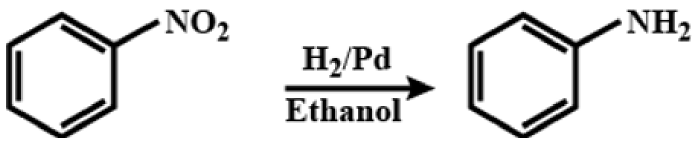
MARKING SCHEME

SAMPLE PAPER (2024 -25)

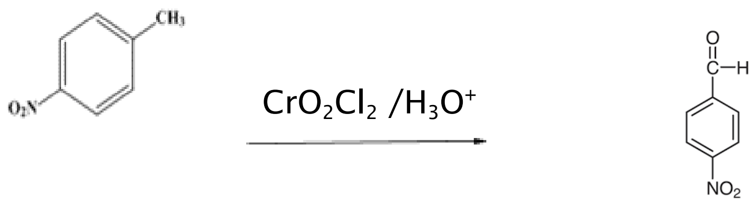
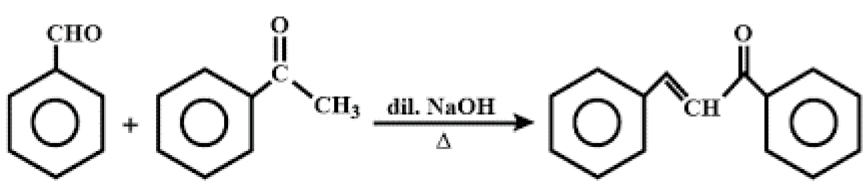
CHEMISTRY THEORY

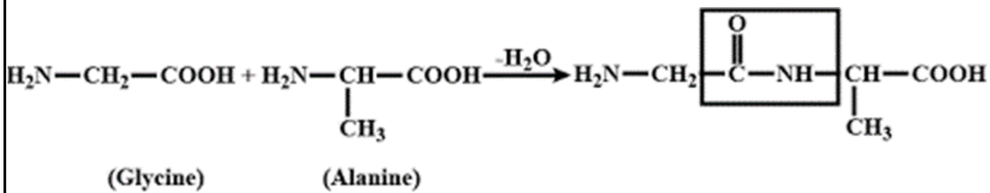
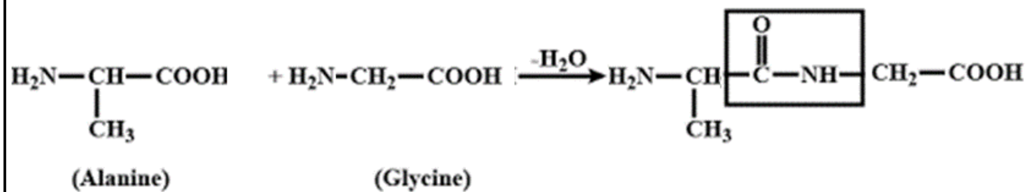
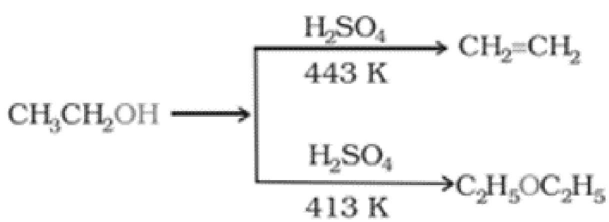
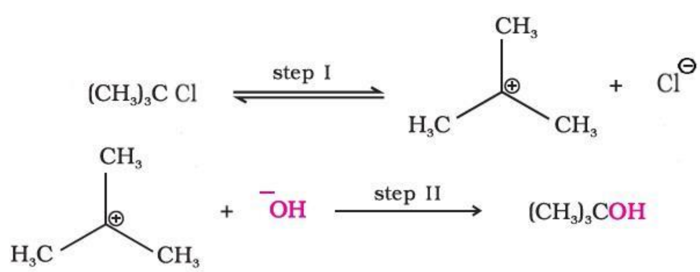
(043)

