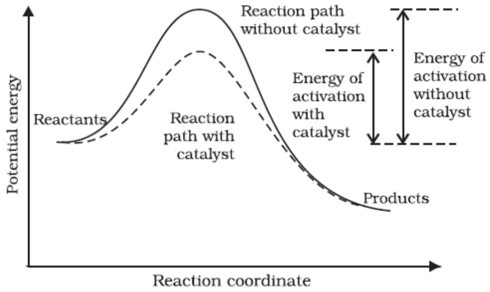
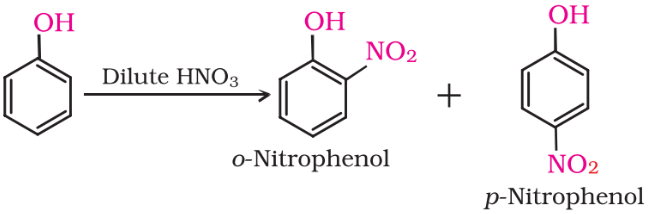
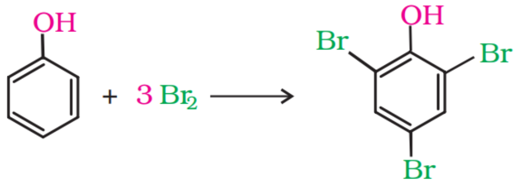
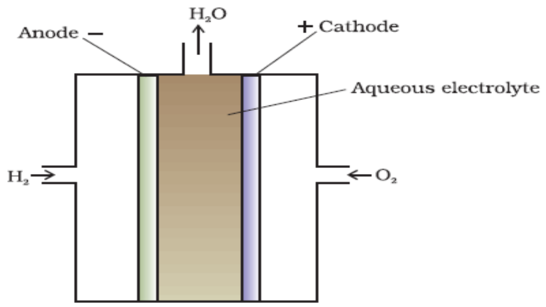
SECOND YEAR HIGHER SECONDARY SECOND TERMINAL EXAMINATION DEC. 2025 – ANSWER KEY

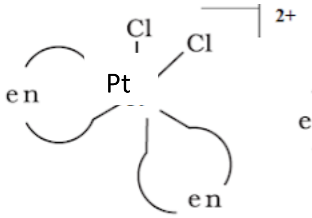
SUBJECT: CHEMISTRY **Qn. Code: SY 4025**

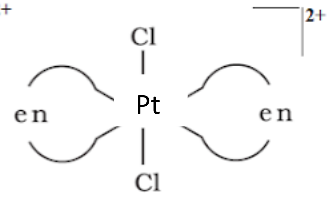
Qn. No.	Sub Qns	Answer Key/Value Points	Score	Total
		Answer any 4 questions from 1 to 5. Each carries 1 score		
1.		(b) 1.35 V	1	1
2.		(c) increase in number of effective collisions	1	1
3.		(d) Geometrical isomerism	1	1
4.		(c) Sc^{3+}	1	1
5.		(a) Both (A) and (R) are true and (R) is the correct explanation of (A)	1	1
		Answer any 8 questions from 6 to 15. Each carries 2 scores		
6		Reverse osmosis When a pressure higher than osmotic pressure is applied to the solution side, the solvent molecules flow from solution side to solvent side through semi-permeable membrane. Application: Desalination of sea water OR, Purification of water	½ ½ 1	2
7.		$E_{cell} = E^0_{cell} - \frac{0.0591}{n}\log\frac{[Zn^{2+}]}{[Cu^{2+}]}$ Here E^0_{cell} = 1.1 V, n =2, $[Zn^{2+}]$ = 0.1 M and $[Cu^{2+}]$ = 1 M $E_{cell} = 1.1 - \frac{0.0591}{2}\log\frac{0.1}{1}$ = 1.13 V	1 ½ ½	2
8.			2	2
9.		This is because in transition elements d and s electrons have comparable energies. So along with s-electrons, d-electrons also participate in chemical reactions. E.g. Manganese can show +2, +3, +4, +5, +6 and +7 oxidation states OR, any other example.	1 1	2
10.		Lanthanoid contraction is the regular decrease in the atomic and ionic radii along lanthanoid series. Consequences: (i) The 2nd and 3rd row transition series elements have similar radii. (ii) Lanthanides have similar physical properties and they occur together in nature. So their isolation is difficult. (iii) The basicity of hydroxides of Lanthanoids decreases from Lanthanum to Lutetium. ***[Any one consequence is required]***	1 1	2
11.		Ambidentate ligands are unidentate ligands which contain more than one donor atoms. E.g.: NO_2^- OR, SCN^-.	1 1	2
12.		$CH_3\text{-}CH_2\text{-}CHBr\text{-}CH_3 + KOH_{(alc)} \longrightarrow CH_3\text{-}CH_2\text{-}CH{=}CH_2 + CH_3\text{-}CH{=}CH\text{-}CH_3$ 2-Bromobutane 1-butene (minor) 2-butene (major) Here the major product is selected based on Zaitsev's rule (Saytzeff's rule). According to this rule in dehydrohalogenation reactions, the preferred product is that alkene which has the greater number of alkyl groups attached to the doubly bonded carbon atoms. Here but-2-ene contains 2 alkyl ($-CH_3$) groups around C = C bond. So it is the major product.	½ + ½ 1	2

