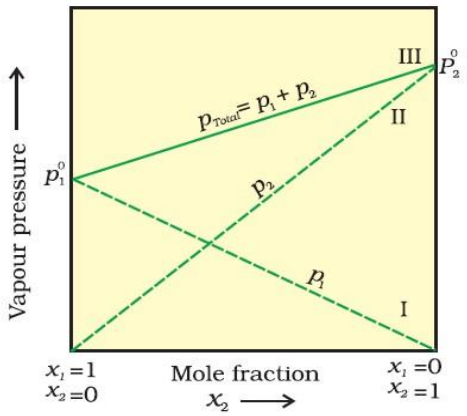
# SECOND YEAR HIGHER SECONDARY EXAMINATION APRIL 2021

**SUBJECT: CHEMISTRY** **Qn. Code: SY 225**

| Qn. No. | Sub qns. | Answer Key/Value Points | Score | Total |
|---|---|---|---|---|
| | | ***Answer questions from 1 to 11. Each carries 2 scores.*** | | |
| 1. | (i) | (A) NaCl | 1 | 2 |
| | (ii) | Like liquids, glass has a tendency to flow / since it is an amorphous solid/ in glass, the particles have only short range order. | 1 | |
| 2. | (i) | 12 | 1 | 2 |
| | (ii) | Total no. of voids = 3N mol or 3N x 6.022 x $10^{23}$ voids | 1 | |
| 3. | |  | 2 | 2 |
| 4. | (i) | 38% $H_2SO_4$ solution or Sulphuric acid solution | 1 | 2 |
| | (ii) | Dry cell/Mercury cell/button cell [Any one example required] | 1 | |
| 5. | | If the order of a reaction is zero, it is called zero order reaction.<br>**Or**, it is the reaction in which the rate of the reaction is independent of the concentration of the reactants. **Or**, Example for zero order reaction.<br>For a zero order reaction, the unit of rate constant is mol/L/s or mol $L^{-1}$ $s^{-1}$. | 1<br><br><br>1 | 2 |
| 6. | A. | Homogeneous catalysis | 1 | 2 |
| | B. | Heterogeneous catalysis | 1 | |
| 7. | (i) | (D) Zinc blende | 1 | 2 |
| | (ii) | Distillation | 1 | |
| 8. | (i) | $HNO_3$/Nitric acid | 1 | 2 |
| | (ii) | Ostwald's process | 1 | |
| 9. | (i) | $PCl_3$ reacts with moisture and form HCl gas/ due to the formation of hydrogen chloride gas.<br>Or, the equation $PCl_3 + 3H_2O \rightarrow H_3PO_3 + 3HCl$ | 1 | 2 |
| | (ii) | Since in $PCl_5$, the axial bond length is greater than the equatorial bond length/ due to its unsymmetrical structure/due to the greater repulsion between axial bond pairs and equatorial bond pairs/due to its trigonal bipyramidal structure. [Any one reason] | 1 | |
| 10. | (i) | Potassiumtetrahydroxidozincate(II) | 1 | 2 |
| | (ii) | Magnesium (Mg) | 1 | |

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|---|---|---|---|---|
| 11. | (i) | $CH_3$-$CH_2$-Cl/ Chloroethane/ Ethyl chloride | 1 | 2 |
| | (ii) | $CH_3$-CHI-$CH_3$/ 2-Iodopropane/ Isopropyl iodide | 1 | |