SECTION A		
1	(c) reacts with Benzenesulphonyl chloride to form a product that is insoluble in alkali	1
2	(b)CH_3Cl The order followed is this $CH_3I<CH_3Br<CH_3F< CH_3Cl$, though F is most electronegative, the bond length is small as compared to C-Cl. Dipole moment is the product of the charge and the bond length.	1
3	(a) (i)-(C), (ii)-(B), (iii)-(A)	1
4	(d) 1 =Bromomethane, 2= 2-Bromo-2-methylpropane, 3=2-Bromobutane, 4= 1-Bromobutane ***(for visually challenged learners)*** d. 1-Bromobutane	1 1
5	(c) the order of reaction is zero as the unit of k is $molL^{-1}s^{-1}$. Thus half life = $[R]_o$ / 2k = $4.62 \times 10^{-2} / 2 \times 2.31 \times 10^{-2}$	1
6	(b) Benzoic acid and ethanoic acid $C_6H_5COOCOCH_3 \xrightarrow{H_2O} C_6H_5COOH + CH_3COOH$	1
7	(b) X=$[Co(NH_3)_4Cl_2]^+Cl^-$, Y= 1:3	1
8	(b) Cellulose Starch contains only α glucose, sucrose contains α-D-glucose and β-D-fructose glucose, maltose contains α-D-glucose and cellulose is a polymer of β-D-glucose.	1
9	(d) $Ti^{3+}< Cr^{3+}< Fe^{2+} < Mn^{2+}$ No. of unpaired electrons : Ti^{3+} (1), Cr^{3+} (3), Fe^{2+} (4) and Mn^{2+} (5) Paramagnetism depends on the number of unpaired electrons	1
10	(d) It never goes to completion First order reaction $[R] = [Ro]\ e^{-kt}$ If [R]=0 then	1

	e^{-kt} = 0, which is not possible for any finite value of t. Here, t is ∞.	
11	(a) Nitrobenzene 	1
12	(a)CH_3COCH_3 Aldehyde and ketones give nucleophilic addition reactions. Other carbonyl compounds do not give nucleophilic addition reactions.	1
13	(a) Both A and R are true and R is the correct explanation of A	1
14	(d) A is false but R is true. $\Lambda_m^\circ = \Lambda_m - A\ c^{1/2}$ is an incorrect equation, the correct equation is $\Lambda_m = \Lambda_m^\circ - A\ c^{1/2}$	1
15	(b) Both A and R are true but R is not the correct explanation of A. Due to the absence of a free aldehydic group, it does not give a reaction with $NaHSO_3$.	1
16	(d)A is false but R is true. The half- life for a zero order reaction $t_{1/2}$ = [Ro]/2k where [Ro] is the initial concentration of the reactant.	1
	SECTION B	
17	(a) Solubility of gas is inversely proportional to the value of Henry's constant K_H. On increasing temperature nitrogen gas becomes less soluble because its K_H value increases. (b) (ii)64.5 °C Chloroform and acetone mixture show negative deviation from Raoult's law therefore, they form maximum boiling azeotrope at a specific composition. The boiling point of the mixture so obtained will be higher than the individual components. **OR** (a) At higher altitudes i.e. in Srinagar the atmospheric pressure is	½ ½ ½ ½ 1

