq)}$ (a weak acid), with $NaOH_{(aq)}$ is more than 13·7 Kcal, in an exothermic reaction.
Reason : Because some heat is lost in the ionisation of weak acid..

OR

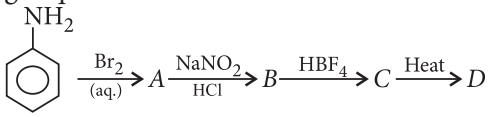
Assertion : Reducing power of the hydrogen halides increases in the order: HI < HBr < HCl < HF.
Reason : Bond dissociation energies of the hydrogen halides increases in the order: HI < HBr < HCl < HF.

(iv) **Assertion :** Liquid HF has been used as a non-aqueous solvent.
Reason : HF is only very slightly ionized in water.

Following questions (No. 3-11) are multiple choice questions carrying 1 mark each:

3. Which of the following statements is not correct?
(a) 5% aqueous solutions of NaCl and KCl are said to be isomolar.
(b) 1 M sucrose solution and 1 M glucose solution are isotonic.
(c) Molecular mass of acetic acid and benzoic acid is higher than normal mass in cryoscopic methods.
(d) For the same solution, $\frac{\Delta T_b}{\Delta T_f} = \frac{K_b}{K_f}$.

4. The product '*D*' in the following sequence of reactions is



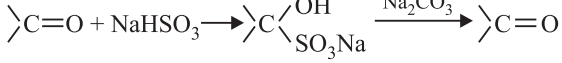
(a) 2, 4, 6-tribromofluorobenzene
(b) fluorobenzene
(c) *p*-bromofluorobenzene
(d) tribromobenzene.

OR

The IUPAC name of a tertiary amine in which one methyl, one ethyl and one *n*-propyl group is attached to nitrogen is
(a) *N*-methyl-*N*-ethylpropanamine
(b) *N*-ethyl-*N*-methylaminopropane
(c) *N*-ethyl-*N*-methylpropanamine
(d) *N*-methyl-*N*-ethylaminopropane.

5. Which of the following statements is incorrect?
(a) An NaCl type *AB* crystal lattice can be interpreted to be made up of two individual *fcc* unit cells of A^+ and B^- fused together in such a manner that the corner of one unit cell becomes the edge centre of the other.
(b) In a face centred cubic unit cell, the body centre is an octahedral void.
(c) In *fcc* cubic unit cell octahedral and tetrahedral voids are equal.
(d) Tetrahedral voids = 2 × octahedral voids, is true for only *ccp* and *hcp*.

6. Study the given reaction and identify the process which is carried out.



(a) It is used for purification of aldehydes and ketones.
(b) It is used to distinguish aldehydes from ketones.
(c) It is used to prepare cyclic aldehydes and ketones.
(d) It is used to study polar nature of aldehydes and ketones.

7. Saturated solution of KNO_3 is used to make 'salt bridge' because
(a) velocity of K^+ is greater than that of NO_3^-
(b) velocity of NO_3^- is greater than that of K^+
(c) velocities of both K^+ and NO_3^- are nearly the same
(d) KNO_3 is highly soluble in water.

OR

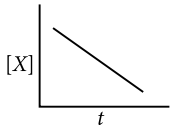
In electrolysis of dilute H_2SO_4, what is liberated at anode?
(a) H_2 (b) SO_4^{2-} (c) SO_2 (d) O_2

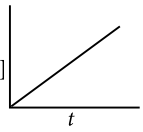
8. Which of the following isomers will give white precipitate with $BaCl_2$ solution?
(a) $[Co(NH_3)_5SO_4]Br$ (b) $[Co(NH_3)_5Br]SO_4$
(c) $[Co(NH_3)_4(SO_4)_2]Br$ (d) $[Co(NH_3)_4Br(SO_4)]$

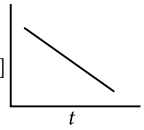
OR

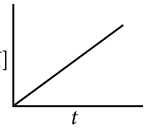
Hexaamminenickel(II) hexanitrocobaltate(III) can be written as
(a) $[Ni(NH_3)_6]_2[Co(NO_2)_6]_3$ (b) $[Ni(NH_3)_6]_3[Co(NO_2)_6]_2$
(c) $[Ni(NH_3)_6]\ [Co(NO_2)_6]$ (d) $[Ni(NH_3)_6(NO_2)_6]Co$

9. Consider four different reactions *A, B, C* and *D* involving a common reactant *X*. The change in the concentration of *X* (while keeping the other reactants in excess) with time *t* is plotted for each reaction. Which of the reactions is of the first order with respect to the species *X*?

(a) 

(b) 

(c) 

(d) 

10. The two main differences between RNA and DNA are
(a) ribose sugar and thymine in RNA
(b) deoxyribose sugar and uracil in DNA
(c) ribose sugar and uracil in RNA
(d) deoxyribose sugar and guanine in DNA.

OR

Which of the following statements is incorrect about proteins?
(a) They do not contain polypeptide linkages.
(b) Many of them are enzymes.
(c) They are nitrogenous organic compounds of high molecular masses.
(d) On hydrolysis by enzymes, they give amino acids.

