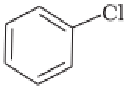
COMMON PRE-BOARD EXAMINATION 2022-23

Subject: CHEMISTRY -043

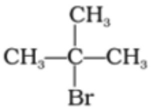
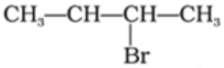
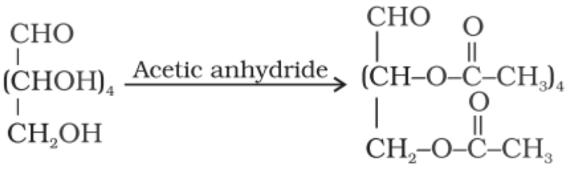
Marking scheme

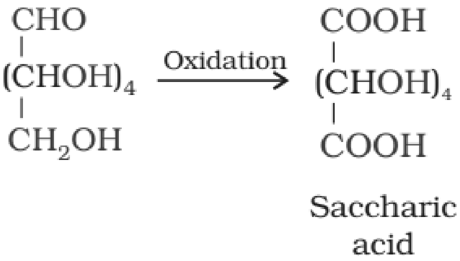
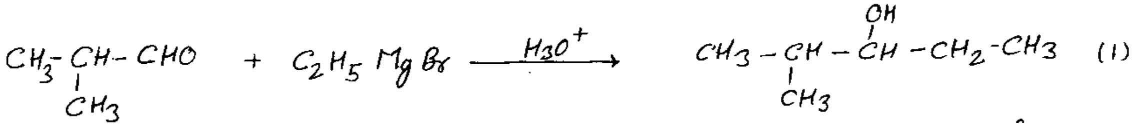
Section A

1	(iii) **treatment with pyridinium chlorochromate**	1
2	(ii) **doubled**	1
3	(i) 	1
4	(ii) **charge transfer from ligand to metal**	1
5	(ii) $\Lambda^{0}_{m\,(NH_4Cl)} + \Lambda^{0}_{m(NaOH)} - \Lambda^{0}_{(NaCl)}$	1
6	(ii) Gatterman reaction	1
7	(iii) **Collision of atoms or molecules possessing sufficient threshold energy results into the product formation.**	1
8	(iii) **$[Fe(C_2O_4)_3]^{3-}$**	1
9	(iii) **A = Phenol, B = Bromoethane**	1
10	(iii) **$(CH_3)_2NH$**	1
11	(iii) **2,4 DNP test**	1
12	(iv) may increase or decrease.	1
13	**(iv) $[Cr(H_2O)_6]Cl_3$**	1
14	(iv) CH_3CHO	1
15	(iv) A is false but R is true.	1
16	(ii) Both A and R are true but R is not the correct explanation of A.	1
17	(i) Both A and R are true and R is the correct explanation of A	1
18	(ii) Both A and R are true but R is not the correct explanation of A.	1

Section B

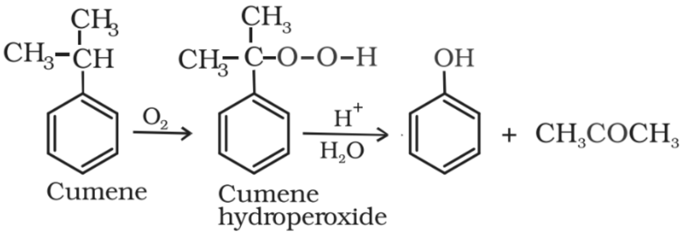
This section contains 7 questions with internal choice in two questions. The following questions are very short answer type and carry 2 marks each.