	lower. The solubility of a gas in a liquid is directly proportional to the partial pressure of the gas over the solution, therefore, the carbon dioxide dissolved in water will be lesser at Srinagar making the soda go flat faster. (b)Preservation of fruits by adding sugar/salt protects against bacterial action. Through osmosis, a bacterium on canned fruit loses water, shrivels and dies.	 1
18	(a) Potassium diaquadioxalatochromate(III) hydrate (b) (i) Haemoglobin: Iron (ii) Vitamin B-12: Cobalt	1 1
19	(a) $Y(s)\|Y^{2+(}aq) \|\| X^{+}(aq)\| X(s)$ (b) ions are carrier of current in salt bridge (c) $Y(s) \rightarrow Y^{2+(}aq) + 2e^{-}$ ***(for visually challenged learners)*** a. Cathode: silver , Anode: Magnesium b. $Mg + 2Ag^{+}$ □ $Mg^{2+} + 2Ag$	1 ½ ½
20	(a)CH_3CH_2CN (major), CH_3CH_2NC (minor) (b) $CH_3CH_2CHBrCH_3$ (major) $CH_3CH_2CH_2CH_2Br$ (minor) (c) $(CH_3)_2C{=}CHCH_3$ (major) $(CH_3)_2CHCHCH_2$ (minor)	½+½ ½+½ ½+½
21	The carbonyl group present in glucose is aldehyde and the C_1 atom . Glucose gets oxidised to six-carbon carboxylic acid (gluconic acid) with COOH group at the C1 atom on reaction with a mild oxidising agent like bromine water. This indicates that the carbonyl group is present as an aldehydic group	½ ,½ 1
	SECTION C	
22	(a) Product of electrolysis of Copper Chloride Cathode(-) $Cu^{2+} + 2e^{-} \rightarrow Cu(s)$ anode(+) $2Cl^{-} \rightarrow Cl_2 + 2e^{-}$ Product of electrolysis of concentrated Copper Sulphate Anode(+) $SO_4^{2-} \rightarrow S_2O_8 + 2e^{-}$ Cathode (-) $Cu^{2+} + 2e^{-} \rightarrow Cu(s)$ (b) $\lambda^0_m[Al_2(SO_4)_3] = 2\ \lambda^0_m (Al^{3+}) + 3\ \lambda^0_m (SO_4^{2-})$	 1 1 1
23	(a) In the case of a lower oxide of a transition metal, the metal atom has some electrons present in the valence shell of the metal atom that are not involved in bonding. As a result, it can donate electrons and behave as a base whereas in higher oxide of a transition metal,	1

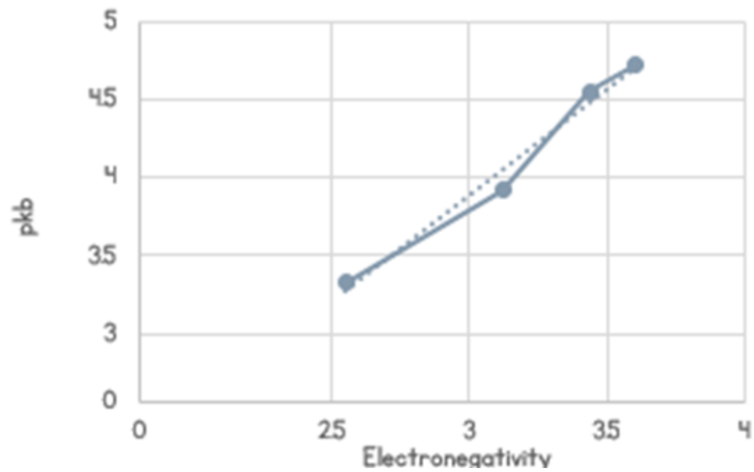
	the metal atom does not have an electron in the valence shell for donation. As a result, it can accept electrons and behave as an acid. (b) Chromium has unpaired electrons which result in strong metallic bonding which results in it being a hard solid and the absence of unpaired electrons in Hg results in it being a liquid. (c) The increase in effective nuclear charge responsible for steady increase in ionisation energy is counterbalanced by shielding effect of (n-1)d electrons	1 1
24	(a)  (b) Benzoic acid undergoes extensive intermolecular hydrogen bonding , leading to the formation of dimer . (c) Benzoic acid does not undergo reaction with CH_3Cl i.e Friedel Craft reaction because the carboxyl group is deactivating and the catalyst aluminium chloride (Lewis acid) gets bonded to the carboxyl group **OR** Compound ‘X’ = Benzaldehyde , Compound Y = Acetophenone  (Major) Cross.Aldol product Chemical test to distinguish between X and Y is the Tollen Test . Benzaldehyde undergoes SIlver mirror test with Tollen reagent and forms silver mirror . However Acetophenone does not react with Tollen Reagent .	1 1 1 ½,½ 1 1