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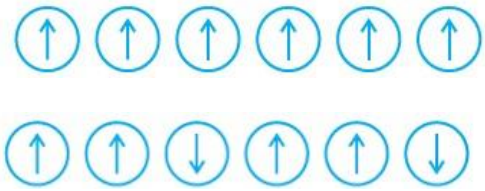
|---|---|---|---|---|
| | | ***Questions 12 to 29 carry 3 scores each.*** | | |
| 12. | | A unit cell is the smallest portion of a crystal lattice which, when repeated in three dimension to generate an entire lattice. Or, it is the building block of a crystal.<br>***Number of atoms present per unit cell*** **bcc:** Here the particles are present at the corners of the cube and also one atom at the body centre.<br>The number of atoms at the corner = 8 × 1/8 = 1<br>The number of atoms at the body-centre = 1<br>Therefore, total number of atoms in the unit cell = 1+1 = **2**<br>**Fcc**: Here the atoms are present at the corners and also at the centre of each faces.<br>Number of corner atoms = 8×1/8 = 1<br>Number of face-centre atoms = 6×1/2 = 3<br>Therefore, total number of atoms = 1+3 = **4** | 1<br><br><br><br>1<br><br><br><br>1 | 3 |
| 13. | (i)<br>(ii) | Ferromagnetic substances<br>Alignment of magnetic moments in a ferromagnetic substance:<br>  <br>Alignment of magnetic moments in a ferrimagnetic substance: | 1<br><br>1<br><br><br>1 | 3 |
| 14. | | Henry's law states that at a constant temperature, the solubility of a gas in a liquid is directly proportional to the pressure of the gas.<br>**Or,** the partial pressure of a gas in vapour phase is proportional to the mole fraction of the gas in the solution.<br>**Or,** its mathematical form: $\mathbf{p = K_H x}$ (where p is the partial pressure of the gas, $K_H$ is the Henry's law constant and x Is the mole fraction of the gas in the solution).<br>**Applications:** Preparation of soda water, a condition known as *Bends* in Scuba divers, a medical condition known as *Anoxia* in people living at high altitudes. (**Any 2 applications required**) | 1<br><br><br><br><br><br>2 | 3 |
| 15. | (i)<br><br><br><br>(ii) | $E_{cell} = E^0_{cell} - \frac{2.303RT}{2F} \log \frac{[Zn^{2+}]}{[Cu^{2+}]}$<br>**OR,**<br>$E_{cell} = E^0_{cell} - \frac{0.0591}{2} \log \frac{[Zn^{2+}]}{[Cu^{2+}]}$ (at 298 K)<br>Conductivity and molar conductivity are related as: $\lambda m = 1000\ k/M$<br>Here $k = 0.0248\ S\ cm^{-1}$ and molarity, M = 0.2 M<br>So $\lambda m = 1000 \times 0.0248/0.2 = 124\ S\ cm^2\ mol^{-1}$ | 1<br><br><br><br><br><br>1<br><br>1 | 3 |

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|---|---|---|---|---|
| 16. | (i)<br>(ii)<br><br>(iii) | I is strong electrolyte and II is weak electrolyte. $\lambda^0$m indicates the limiting molar conductivity **or** molar conductivity at zero concentration.<br>By using Kohlrausch's law | 1<br>1<br><br>1 | 3 |
| 17. | (i) | $P_{Total} = P_{A0} + (P_{B0} - P_{A0})x_B$<br>Here $P_A^0$ = 400 mm of Hg, $P_B^0$ = 600 mm of Hg and $x_B$ = 0.4 So, $P_{Total}$ = 400 + (600 – 400) x 0.4 = **480 mm of Hg OR**<br>Since $x_B$ = 0.4, $x_A = 1 - x_B = 1 - 0.4 = 0.6$<br>$P_A = P^0_A.x_A$ = 400 x 0.6 = 240 mm of Hg | 2 | 3 |
| | (ii) | $P_B = P^0_B.x_B$ = 600 x 0.4 = 240 mm of Hg<br>$P_{Total} = P_A + P_B$ = 240 + 240 = **480 mm of Hg** (B)<br>$\Delta H_{mix}$ = 0 | 1 | |
| 18. | (i)<br><br>(ii) | Half life period is the time taken for half of a reaction to complete. **Or**, it is the time taken for the concentration of a reactant is reduced to half of its initial concentration.<br>For a first order reaction, the integrated rate law equation is $k = \frac{2.303}{t} \log\frac{[R]_0}{[R]}$ (1)<br>When t = $t_{1/2}$, $[R] = [R]_0/2$<br>Substitute these values in the above equation, we get k<br>$= \frac{2.303}{t_{1/2}} \log\frac{[R]_0}{[R]_0/2}$<br>Or, $t_{1/2} = \frac{2.303}{k} \log 2 = \frac{2.303 \times 0.3010}{k}$ Or, $\boldsymbol{t_{1/2} = \frac{0.693}{k}}$ | 1<br><br><br><br><br>2 | 3 |
| 19. | (i)<br><br><br><br>(ii) | In chemisorption, the force of attraction between adsorbent and adsorbate is chemical bond. It is irreversible, highly specific, very high heat of adsorption, only unimolecular layer of adsorption occurs, its rate increases with increase in temperature etc. (***Only 2 characteristics required***).<br>Due to the greater surface area of finely divided substances/as the surface area increases, extend of adsorption also increases. | 2<br><br><br><br>1 | 3 |
| 20. | (i)<br><br>(ii)<br><br>(iii) | In calcination, the ore is heated in the absence or limited supply of air but in roasting, the ore is heated in presence of excess of air.<br>Pig iron is the iron obtained from blast furnace. It contains about 4% C and smaller amounts of impurities. While wrought iron is the purest form of commercial iron. The metallic compounds present in the earth crust are called **minerals**. A mineral from which a metal can be extracted conveniently and profitably is called **ore**. | 1<br><br>1<br><br>1 | 3 |

