SAMPLE QUESTION PAPER 2023

CHEMISTRY

THEORY (043)

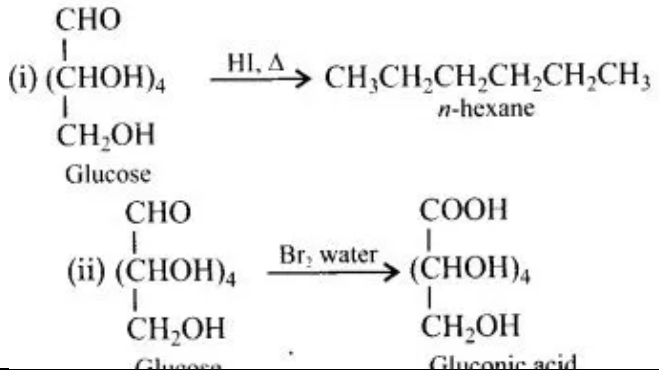
ANSWER KEY

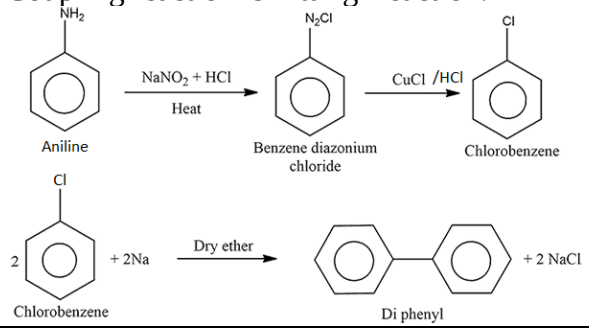
Time Allowed: 3 hours **Maximum Marks: 70**

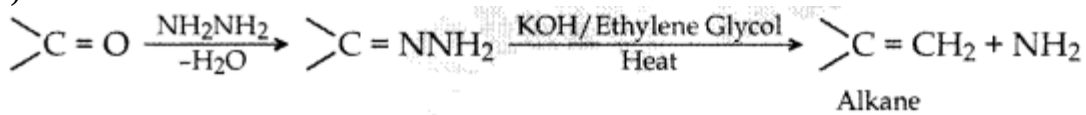
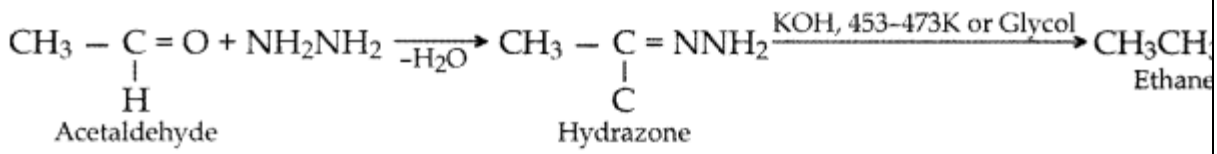
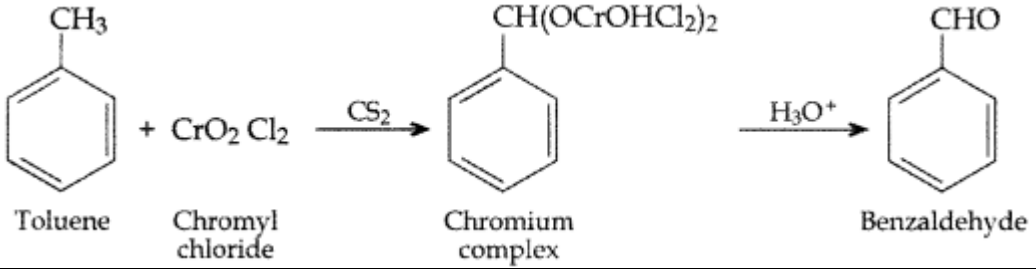
General Instructions:
Read the following instructions carefully

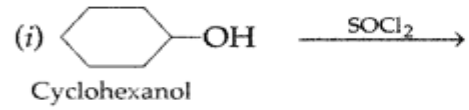
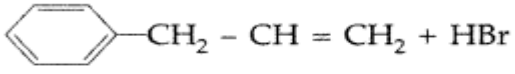
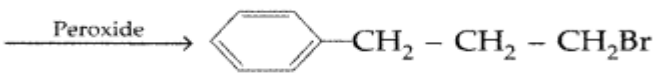
- **a.** There are **35** questions in this question paper with internal choice.
- **b.** SECTION A consists of 18 multiple-choice questions carrying 1 mark each
- **c.** SECTION B consists of 7 very short answer questions carrying 2 marks each
- **d.** SECTION C consists of 5 short answer questions carrying 3 marks each
- **e.** SECTION D consists of 2 case- based questions carrying 4 marks each
- **f.** SECTION E consists of 3 long answer questions carrying 5 marks each
- **g.** All questions are compulsory
- **h.** **Use of log tables and calculators is not allowed**