25	(a)   (b) (i) Keratin is a fibrous protein. fibre- like structure is formed. Such proteins are generally insoluble in water. (ii)Insulin is a globular protein . This structure results when the chains of polypeptides coil around to give a spherical shape. These are usually soluble in water.	1 1 ½ ½
26	(a) Ethanol undergoes a dehydration reaction. At 140°C, diethyl ether is formed. The formation of ether is a nucleophilic S_N2 substitution bimolecular reaction (b) When the temperature exceeds 170°C, ethene is the major product. Nucleophilic substitution S_N1 unimolecular reaction 	1+½ 1+½
27	"A" is $(CH_3)_3CCl$, the carbocation intermediate obtained in tertiary alkyl halide is most stable, making A most reactive of all possible isomers. 	½ +½ 1 1

28	$$E_{Cell} = E^{o}_{Cell} - \frac{2.303RT}{nF} \log Kc$$ At 298 K $$E_{Cell} = E^{o}_{Cell} - \frac{0.0591}{n} \log Kc$$	½
	At equilibrium Ecell =0, n= 6	½
	$$E^{o}_{Cell} = \frac{0.0591}{n} \log Kc$$	½
	$= 0.059/6 \log 4.617 \times 10^{184}$ $= 0.00983 \times 184.6644$ $= 1.8152$	½
	(ii) $E^{o}_{cell} = E^{0}_{Sn4+/Sn2+} - E^{0}_{Al3+/Al}$ $1.81 = -0.15 - E^{0}_{Al3+/Al}$	½
	$E^{0}_{Al3+/Al} = -1.66$ V	½

SECTION D

29	a. Rate = $k [H_2] [Br_2]^{1/2}$	½
	order = 3/2	½
	units of k = $\frac{molL^{-1}s^{-1}}{mol^{3/2}L^{-3/2}} = mol^{-1/2}L^{1/2}s^{-1}$	1
	b. Rate = $k [H_2] [Br_2]^{1/2}$ If conc of Br_2 is tripled Rate' = $k [H_2] [3Br_2]^{1/2}$ Rate' = $\sqrt{3}\, k [H_2] [Br_2]^{1/2}$ Rate' = $\sqrt{3}$ Rate	1
	OR	
	Rate = $k [H_2] [Br_2]^{1/2}$ If conc of Br_2 is tripled Rate' = 3 Rate= $k [xH_2] [Br_2]^{1/2}$ 3 Rate = $k [x H_2] [Br_2]^{1/2}$ x = 3, the concentration of H_2 is tripled	1

	c. The slowest step is the rate-determining step. From mechanism 2, Rate = k [A] [B] while from mechanism 1 Rate = k [A] Therefore mechanism 2, is consistent with the experimental finding	1
30	a 	1½
	……. Is the line of best fit The pKb increases with an increase in the electronegativity of the substituent, therefore the basic strength decreases with an increase in the electronegativity of the substituent	½
	b. (iv) 9.1	1
	c. (i) 3.5	1
	OR	
	(iii) 10.15	1
	(for visually challenged learners) The pKb increases with an increase in the electronegativity of the substituent, therefore the basic strength decreases with an increase in the electronegativity of the substituent	1

Substituent "X"	Electro-negativity of X	Compound	pKa	pKb

CH_2	2.55	$CH_3CH_2CH_2NH_2$	10.67	3.33
NH	3.12	$NH_2CH_2CH_2NH_2$	10.08	3.2
O	3.44	$HOCH_2CH_2NH_2$	9.45	4.55
CH_3CON	3.6	$CH_3CONHCH_2CH_2NH_2$	9.28	4.72