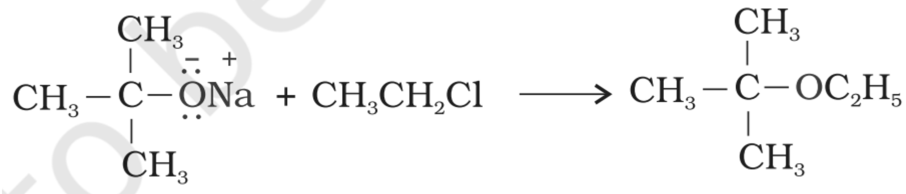
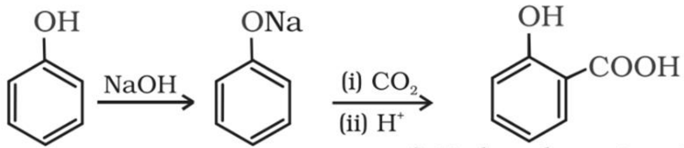
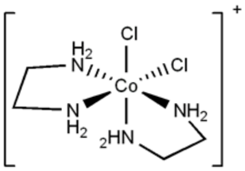
19	$K = \frac{0.693}{t_{1/2}} = \frac{0.693}{69.3}$ ½ $t = \frac{2.303}{k} \log \frac{R_0}{R}$ ½ $= \frac{2.303}{0.693} \times 69.3 \log \frac{100}{20}$ ½ $= 161$ min. ½	2
20	(a) p-dibromobenzene has higher melting point than its o-isomer due to symmetry. Due to symmetry, p- isomer fits in the crystal lattice better than the o-isomer. (1) (b) The haloalkanes are slightly soluble in water. Less energy is released when new attractions are set up between the haloalkane and the water molecules as these are not as strong as the original hydrogen bonds in water. As a result, the solubility of haloalkanes in water is low.(1) **OR** (a) (i) The structure of 'A' is  $CH_3-\overset{CH_3}{\underset{Br}{C}}-CH_3$ The structure of 'B' is  $CH_3-CH-\underset{Br}{CH}-CH_3$ (1/2 +1/2) (b) 'B' (1)	1 + 1
21	Anode half reaction $Pb\,(s) + SO_4^{2-}\,(aq) \longrightarrow PbSO_4\,(s) + 2e^-$ Cathode half cell reaction: $PbO_2\,(s) + 4H^+\,(aq) + SO_4^{2-} + 2e^- \longrightarrow PbSO_4\,(s) + 2H_2O\,(l)$ Net reaction, $Pb(s) + PbO_2 + 2H_2SO_4\,(aq) \longrightarrow 2PbSO_4\,(s) + 2H_2O\,(l)$ density of the electrolyte decreases when the battery is discharged	½ + ½ + ½ + ½
22	a.  $\overset{CHO}{\underset{CH_2OH}{(CHOH)_4}} \xrightarrow{\text{Acetic anhydride}} \overset{CHO}{\underset{CH_2-O-\overset{O}{\overset{\|}{C}}-CH_3}{(CH-O-\overset{O}{\overset{\|}{C}}-CH_3)_4}}$	1 + 1

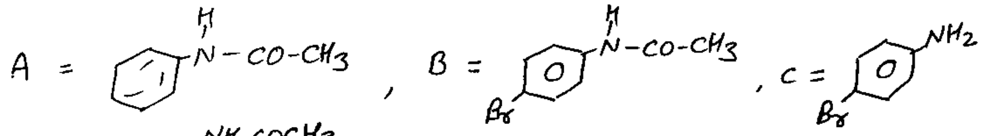
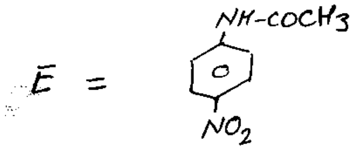
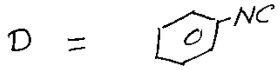
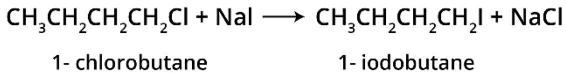
	b.  **OR** Sucrose is dextrorotatory but after hydrolysis gives dextrorotatory glucose and laevorotatory fructose. (1 mark) Since the laevorotation of fructose (–92.4°) is more than dextrorotation of glucose (+ 52.5°), the mixture is laevorotatory. (1 Mark)	
23	Linkage isomerism arises in a coordination compound containing ambidentate ligand. Examples of such ligands are the NO_2^- and SCN^- ions.	1 + ½ + ½
24	(a) Bimolecular reaction becomes kinetically first order when one of the reactants is in excess. (b) In elementary reaction order and molecularity have same value because elementary reaction proceeds in a single step.	1 + 1
25	 IUPAC – 2-Methyl pentan-3-ol (1)	2

Section C

This section contains 5 questions with internal choice in two questions. The following questions are short answer type and carry 3 marks each.