Q.No	Questions	Marks
	SECTION-A The following questions are multiple choice questions with one correct answer. Each question carries 1 mark. There is no internal choice in this section.	
1	Ans: b	1
2	Ans :d	1
3	Ans: d	1
4	Ans : c	1
5	**Ans**: b	1
6	Ans: a	1
7	Ans: c III is most reactive due to stability of 3° carbocation, $-NO_2$ (electron withdrawing) group increase nucleophilic substitution reaction.	1
8	Ans: b	1
9	Ans: c	1
10	Ans: C	1
11	Ans: b	1
12	Ans: a Explaination: (a) When we plot Ink Vs 1T slope of line = −EaR	1

13	Ans: d	1
14	Ans: b	1
	Given below are two statements labelled as Assertion (A) and Reason (R)	
15	Ans: c	1
16	Ans: A	1
17	Ans: b	1
18	Ansd: d	1
	SECTION-B	
19	Ans: $\text{Rate} = \frac{[R]_0 - [R]}{t}$ $\Rightarrow 0.6 \times 10^{-3} \times 20 \times 60 = [R]_0 - [R]$ $\Rightarrow 0.72\ M$ Amount of [B] produced = $[R]_0 - [R]$ $= 0.72\ M$	2
20	Ans: a) Vitamin C is a water-soluble vitamin. Water-soluble vitamins when supplied regularly in the diet cannot be stored in out body because they are readily excreted in urine. b) All those carbohydrates which reduce Fehling's solution and Tollen's reagent are referred to as reducing sugars. All monosaccharides whether aldose or ketose are reducing sugars. OR  	2
21	Ans: a)It is because tert. butyl carbocation is more stable than n-butyl carbocation. b) **Pent 2 ene** OR a) The melting point of p-dibromobenzene is higher than that of the other two compounds. This is due to the symmetry of p-dibromobenzene, which allows the molecule to fit into the crystal lattice more easily. As a result, breaking the bonds between the molecules demands a higher temperature, resulting in a higher melting point. b) Because energy is required to overcome the attractions between the haloalkane molecules as well as to break the hydrogen bonds between water molecules in order to dissolve a haloalkane in water, haloalkane are only minimally soluble. New attractions between the haloalkane and the water molecules, on the other hand, release less energy since they are weaker than the initial hydrogen bonds in water.	2
22	Ans:	2

	With weak field ligands, $\Delta_o < P$. Electronic configuration of Co(III) will be $t_{2g}^4 e_g^2$. Thus, it has 4 unpaired electrons and is paramagnetic. With strong field ligands, $\Delta_o > P$. Electronic configuration will be $t_{2g}^6 e_g^0$ has no unpaired electron and is diamagnetic.	
23	Ans: The oxidation reactions taking place at anode is: $2Cl^-(aq) \rightarrow Cl_2(g) + 2e^-$ $E^0_{(oxid)} = -1.36$ V $2H_2O(l) \rightarrow O_2(g) + 4H^+(aq) + 4e^-$ $E^0_{(oxid)} = -1.23$ V Due to the overvoltage of oxygen (O_2), its liberation is kinetically slower than that of CI ions. Therefore, Cl ions are oxidised to Cl_2 gas.	2
24	Ans; A reaction which is of higher order but follows the kinetics of first order under special conditions is called a pseudo first order reaction. Example, Acid hydrolysis of ethyl acetate. $CH_3—COOC_2H_5 + H_2O \xrightarrow{H^+} CH_3—COOH + C_2H_5—OH$ Here, the rate law is given by expression $Rate = K[CH_3—COOC_2H_5]$ The concentration of H_2O is so large that it hardly undergoes any change during the reaction, therefore, it does not appear in the rate law.	2
25	Ans: A= Anilne B= Chorobenzene C= Na in Dry ether medium (If only Na written will be given mark) Coupling reaction is Fitting Reaction. 	2
	SECTION-C	
26	Ans: a) 2-Ethyl cyclohexanone.	3