1

b. (iv) 9.1 — 1

c. (i) 3.5 — 1

OR

(iii) 10.15 — 1

SECTION E

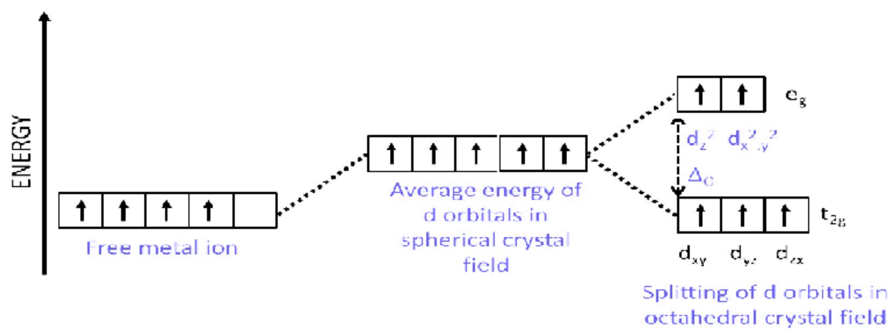
31 (a) (i) Test tube C — 1

$10I^- + MnO_4^- + 16\,H^+ \rightarrow 5I_2 + 2Mn^{2+} + 8\,H_2O$

(ii) Test tube A — 1

$C_2O_4^{2-} + 2MnO_4^- + 16\,H^+ \rightarrow 10CO_2 + 2Mn^{2+} + 8\,H_2O$

(b) (i) — 2



(ii) Sp^3d^2 , Since $\Delta_0 > P$ it will form an outer orbital complex as the electrons in the 3d orbital will not pair up. — ½

(iii) Optical isomerism. — ½

OR

a. A = Co^{2+}

B = 3 — ½

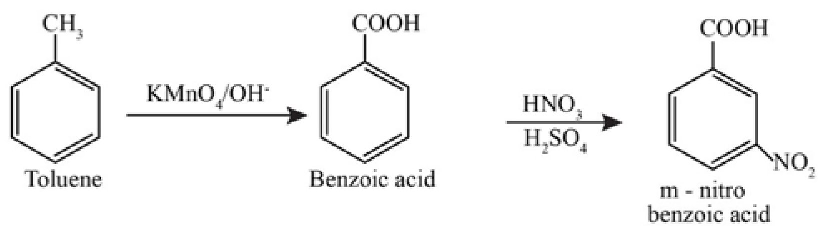
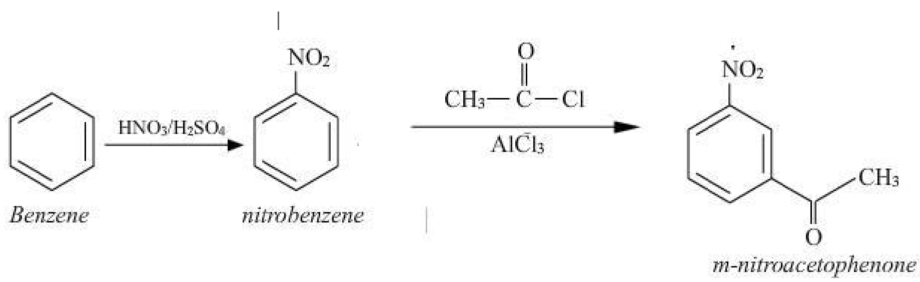
C = d^2sp^3 — ½

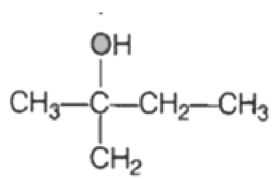
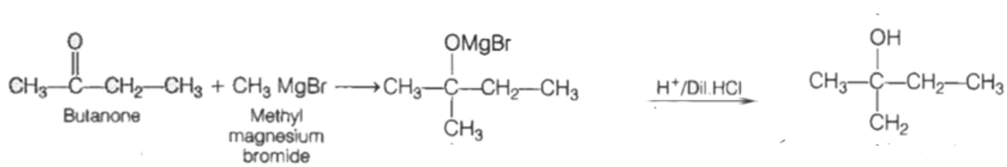
D = Paramagnetic — ½