26	(a) Industrial preparation of phenol 	1

	(b) Williamson synthesis for the preparation of 2-methoxy-2-methyl propane.  $CH_3-\underset{CH_3}{\overset{CH_3}{C}}-\overset{-\ +}{\underset{..}{O}}Na + CH_3CH_2Cl \longrightarrow CH_3-\underset{CH_3}{\overset{CH_3}{C}}-OC_2H_5$ (c) Kolbe's reaction  2-Hydroxybenzoic acid (Salicylic acid)	1 1
27	(a) $[Fe(NH_3)_6]^{2+}$ - Hexaammineiron(III) (b) $[CoF_6]^{3-}$ - Hexafluoridocobaltate(III) (c) $[Ni(CN)_4]^{2-}$ - Tetracyanidonickelate(II) OR Hyb : d^2sp^3 paramagnetic  cis-isomer	1 + 1 + 1
28	(a) Henry's law: the partial pressure of the gas in vapour phase (p) is proportional to the mole fraction of the gas (x) in the solution. (½) The pressure underwater is high, so the solubility of gases in blood increases. When the diver comes to surface the pressure decreases so does the solubility causing bubbles of nitrogen in blood this blocks capillaries and creates a medical condition known as bends, to avoid this situation and maintain the same partial pressure of nitrogen underwater too, the dilution is done. (1) (b) Henry's law constant for CO_2 in water is 1.67×10^8 Pa at 298 K. Calculate the solubility of CO_2 in when packed under 2.53×10^5 Pa at the same temperature. $\chi Co_2 = \rho Co_2/K_H$ ½ $= 2.53 \times 10^5$ Pa$/1.67 \times 10^8$ Pa ½ $= 1.51 \times 10^{-3}$ ½	½ 1

29	  $(\frac{1}{2} \times 4 = 2$ Marks)  (1 Mark)	3
30	(a) Electrophilic substitution reaction in haloarenes occur slowly because halogen has a negative inductive effect, it decreases the electron density on the benzene ring (b) 2–Bromo–2–Methylbutane < 2–Bromopentane < 1–Bromopentane (c) Thionyl chloride is preferred because alkyl halide is prepared using thionyl chloride the by-products that we get are SO_2 and HCl . These are both gases and they escape out leaving behind the desired product which is an alkyl chloride. **OR** (a)  $\underset{\text{1- chlorobutane}}{CH_3CH_2CH_2CH_2Cl} + NaI \longrightarrow \underset{\text{1- iodobutane}}{CH_3CH_2CH_2CH_2I} + NaCl$ (b) 2-bromo-2-methylbutane because the order of reactivity is tert > sec > pri and it is tertiary. (c) Grignard reagents are very reactive. In the presence of moisture, they react to give alkanes.	1 + 1 + 1

Section D

The following questions 31 and 32 are case-based questions. Each question has an internal choice and carries 4 (1+1+2) marks each. Read the passage carefully and answer the questions that follow.

31		
a	A nucleotide consists of a sugar molecule (either ribose in RNA or deoxyribose in DNA) attached to a phosphate group and a nitrogen-containing base.	1
b	Two main functions of DNA • store the genetic information • To transfer the genetic information from one generation to another. (or any other suitable function)	½ + ½

<table>
<tr><td>c</td><td>As it contains uracil (1) so it must be RNA (1)
OR<table>
<tr><td>DNA</td><td>RNA</td></tr>
<tr><td>DNA has a double helix structure.</td><td>RNA has a single helix structure.</td></tr>
<tr><td>The nitrogenous bases present in DNA are Adenine, Guanine, Thymine, and Cytosine.</td><td>The nitrogenous bases present in RNA are Adenine, Guanine, Uracil, and Cytosine.</td></tr>
<tr><td>DNA is responsible for storing the genetic information,</td><td>RNA directly codes for amino acids.</td></tr>
<tr><td>DNA is responsible for transfer of transferring genetic information from one generation to another</td><td>RNA acts as a messenger between DNA and ribosomes to make proteins.</td></tr>
<tr><td colspan="2">(or any other suitable difference)</td></tr>
</table></td><td>1 + 1
OR
½ X 4</td></tr>
<tr><td>32</td><td></td><td></td></tr>
<tr><td>a</td><td>Properties of solution which depend only on the number of solute particles present and not on the type of solute present.</td><td>1</td></tr>
<tr><td>b</td><td>On adding a non-volatile solute, the vapour pressure of the solvent is lowered. Therefore, it has to be heated to a higher temperature to boil.</td><td>1</td></tr>
<tr><td>c</td><td>$\Delta T_f = K_f \cdot m$ (½)
$= 1.86 \times \frac{31}{62} \times \frac{1000}{600}$ (½)
$= 1.55$ (½)
$F.P = -1.55\,^\circ C$ or $271.45\,K$ (½)
OR
$\Delta T_f = i\ K_f\ m$ (½)
$2 = 2 \times 1.86 \times \frac{x}{58.5} \times \frac{1000}{100}$ (1)
$x = 3.15\ g$ (½)</td><td>2</td></tr>
</table>

SECTION E

The following questions are long answer type and carry 5 marks each. Two questions have an internal choice.