	b) Wolff-Kishner reduction  Alkane *Or*  Acetaldehyde Hydrazone Ethane (c) Etard reaction  Toluene Chromyl chloride Chromium complex Benzaldehyde	
27	Ans: (a)due to back bonding or synergic effect. (b) t^3_{2g} and e^2_g (c)presence of unpaired electrons	3
28	Ans: a) Mass of acetic acid (w_1) = 75 g Molar mass of ascorbic acid ($C_6H_8O_6$), M_2 = 6 x 12 + 8 x 1 + 6 x 16 = 176 g mol^{-1} Lowering the melting point ΔT_f = 1.5 K We know that: $\Delta T_f = \frac{K_f \times w_2 \times 1000}{M_2 \times w_1}$ => $w_2 = \frac{\Delta T_f \times M_2 \times w_1}{K_f \times 1000}$ = $\frac{1.5 \times 176 \times 75}{3.9 \times 1000}$ = 5.08 g (approx) b) Hence, the amount of ascorbic acid needed to be dissolved is 5.08 g.	3

	Mass percentage of Benzene (C_6H_6) = $\frac{Mass\ of\ C_6H_6}{Total\ mass\ of\ the\ solution}\ v \times\ 100$ = $\frac{Mass\ of\ C_6H_6}{Mass\ of\ C_6H_6 + Mass\ of\ CCl_4} \times\ 100$ = $\frac{22}{22+122} \times\ 100$ = 15.28% Mass percentage of Carbon Tetrachloride (CCl_4) = $\frac{Mass\ of\ CCl_4}{Total\ mass\ of\ the\ solution} \times\ 100$ = $\frac{Mass\ of\ CCl_4}{Mass\ of\ C_6H_6 + Mass\ of\ CCl_4} \times\ 100$ = $\frac{122}{22+122} \times\ 100$ = 84.72%	
29	Ans: (a)p-Bromoaniline (b) N-Phenyletanamide or acetanilide (c) $C_6H_5NH_2 < NH_3 < C_2H_5NH_2 < (C_2H_5)_2NH$ (d) $AlCl_3$ is acidic in nature, while aniline is a strong base. Thus, aniline reacts with AlCl3 to form a salt.	3
30	**Ans.** a) Chloroform gets oxidsed slowly by air in the presence of light to an extremely poisonous gas phosgene. Therefore to avoid any exposure to air and sunlight, it is kept in dark coloured bottles. $2CHCl_3 + O_2 \xrightarrow[light]{} 2COCl_2 + 2HCl$ b) (i)  Cyclohexanol  Chlorocyclohexane (ii)  3-Phynyl propene  1-Bromo-3-phenyl propane	3
	SECTION-D	
31	Ans: a) iii. glucose b) Glycosidic linkage c) Non-essential amino acids : The amino acids which can be synthesised in the body, are known as non-essential amino acids. Example : Glycine, Alanine etc.	4

	Essential amino acids : The amino acids which cannot be synthesised in the body and must be obtained through diet are known as essential amino acids. Example : Valine, Leucine etc. OR d) i)These are the simplest carbohydrates which cannot be hydrolysed to smaller molecules. Their general formula is $(CH_2O)_n$ where n = 3 – 7 Example : glucose, fructose etc. ii)Reducing sugar contains aldehydic or ketonic group in the hemiacetal and hemiketal forms and can reduce Tollen's reagent or Felhing's solution.	
32	Ans: a) ii: boil below 100°C and freeze above 0°C b) The property which depend on amount of substance present in the solution or any proper definition. c) Solution B because of its highest concentration. d) Molality because it only depend on the mass of the solvent which don't change with temperature.	4
	SECTION-E	
33	Answer: a) (i) Fuel cells : These cells are the devices which convert the energy produced during combustion of fuels like H_2, CH_4, etc. directly into electrical energy. (ii) The molar conductivity of a solution at infinite dilution is called limiting molar conductivity and is represented by the symbol Λ°_m. b) (b) $Ni_{(s)} \mid Ni^{2+}_{(aq)} \parallel Ag^{+}_{(aq)} \mid Ag_{(s)}$ **Given :** $E^o_{Ni^{2+}/Ni} = 0.25\,V$, $E^o_{Ag^+/Ag} = 0.80\,V$ $Ni + 2Ag^+ \longrightarrow Ni^{2+} + 2Ag$ $E^o_{Cell} = E^o_{Cathode} - E^o_{Anode} = 0.80\ V - 0.25\ V$ $\therefore \quad E^o_{Cell} = 0.55\ V$ *Using formula,* $\log K_C = \frac{nE^o_{Cell}}{0.0591} \Rightarrow \log K_C = \frac{2 \times 0.55}{0.059}$ $\Rightarrow \log K_C = 18.644$ or $K_C = 4.406 \times 10^{18}$ Maximum work done can be calculated as, $\Delta G^o = -nF\ E^o_{Cell}$ $= -2 \times 96500\ C\ mol^{-1} \times 0.55\ V$ $= -106{,}150\ J\ mol^{-1}$ Maximum work = 106.150 KJ mol^{-1} OR a) Conductivity : The conductance of the solution of an electrolyte enclosed in a cell between two electrodes of unit area of cross section separated by 1 cm. It is represented as K with unit	5