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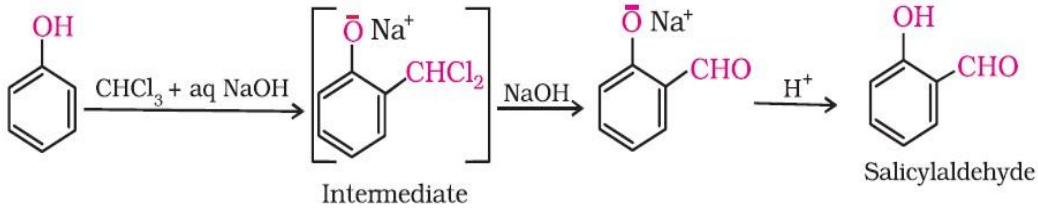
| 21. | (i)<br>(ii) | Chromite ore/ $FeCr_2O_4$<br>First sodium chromate is acidified with sulphuric acid to produce sodium dichromate.<br>$2Na_2CrO_4 + 2\ H^+ \rightarrow Na_2Cr_2O_7 + 2\ Na^+ + H_2O$<br>Then the solution of sodium dichromate is treated with potassium chloride so that orange crystals of potassium dichromate crystallise out. $Na_2Cr_2O_7 + 2\ KCl \rightarrow K_2Cr_2O_7 + 2\ NaCl$<br>**[Either explanation or equation is required] (1 Score for each step)** | 1<br>2 | 3 |
| 22. | (i)<br><br><br>(ii) | A) Due to lanthanoid contraction/lanthanide contraction.<br>B) This is due to their large surface area and their ability to show variable oxidation state.<br>The electronic configuration of $M^{2+}$ (Z = 27) is $[Ar]3d^7$<br>So the no. of unpaired electrons = 3<br>Spin only magnetic moment, $\mu_s = \sqrt{n(n+2)} = \sqrt{3(3+2)} = \sqrt{15} = 3.87$ BM | 1<br>1<br>1 | 3 |
| 23. | (i) | **Reimer-Tiemann Reaction:** Phenol when treated with chloroform in the presence of NaOH, followed by acidification, we get salicylaldehyde (o-hydroxybenzaldehyde).<br>*Or, the equation:* | 1½ | 3 |
| | (ii) |  <br><br>Intermediate Salicylaldehyde<br>**Williamson's synthesis:** Alkyl halide reacts with sodium alkoxide to form ether. This reaction is called Williamson's ether synthesis.<br>R-X + R'-ONa → R-O-R' + NaX Or, any correct example | 1½ | |
| 24. | (i)<br><br><br><br><br>(ii) | A. Propene reacts with water in the presence of acid as catalyst to form propan-2-ol. Or the equation:<br>$CH_3\text{-}CH{=}CH_2 + H_2O \xrightarrow{H^+} CH_3\text{-}CH(OH)\text{-}CH_3$<br>B. Ethanal when reduced using lithium aluminium hydride ($LiAlH_4$) or sodium borohydride ($NaBH_4$) or on catalytic hydrogenation, we get ethanol.<br>$CH_3\text{-}CHO + [H] \xrightarrow{LiAlH_4} CH_3\text{-}CH_2OH$ Zymase | 1<br><br>1<br><br>1 | 3 |
| 25. | (i)<br>(ii) | (A) Tollens' test<br>$CH_3\text{-}CHO$<br>$C_6H_5\text{-}CHO$ (Benzaldehyde) is less reactive because of the less electrophilicity of the carbonyl carbon due to resonance. **Or**, the polarity of the carbonyl carbon in $C_6H_5\text{-}CHO$ is less/due to the presence of bulky phenyl group (steric hindrance). | 1<br>1<br>1 | 3 |