33 (a) 5

$$E^\circ_{cell} = E^\circ_{Red} - E^\circ_{oxi.} = 0.34 - (-2.36)$$

$$= 2.7\ V. \quad (½)$$

$$emf = E^\circ_{cell} - \frac{0.059}{n} \log \frac{[Mg^{2+}]}{[Ca^{2+}]} \quad (½)$$

$$= 2.7 - \frac{0.059}{2} \log \frac{1\times10^{-3}}{1\times10^{-4}} \quad (½)$$

$$= 2.7 - 0.0295 = 2.67\ V. \quad (½)$$

(b) Fuel cells have high efficiency run continuously as long as reactants are supplied and products are removed continuously. (1)

Primary batteries contain a limited amount of reactants and are discharged when the reactants have been consumed. Secondary batteries can be recharged but it takes a long time. (1)

(c) cell reaction stops completely and no current will flow through the cell. (1)

OR

(a) The cell potential remains constant during its life as the overall reaction does not involve any ion in solution whose concentration can change during its life time. (1)

(b) Cathode: $H_2O(l) + e^- \rightarrow ½\ H_2(g) + OH^-\ (aq)$ (½)

Anode: $Cl^-\ (aq) \rightarrow ½\ Cl_2(g) + e^-$ (½)

Net reaction:

$NaCl(aq) + H_2O(l) \rightarrow Na^+(aq) + OH^-(aq) + ½H_2(g) + ½Cl_2(g)$ (1)

(c) 1 mole of magnesium ions gains two moles of electrons or 2F to form 1 mole of Mg

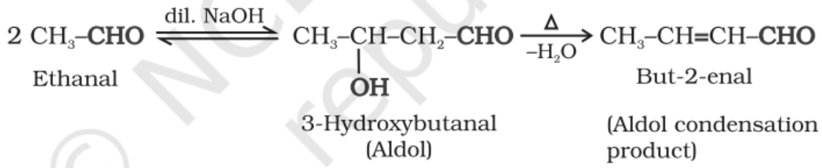
24 g Mg requires 2 F electricity

4.8 g Mg requires 2 x4.8/24 = 0.4 F = 0.4 x96500 = 38600C (1)

$Ca^{2+} + 2e^- \rightarrow Ca$

2 F electricity is required to produce 1 mole =40 g Ca

0.4 F electricity will produce 8 g Ca (1)

34	(a) (i) (A) 2-methylbut-2-ene, (B) Ethanal and (C) Propanone. (½ X 3) (name or formula) (ii)  $2\,CH_3-CHO \overset{\text{dil. NaOH}}{\rightleftharpoons} CH_3-\underset{OH}{\underset{\mid}{CH}}-CH_2-CHO \xrightarrow[-H_2O]{\Delta} CH_3-CH{=}CH-CHO$ Ethanal; 3-Hydroxybutanal (Aldol); But-2-enal (Aldol condensation product) (½) (b) (i) Propanal gives silver mirror on reacting with tollen's reagent while propanone will not. (or any other suitable test) (1) (ii) Benzoic acid releases carbon dioxide gas on reacting with sodium bicarbonate while phenol will not. (or any other suitable test) (1) (c) Semicarbazide undergoes resonance involving only one of the two $-NH_2$ groups, which is attached directly to the carbonyl-carbon atom. So that $-NH_2$ do not react. (1)	5
35	(i) Cr^{3+} = 3 unpaired electrons and V^{3+} = 2 unpaired electrons (½ + ½) Cr^{3+} is more stable in aqueous solution because of t_2g^3 electronic configuration. (1) (ii) Complete the following reactions: (a) $2\,MnO_2 + 4\,KOH + O_2 \longrightarrow 2\,K_2MnO_4 + 2\,H_2O$ (1) (b) $10\,I^- + 2\,MnO_4^- + 16\,H^+ \longrightarrow 2\,Mn^{2+} + 8\,H_2O + 5\,I_2$ (1) (c) $Cr_2O_7^{2-} + 14\,H^+ + 3\,Sn^{2+} \longrightarrow 2\,Cr^{3+} + 3\,Sn^{4+} + 7\,H_2O$ (1) OR (i) Write the chemical equations for the preparation of $KMnO_4$ from MnO_2. $2MnO_2 + 4KOH + O_2 \rightarrow 2K_2MnO_4 + 2H_2O$ $3MnO_4^{2-} + 4H^+ \rightarrow 2MnO_4^- + MnO_2 + 2H_2O$ (1+1) (ii) (a) This is because electronic configuration of manganese is $3d^5 4s^2$ and it has maximum number of electrons (5d and 2s electrons) to lose or share. (b) because Cr^{3+} exist in $3d^3$ half-filled d orbital (t_2g^3) extra stability is attained by Cr^{3+} than Cr^{2+}. (c) Ti^{4+} is colourless as it does not contain any unpaired electron. V^{4+} is colored as it has unpaired electron in 3d which can undergo d-d transitions.	5