13.		When phenol is treated with dil. HNO_3, we get ortho and para nitrophenols. OR,  When phenol is treated with bromine water, we get 2,4,6-tribromophenol. OR,  2,4,6-Tribromophenol	1 1	2
14.		Because of the electron withdrawing inductive effect of chlorine, the carboxylate ion formed from chloroacetic acid (CH_2Cl-COOH) is more stabilized. So the release of H^+ becomes easier. **OR**, Due to the -I effect of chlorine, the electron density on O-H bond in -COOH group decreases. **OR**, due to the greater stability of conjugate base formed from chloroacetic acid.	2	2
15.		Acetyl chloride is hydrogenated over palladium on $BaSO_4$, we get acetaldehyde. OR, $CH_3\text{-}COCl + H_2 \xrightarrow{Pd/BaSO_4} CH_3\text{-}CHO + HCl$ The reaction is known as Rosenmund reduction.	1 1	2
		Answer any 8 questions from 16 to 26. Each carries 3 scores		
16.	(i)	 	1	3
	(ii)	Anode reaction: $H_{2(g)} + 2OH^-_{(aq)} \longrightarrow 2H_2O_{(l)} + 2e^-$ Cathode reaction: $O_{2(g)} + 2H_2O_{(l)} + 4e^- \longrightarrow 4OH^-_{(aq)}$	½ ½	
	(iii)	The advantages of fuel cell are: i) The cell works continuously as long as the fuels are supplied. ii) It has higher efficiency as compared to other conventional cells. iii) It is eco-friendly (Or, pollution free). iv) Water obtained from $H_2 - O_2$ fuel cell can be used for drinking. ***[Any 2 required]***	1	
17.	(a)	Arrhenius equation is $k = A.e^{\frac{-E_a}{RT}}$ OR, $\ln k = \ln A - \frac{E_a}{RT}$ OR, $\log k = \log A - \frac{E_a}{2.303RT}$	1	
	(b)	We know that, $\log\frac{k_2}{k_1} = \frac{E_a}{2.303\,R}\,\frac{T_2 - T_1}{T_1\,T_2}$ Here T_1 = 300 K, T_2 = 310 K, and R = 8.314 J K^{-1} mol^{-1} . Let k_1 = x, then k_2 = 2x	1	

<table>
<tr><td></td><td></td><td>Then,
$\log\frac{2x}{x} = \frac{E_a}{2.303 \times 8.314}\,\frac{310-300}{300 \times 310}$
$E_a = \frac{0.3010 \times 2.303 \times 8.314 \times 300 \times 310}{10}$ = 53598.6 J mol^{-1} = 53.598 kJ mol^{-1}</td><td>½
½</td><td></td></tr>
<tr><td>18.</td><td>(i)