E= sp^3 — ½

F = tetrahedral — ½

b. — ½

	(i) $Cr_2O_7^{2-} + 8H^+ + 3H_2S \rightarrow 2Cr^{3+} + 3S + 7H_2O$	1
	(ii) $Cr_2O_7^{2-} + 14H^+ + 6Fe^{2+} \rightarrow 2Cr^{3+} + 6Fe^{3+} + 7H_2O$	1
	.	
32	a. (i) The reaction of ethanol with acetyl chloride is carried out in the presence of pyridine . Pyridine is a strong organic base .The function of pyridine is to remove HCl formed in the reaction.	1
	(ii) The electron releasing groups, such as alkyl groups, in general, do not favour the formation of phenoxide ion resulting in decrease in acid strength. Cresols, for example, are less acidic than phenol.	1
	b. C_2H_5Br and $CH_3CH_2CH(CH_3)CH_2CH_2ONa$ yields 2-ethoxy-3-methylpentane	1
	c. (i) 	1
	(ii) 	1
	OR	
	a. Acetic acid will give HVZ reaction.	½
	Carboxylic acids having an α-hydrogen are halogenated at the α-position on treatment with chlorine or bromine in the presence of a small amount of red phosphorus to give α-halo carboxylic acids.	1
	$CH_3COOH \xrightarrow{Br_2/\text{red P}} CH_2BrCOOH$	½
	b. Isomers of butanol are: Butan-1-ol , butan-2-ol , 2-methylpropanol , 2-methylpropan-2-ol .	
	Acidic strength in isomeric alcohols varies as follows : 	

	The acidic character of alcohols is due to the polar nature of O–H bond. An electron-releasing group (–CH_3 , –C_2H_5) increases electron density on oxygen tending to decrease the polarity of O-H bond 2-methylpropan-2-ol< 2-methylpropanol < butan-2-ol <Butan-1-ol c. An organic compound A is a Grignard reagent : RMgX B is a ketone RCOR' A + B □  (2-methylbutan-2-ol) Ketones lead to the formation of tertiary alcohol ,so the compound B is a ketone B – Butan-2-one and A ' is CH_3 MgBr 	½ ½ ½ + ½ 1
33	a. Depression in the freezing point is a colligative property. In dilute solutions the depression of freezing point (ΔTf) is directly proportional to the molal concentration of the solute in a solution. From the graph it is interpreted that Solution 2 shows more depression in freezing point 1 M $Al(NO)_3$ has higher i value (i=3) than 1 M glucose (i=1) 1 M $Al(NO)_3$ will have higher depression , hence solution 2 is $Al(NO)_3$ solution and solution 1 is glucose solution. ***(for visually challenged learners)*** a. 1 M $Al(NO)_3$ shows greater depression in freezing point 1 M $Al(NO)_3$ has higher i value (i=3) than 1 M glucose (i=1) and we know that $\Delta T_f = iK_f\, m$ b. $\pi = (n_2/V)\, RT$ Given π = 2.64 atm	1 ½ ½ 1 1 ½

	Let $V_1 = V$ $V_2 = 5V$ (On dilution by 5 times) $\frac{\pi 1}{\pi 2} = \frac{(n/V_1)}{(n/V_2)}$	1
	$\frac{2.64}{\pi 2} = \frac{(n/V)}{(n/5V)}$	
	$\pi 2 = 0.528$ atm	½
	Osmotic pressure is directly proportional to temperature.	½
	The osmotic pressure of cane sugar can be decreased by decreasing the temperature.	½
	OR	
	a. While giving intravenous injection to the patients , utmost care of concentration of the solution is to be taken . The solution must have same concentration as that of blood cells .	1
	If the solution becomes more concentrated than the concentration of the blood it will lead to the shrinking of blood cells and fluid will start flowing out because of endosmosis. If concentration is less concentrated than the concentration of the blood it will lead to swelling of blood cells will take place. Both situations are life-threatening.	1
	b. $2C_6H_5OH \longrightarrow (C_6H_5OH)_2$ Initial concentration : C 0 Final concentration C (1-α) Cα/n, where α is degree of association .	½
	Experimentally, phenol is 73 % associated . Hence α = 0.73 . Relation between i (vant hoff factor) and α is given as : α=(1-i)/ (1-n) , where n for phenol = ½ as phenol acts as dimer , association is taking place	½
	Substituting the values : 0.73=(1-i)/(-0.5)	

	$i = 1 - 0.73/2$ $i = 0.635$ Depression in freezing point can be calculated as: $\Delta T_f = iK_f\, m$ $= iK_f\,(w_b / M_b \times w_a)$ $K_f = 5.12$ K Kg/mol, $w_b = 2 \times 10^{-2}$ kg = 20 g, $w_a = 1$ kg $M_b = 94$ $\Delta T_f = (0.635 \times 5.12 \times 20 / (94)$ $= 0.691$ K ____	 ½ 1 ½