11. The number of unpaired electrons in gaseous species of Mn^{3+}, Cr^{3+} and V^{3+} respectively are _____ and the most stable species is _____ .
(a) 4, 3 and 2 ; V^{3+} (b) 3, 3 and 2 ; Cr^{3+} (c) 4, 3 and 2 ; Cr^{3+} (d) 3, 3 and 3; Mn^{3+}

In the following questions (Q. No. 12-16) 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 assertion.
(b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.
(c) Assertion is correct statement but reason is wrong statement.
(d) Assertion is wrong statement but reason is correct statement.

12. Assertion : Most carboxylic acids exist as dimers in the vapour phase or in aprotic solvents.
Reason : Higher carboxylic acids are practically insoluble in water due to the increased hydrophobic interaction of hydrocarbon part.

13. **Assertion :** The kinetics of the reaction:
$mA + nB + pC \longrightarrow m'X + n'Y + p'Z$
obey the rate expression as $\frac{dn}{dt} = K[A]^m[B]^n$
Reason : The rate of reaction does not depend upon concentration of *C*.

14. **Assertion :** Cr^{2+} is reducing and Mn^{3+} is oxidising.
Reason : Cr^{2+} and Mn^{3+} have d^4 configuration.

15. **Assertion :** Lyophilic colloids have a unique property of protecting lyophobic colloids.
Reason : Lyophilic colloids are extensively solvated.

16. **Assertion :** Anisole undergoes electrophilic substitution at *ortho* and *para*-positions.
Reason : Anisole is less reactive than phenol towards electrophilic substitution reactions.

OR

Assertion : *tert*-Butyl methyl ether on cleavage with HI at 373 K gives *tert*-butyl iodide and methanol.
Reason : The reaction occurs by S_N2 mechanism.

SECTION - B

The following questions, Q. No. 17-25 are short answer type and carry 2 marks each.

17. Explain why
(a) 4% NaOH solution (mass/volume) and 6% urea solution (mass/volume) are equimolar but not isotonic.
(b) A solution of chloroform and acetone shows negative deviation from Raoult's law.

18. The outer electronic configuration of two members of the lanthanoids are as follows :
$4f^1\ 5d^1\ 6s^2$ and $4f^7\ 5d^0\ 6s^2$.
What are their atomic numbers? Predict the oxidation states exhibited by these elements in their compounds.

OR

Describe the variability of oxidation states in the first row of the transition elements (Sc – Cu) and indicate the general trend.

19. Explain the following :
(i) Sulphur exhibits tendency for catenation but oxygen does not.
(ii) Why HF acid is stored in wax coated glass bottles?

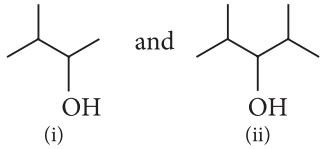
20. Identify the reaction and write the IUPAC name of the product formed :
(a)  + NaOH $\xrightarrow[\Delta]{CaO}$
(b) $CH_3COOH \xrightarrow{Cl_2/P}$

21. Write two differences between 'order of reaction' and 'molecularity of reaction'.

OR

The decomposition of NH_3 on platinum surface, $2NH_{3(g)} \xrightarrow{Pt} N_{2(g)} + 3H_{2(g)}$ is a zero order reaction with $k = 2.5 \times 10^{-4}$ mol L^{-1} s^{-1}. What are the rates of production of N_2 and H_2?

22. (a) Identify the chiral molecule in the following pair :



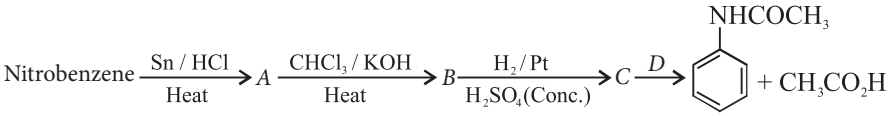
(i) (ii)

(b) Write the structure of the alkene formed by dehydrohalogenation of 1-bromo-1-methylcyclohexane with alcoholic KOH.

23. Describe the preparation of the following colloidal solution and name the method used in each case
(i) Silver solution (ii) Sulphur solution

24. Explain the following :
(i) Pyranose structure of glucose.
(ii) Amino acids behave like salts rather than simple amines or carboxylic acids.

25. Write the structure of the reagents/organic compounds of *A* to *D* in the following sequence of reactions :



OR

How would you achieve the following conversions :
(i) Nitrobenzene to aniline.
(ii) An alkyl halide to a quaternary ammonium salt.

SECTION - C

Q. No. 26-30 are short answer type II carrying 3 marks each.

26. Give reason for the following :
(i) *m*-Aminophenol is stronger acid than *o*-aminophenol.
(ii) Alcohol acts as weak base.
(iii) The boiling points of ethers are lower than isomeric alcohols.

OR

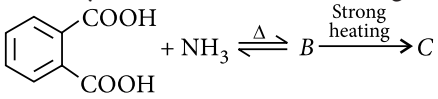
How would you obtain the following :
(i) Benzoquinone from phenol
(ii) 2-Methylpropan-2-ol from methyl magnesium bromide
(iii) Propan-2-ol from propene?