(ii)</td><td>The important postulates of Werner’s theory are:
1) Every metal has two types of valencies – primary (1^0) valency and secondary (2^0) valency. Primary valency is ionisable, while secondary valency is non-ionisable.
2) Primary valency is denoted by doted lines, while secondary valency is denoted by solid lines.
3) Primary valency gives the oxidation state of the metal, while secondary valency gives the co-ordination number of the metal.
4) Primary valency is always satisfied by –ve ions, while secondary valency may be satisfied by –ve ions or neutral molecules.
5) Every metal has a fixed number of secondary valencies. In order to satisfy this requirement, some negative ions may act as primary and secondary valencies simultaneously.
6) The primary valencies are non-directional, while the secondary valencies are directional.
7) Since secondary valencies are directional, co-ordination compounds have a definite geometry and they show isomerism. <i>[Any 2 required]</i>
$[Co(NH_3)_5(CO_3)]Cl$</td><td>2 x 1

1</td><td>3</td></tr>
<tr><td>19.</td><td></td><td>

cis- isomer


trans-isomer
cis isomer is optically active, since it has no plane of symmetry. [Or, due to its asymmetric structure].</td><td>2
½ + ½</td><td>3</td></tr>
<tr><td>20.</td><td>(i)

(ii)</td><td>(a) $CH_3CH_2NC + AgBr$ [Only the main product is required].
(b) $CH_3CH_2I + NaBr$ [Only the main product is required].
To prevent the oxidation of chloroform to phosgene.
OR, When chloroform is exposed to air and sunlight, it gets oxidised to form the poisonous gas called phosgene.
OR, $2CHCl_3 + O_2 \xrightarrow{light} 2COCl_2 + HCl$</td><td>1
1
1</td><td>3</td></tr>
<tr><td>21.</td><td>(i)</td><td><table>
<tr><th>S_N1 Reaction</th><th>S_N2 Reaction</th></tr>
<tr><td>Proceeds in 2 steps</td><td>Proceeds in a single step</td></tr>
<tr><td>An intermediate (carbocation) is formed</td><td>No intermediate is formed</td></tr>
<tr><td>Order and molecularity of the reaction = 1</td><td>Order and molecularity of the reaction = 2</td></tr>
<tr><td>For optically active compounds, the reaction proceeds through racemisation.</td><td>For optically active compounds, the reaction proceeds through inversion of configuration.</td></tr>
<tr><td>The order of reactivity of alkyl halides is $3^0 > 2^0 > 1^0$</td><td>The order of reactivity of alkyl halides is $1^0 > 2^0 > 3^0$</td></tr>
</table>
<i>[Any 2 differences required]</i></td><td>2 x 1</td><td>3</td></tr>
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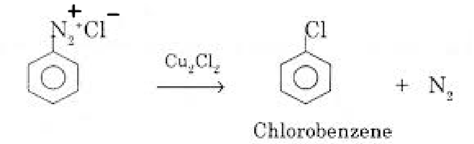
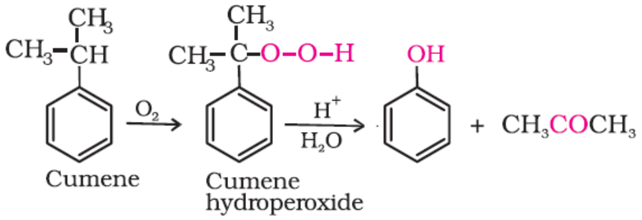
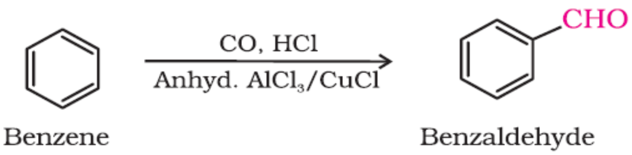
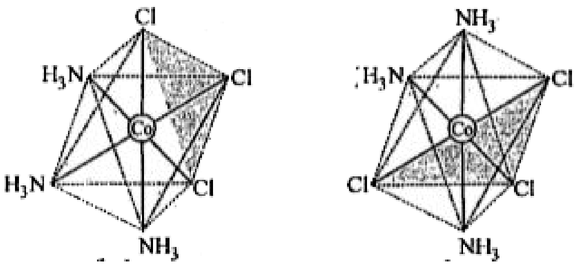
	(ii)	By treating benzene diazonium chloride with cuprous chloride [Sandmeyer reaction]. **OR,**  **OR,** by treating benzene diazonium chloride with HCl in presence of copper powder [Gatterman reaction].	1	
22.	(i) (ii)	When Grignard reagent is added to formaldehyde followed by hydrolysis, we get primary alcohol. When Grignard reagent is added to aldehyde other than formaldehyde followed by hydrolysis, we get secondary alcohol. OR, $\text{H-CHO} + \text{RMgX} \longrightarrow \text{R-CH}_2\text{-OMgX} \xrightarrow{H_2O} \text{R-CH}_2\text{-OH} + \text{MgX(OH)}$ Formaldehyde adduct 1^0 alcohol $\text{R-CHO} + \text{RMgX} \longrightarrow \text{R}_2\text{CHOMgX} \xrightarrow{H_2O} \text{R}_2\text{CHOH} + \text{MgX(OH)}$ Aldehyde adduct 2^0 alcohol A is $(CH_3CH_2CH_2)_3B$ (Tripropyl borane) and B is $CH_3CH_2CH_2OH$ (Propan-1-ol or, n-Propyl alcohol)	1 1 ½ ½	3
23.	(i) (ii)	Cumene is isopropylbenzene (2-phenyl propane). When cumene is oxidised in presence of air, we get cumene hydroperoxide, which on acidification we get phenol. OR,  Methanol is manufactured by the catalytic hydrogenation of carbon monoxide at about 573-673 K temperature and 200-300 atm pressure and in the presence of ZnO – Cr_2O_3 catalyst. $\text{CO} + 2\text{H}_2 \xrightarrow[\substack{200\text{-}300\ \text{atm}\\ 573\text{-}673\ \text{K}}]{\text{ZnO-Cr}_2\text{O}_3} \text{CH}_3\text{OH}$	½ 1½ 1	3
24.	(i) (ii)	Phenols are more acidic due to the greater stability of the phenoxide ion formed. **OR,** due to the greater electronegativity of sp^2 hybridised carbon to which -OH group is bonded. **OR,** due to the electron withdrawing effect (-I effect) of phenyl group. Primary and secondary alcohols can be distinguished by Lucas Test. On treating with Lucas reagent, secondary alcohols form a turbidity within 5 minutes, while primary alcohols do not form turbidity at room temperature.	1 2	3
25.	(i)	Gatterman-Koch Reaction: Benzene when treated with CO and HCl in the presence of anhydrous aluminium chloride or cuprous chloride, we get benzaldehyde. OR, 	1	