$ohm^{-1}\ cm^{-1}$

Molar conductivity : It is the conductance of the volume V of solution containing one mole of electrolyte kept between two electrodes with area of cross section A and distance of unit length.

Molar conductivity increases with decrease in concentration of solute for both weak and strong electrolytes.

(*b*) **Given :** $E^0_{Ag^+/Ag} = 0.80\ V, E^0_{Fe^{3+}/Fe^{2+}} = 0.77\ V$

$\Delta_r G^\circ = ?$ $K_C = ?$

Cell Reaction

$$Fe^{2+}(aq) + Ag^+(aq) \longrightarrow Fe^{3+}(aq) + Ag(s)$$

$$E^0_{Cell} = E^0_{Cathode} - E^0_{Anode} = 0.80\ V - (0.77\ V)$$
$$= 0.03\ V$$

$$\Delta_r G^\circ = -nF E^\circ_{Cell}$$
$$= -1 \times 96500\ C\ mol^{-1} \times 0.03\ V$$

$\therefore \quad \Delta_r G^\circ = -2895\ J\ mol^{-1}$

$$\log K_C = \frac{nE^\circ_{Cell}}{0.0591}, \quad \log K_C = \frac{1 \times 0.03\ V}{0.0591},$$
$$\log K_C = 0.5076$$
$$\log K_C = 0.508$$

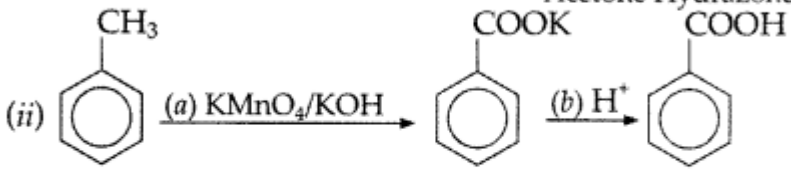
$\therefore \quad K_C = \text{antilog } 0.508 \quad \therefore K_C = \mathbf{3.221}$

34 Ans: 5

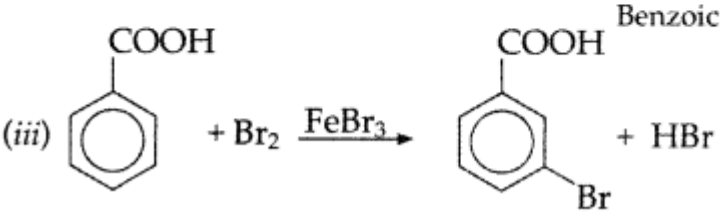
a)

(*i*) $CH_3-\overset{\overset{CH_3}{|}}{C}=O + H_2N\,NH_2 \longrightarrow CH_3-\overset{\overset{CH_3}{|}}{C}=NNH_2 + H_2O$

Acetone Hydrazone

(*ii*) 

Benzoic Acid

(*iii*) 

m-bromobenzoic acid

b)

i) **Bromobenzene to 1-phenylethanol**

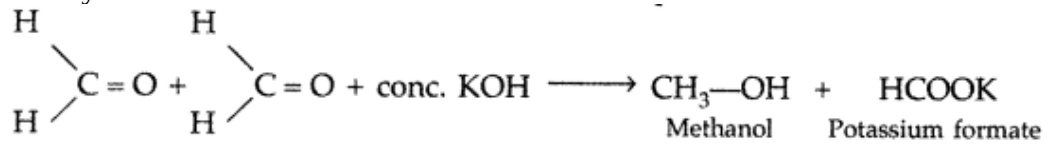
$$\underset{\text{Bromobenzene}}{C_6H_5Br} \xrightarrow{Mg/\text{dry ether}} \underset{\substack{\text{Phenyl mag.}\\ \text{bromide}\\ \text{(Grignard reagent)}}}{C_6H_5MgBr} \xrightarrow[(ii)\,H_3O^+]{(i)\,CH_3CHO} \underset{\text{1-Phenylethanol}}{C_6H_5-\overset{\overset{OH}{|}}{CH}-CH_3}$$

ii) **Propanone to propene**

$$\underset{\text{Propanone}}{CH_3-\overset{\overset{O}{\|}}{C}-CH_3} \xrightarrow[\text{(Reduction)}]{NaBH_4, CH_3OH} \underset{\text{2-Propanol}}{CH_3-\overset{\overset{OH}{|}}{CH}-CH_3} \xrightarrow[443\ K - H_2O]{\text{Conc. } H_2SO_4} \underset{\text{Propene}}{CH_3-CH=CH_2}$$