27. The following rate data was obtained at 300 K for the reaction $2A + B \rightarrow C + D$:

Expt.	$[A]$/mol L^{-1}	$[B]$/mol L^{-1}	Rate of formation of D/mol L^{-1} s^{-1}
1.	0.1	0.1	6.0×10^{-3}
2.	0.3	0.2	7.2×10^{-2}
3.	0.3	0.4	2.88×10^{-1}
4.	0.4	0.1	2.4×10^{-2}

Find the rate law for the given reaction.

28. (i) Identify *B* and *C* in the following sequence of reactions :



(ii) Give chemical tests to distinguish between the following pairs of compounds :

(a) Aniline and ethylamine

(b) Ethylamine and dimethylamine.

29. Following ions are given : Cr^{2+}, Cu^{2+}, Cu^{+}, Fe^{2+}, Fe^{3+}, Mn^{3+}. Identify the ion which is

(i) a strong reducing agent.

(ii) unstable in aqueous solution.

(iii) a strong oxidising agent.

Give suitable reason in each.

OR

Assign suitable reasons for the following :

(i) The Mn^{2+} compounds are more stable than Fe^{2+} towards oxidation to their +3 state.

(ii) In the 3*d* series from Sc ($Z = 21$) to Zn ($Z = 30$), the enthalpy of atomization of Zn is the lowest.

(iii) Sc^{3+} is colourless in aqueous solution whereas Ti^{3+} is coloured.

30. Examine the given defective crystal.

A^+	B^-	A^+	B^-	A^+
B^-	O	B^-	A^+	B^-
A^+	B^-	A^+	O	A^+
B^-	A^+	B^-	A^+	B^-

Answer the following questions :

(i) What type of stoichiometric defect is shown by the crystal?

(ii) How is the density of the crystal affected by this defect?

(iii) What type of ionic substances show such defect?

SECTION - D

Q. No. 31-33 are long answer type carrying 5 marks each.

31. (a) Describe the following giving a chemical equation for each :

(i) Cannizzaro's reaction.

(ii) *Trans*-esterification.

(b) Why are carboxylic acids more acidic than alcohols or phenols although all of them have hydrogen atom attached to a oxygen atom (—O—H)?

OR

(i) Write the reactions with conditions to bring about the following conversions :

(a) Benzaldehyde to benzyl alcohol.

(b) Toluene to benzaldehyde.

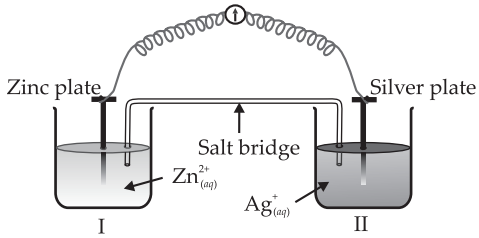
(c) Propanone to propene.

(ii) To illustrate the following write one chemical reaction in each case :

(a) Etard reaction.

(b) Wacker's process for converting ethylene to ethanal.

32. Consider the figure and answer the questions (i) to (v) given below.



(i) Redraw the diagram to show the direction of electron flow.

(ii) Is silver plate the anode or cathode?

(iii) What will happen if salt bridge is removed?

(iv) How will concentration of Zn^{2+} ions and Ag^{+} ions be affected when the cell functions?

(v) How will the concentration of Zn^{2+} ions and Ag^{+} ions be affected after the cell becomes 'dead'?

OR

An excess of liquid mercury is added to an acidified solution of 1.0×10^{-3} M Fe^{3+}. It is found that 5% of Fe^{3+} remains at equilibrium at 25°C. Calculate $E°_{(Hg^{2+}/Hg)}$ assuming that the only reaction that occurs is $2Hg + 2Fe^{3+} \longrightarrow Hg_2^{2+} + 2Fe^{2+}$.

(Given $E°_{(Fe^{3+}/Fe^{2+})} = 0.77$ V)

33. (a) Specify the oxidation numbers of the metals in the following coordination entities :

(i) $[Co(H_2O)(CN)(en)_2]^{2+}$ (ii) $[PtCl_4]^{2-}$

(iii) $K_3[Fe(CN)_6]$ (iv) $[Cr(NH_3)_3Cl_3]$

(b) Explain with example homoleptic and heteroleptic complexes.

(c) Using IUPAC norms write the formulae for the following :

(i) Sodium dicyanidoaurate(I)

(ii) Tetraamminechloridonitrito-N-platinum(IV) sulphate

OR

(a) What will be the correct order of absorption of wavelength of light in the visible region for the complexes : $[Co(NH_3)_6]^{3+}$, $[Co(CN)_6]^{3-}$ and $[Co(H_2O)_6]^{3+}$? Give reason.

(b) For the complex $[Fe(en)_2Cl_2]Cl$, answer the following :

(i) Oxidation number of iron.

(ii) Hybrid orbitals and shape of the complex.

(iii) Number of its geometrical isomers.

(iv) Whether there may be optical isomer also.

(v) Name of the complex.