	(ii)	(a) Propanal (being an aldehyde) gives the following tests: i) **Tollen's test**: A bright silver mirror is formed when heated with Tollen's reagent. ii) **Fehling's test**: A reddish brown ppt is formed when heated with equal volume of Fehling's solutions A and B. The above tests are not answered by propanone (being a ketone). **Iodoform (Haloform) Test**: Propanone gives an yellow ppt, when treated with sodium hypoiodite or I_2 in presence of NaOH. Propanal does not give this test. [**Any one test is required**] (b) Phenol and benzoic acid can be distinguished **by treating with $NaHCO_3$.** Benzoic acid gives brisk effervescence of CO_2 on treating with $NaHCO_3$, but phenol does not. **OR, by treating with neutral ferric chloride.** Phenol gives a violet colouration with neutral ferric chloride, while benzoic acid does not.	1 1	3
26.			6 x ½	3

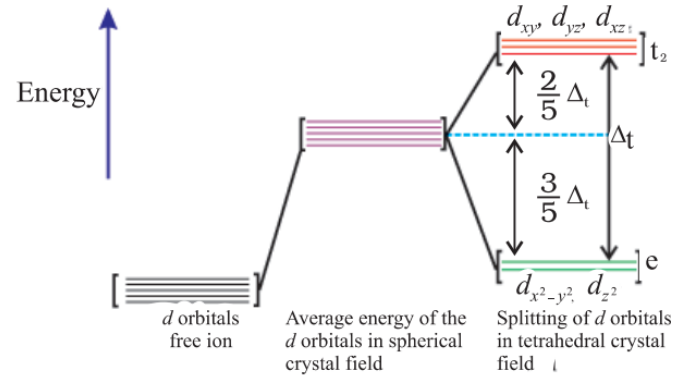
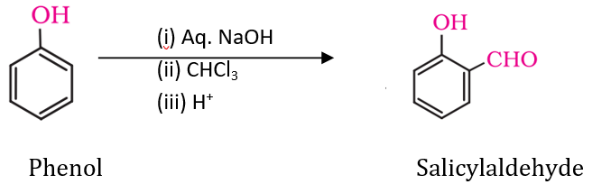
Sl. No.	Reactant	Reagent	Organic Product	Name of reaction
1.	RCN	$SnCl_2$/HCl	RCH=NH	Stephen reaction
2.	CH_3COOH	Cl_2/Red P	$CH_2ClCOOH$	HVZ Reaction
3.	CH_3CHO	Zn/Hg and conc. HCl	CH_3CH_3	Clemmensen reduction