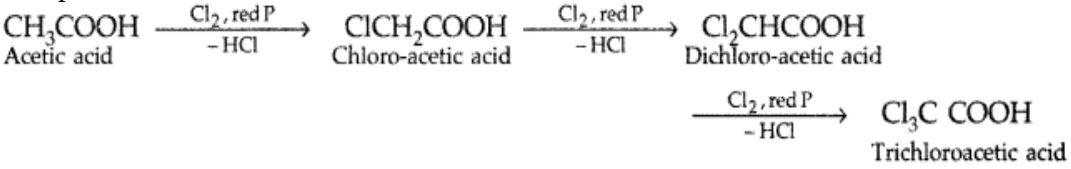
OR

(a) (i) Cannizzaro's reaction: Aldehydes, which do not have an oc-hydrogen atom undergo self oxidation and reduction on treatment with cone, alkali and produce alcohol and carboxylic acid salt.



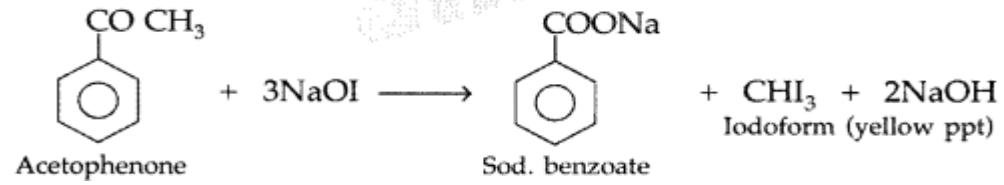
(ii) Hell-Volhard-Zelinsky reaction : Carboxylic acid reacts with chlorine or bromine in presence of small quantities of red phosphorous to give exclusively α-chloro or α-bromo acids.

Example :

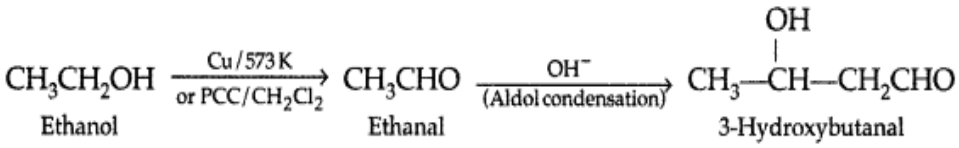


(b) (i) Propanal and propanone: Propanal gives a positive test with the Fehling solution in which a red ppt. of cuprous oxide is obtained while propanone does not respond to test

(ii) Acetophenone and Benzophenone: They can be distinguished by iodoform test which is given by only acetophenone with the formation of yellow ppt. while benzophenone does not respond to iodoform test



(c) Ethanol to 3-hydroxybutanal



35	Ans: (a) From titanium to copper the atomic size of elements decreases and mass increases as a result of which density increases. (b) The catalytic properties of the transition elements are due to the presence of unpaired electrons in their incomplete d- orbitals and variable oxidation states. (c)Lanthanoids show limited number of oxidation state, viz. +2, +3 and +4 (out of which +3 is most common) because of large energy gap between 4f and 5d subshells. Actinoids also show stable +3 oxidation state but show a number of oxidation states i.e. +4, +5 and + 6, +7 due to small energy difference between 5f, 6d and 7s subshells. (d) Due to irregulaties in the electronic configuration there is irregularities in the enthalpies of atomisation. Hence there is irregular variation in I.E.	5

(e)

It oxidises iodide ion (I^-) to iodine (I_2)

$$Cr_2O_7^{2-} + 14\ H^+ + 6\ e^- \longrightarrow 2\ Cr^{3+} + 7\ H_2O$$

$$6\ I^- \longrightarrow 3\ I_2 + 6\ e^-$$

$$Cr_2O_7^{2-} + 14\ H^+ + 6I^- \longrightarrow 2\ Cr^{3+} + 3\ I_2 + 7\ H_2O$$