Answer any 4 questions from 27 to 31. Each carries 4 scores

27.	(i)	Henry's law It states that at constant temperature, the solubility of a gas in a liquid is directly proportional to the pressure of the gas. **OR,** at constant temperature, the partial pressure of the gas in vapour phase is proportional to the mole fraction of the gas in the solution. Applications: i. In the preparation of soda water and soft drinks, the bottle is sealed at high pressure. ii. A medical condition known as Bends in Scuba divers. iii. A medical condition known as Anoxia in people living at high altitudes or climbers. ***[Any one application is required]***	½ 1 ½	4
	(ii)	We know that, $\frac{\Delta P}{P_1^0} = \frac{w_2 \times M_1}{w_1 \times M_2}$ Here, vapour pressure of pure solvent (benzene) (P_1^0) = 0.850 bar, Mass of benzene (w_1) = 39 g, mass of solute (w_2) = 0.5 g, molar mass of benzene (M_1) = 78 g mol^{-1} and vapour pressure of solution (P_1) = 0.845 bar $\Delta P = P_1^0 - P_1 = 0.850 - 0.845 = 0.005$ bar On substituting in the above equation, we get, $\frac{0.005}{0.850} = \frac{0.5 \times 78}{39 \times M_2}$ So, $M_2 = \frac{0.5 \times 78 \times 0.850}{0.005 \times 39}$ = **170 g mol^{-1}**	1 ½ ½	
28.	(i)	Facial – meridional (fac-mer) isomerism	1 ½ + ½	4



Fac-isomer Mer-isomer

	(ii)	Crystal field splitting in tetrahedral field:  	2	
29.	(i) (ii)	(a) X is CH_3CH_2Cl [Chloroethane OR, Ethyl chloride] (b) Y is CH_3F [Fluoromethane OR, Methyl fluoride] Aryl halides are less reactive towards nucleophilic substitution reactions due to the following reasons: 1. Resonance effect: Due to this, the C – X bond gets a partial double bond character. 2. sp^2 hybridisation of the carbon to which halogen atom is bonded. 3. Due to instability of phenyl cation, S_N2 reaction does not occur. 4. Due to repulsion between nucleophile and electron rich benzene ring. ***[Any 2 reasons required]***	1 1 2 x 1	4
30.	(i) (ii)	Benzene OR, C_6H_6 **(a) Reimer-Tiemann Reaction:** When phenol is treated with chloroform in the presence of sodium hydroxide, followed by acidification, we get salicylaldehyde. **OR,**  **(b) Williamson's synthesis:** Alkyl halides react with sodium alkoxide to form ether. **OR,** $R\text{-}X + NaOR \longrightarrow R\text{-}O\text{-}R + NaX$ **OR,** Any one example.	1 1½ 1½	4
31.	(i) (ii)	Toluene OR, Methyl benzene OR, $C_6H_5\text{-}CH_3$ Etard reaction (a) Cannizzaro reaction (b) $CH_3\text{-}OH$ (Methanol) and H-COONa (Sodium methanoate Or, Sodium formate) **OR,** $\underset{\text{Formaldehyde}}{2\ HCHO} \xrightarrow{\text{Conc.NaOH}} \underset{\text{methanol}}{CH_3\text{-}OH} + \underset{\text{sodium formate}}{H\text{-}COONa}$	1 1 1 ½ + ½	4

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