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| 26. | (i)<br><br><br>(ii) | Methanol and potassium formate<br>**Or,** the equation: 2 HCHO Conc. KOH $CH_3$-OH + H-COOK This reaction is known as **Cannizzaro reaction.**<br>3-hydroxybutanal (β-hydroxybutyraldehyde) and but-2-enal (crotanaldehyde) **Or**, the equation:<br>$2CH_3$-CHO dil. NaOH $CH_3$-CH(OH)-$CH_2$-CHO Δ $CH_3$-CH=CH-CHO<br>Ethanal 3-Hydroxybutanal But-2-enal<br>This reaction is known as **Aldol reaction (Aldol condensation reaction).** | 1½<br><br>1½ | 3 |
| 27. | (i)<br><br>(ii)<br><br>(iii) | Monosaccharides: Ribose, Fructose<br>Disaccharides: Maltose, Sucrose<br>Starch is the storage polysaccharide of plants while glycogen is the storage polysaccharide of animals. Insulin and glucagon | 1<br><br>1<br><br>1 | 3 |
| 28. | (i)<br><br>(ii)<br><br>(iii) | Vinyl chloride/Chloroethene/$CH_2$=CHCl. PVC is used for making pipes, rain coats, hand bags, vinyl flooring etc. ***[Any one use is required]***<br>Tetrafluoroethene ($CF_2$=$CF_2$). Teflon is used for making oil seals, gaskets and non-sticky cooking pans. ***[Any one use is required]***<br>Adipic acid and hexamethylene diamine. Nylon 6,6 is used for making sheets, bristles for brushes and in textile industry. ***[Any one use is required]*** | 1<br><br>1<br><br>1 | 3 |
| 29. | (i)<br><br><br>(ii) | A. BHT (Butylated hydroxytoluene) is used as an antioxidant in food.<br>B. Saccharin is used as an artificial sweetener in food.<br>Antidepressant drugs/Tranquilizers.<br>E.g. Iproniazid, phenelzine, chlordiazepoxide, meprobamate, equanil etc. ***[Any one example is required]*** | 1<br><br><br>2 | 3 |

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| | | ***Questions 30 to 40 carry 4 scores each.*** | | |
| 30. | (i)<br><br><br><br><br>(ii) | A. **Schottky defect:** It is the stoichiometric defect arising due to the missing of equal no. of anions and cations from the lattice site.<br>B. **Frenkel defect:** It is the stoichiometric defect arising due to the shifting of a cation from the lattice site to the interstitial site.<br>C. **f-centres:** These are the electrons occupied at the anion vacancies or lattice sites.<br>(C) AgBr | 1<br><br>1<br><br>1<br>1 | 4 |
| 31. | (i)<br><br>(ii) | Colligative properties are the properties which depend only on the number of solute particles and not on their nature. Molarmass ($M_2$) = $\frac{w_2RT}{\pi V}$<br>Here $w_2$ = 1.26 g, V = 400 $cm^3$ = 0.4 L, T = 300 K, π = 2.57 x $10^{-4}$ atm and R = 0.0821 Latm $K^{-1}mol^{-1}$.<br>So, $M_2 = \frac{1.26 \times 0.0821 \times 300}{2.57 \times 10^{-4} \times 0.4}$ = **30.19 x $10^4$ atm** | 2<br><br>2 | 4 |

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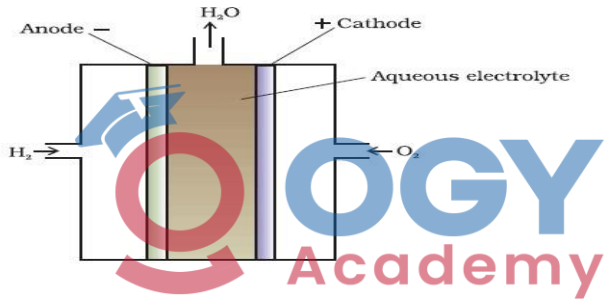
| 32. | (i) | In $H_2 - O_2$ fuel cells, hydrogen and oxygen gases are bubbled through porous carbon electrodes into concentrated aqueous sodium hydroxide solution. Catalysts like finely divided platinum or palladium metal are filled in the electrodes. *Or, the Diagram:*<br>  <br><br>The electrode reactions are: | 3 | |
| | (ii) | $O_2(g) + 2H_2O(l) + 4e^- \rightarrow 4OH^-(aq)$<br>$2H_2(g) + 4OH^-(aq) \rightarrow 4H_2O(l) + 4e^-$<br>Overall reaction is: $2H_2(g) + O_2(g) \longrightarrow 2H_2O(l)$<br>Cathode:<br>Anode: | 2 | 4 |
| | | The methods to prevent corrosion of metals are:<br>a) By giving a non-metallic coating on the metal surface with paint, varnish etc.<br>b) By coating the metal surface with electropositive metal like zinc, magnesium etc.<br>c) By coating with anti-rust solution.<br>d) By connecting the metal with a sacrificial electrode of another metal (like Mg, Zn, etc.) which corrodes itself but saves the iron object (sacrificial protection). ***[Any 2 methods required]*** | | |
| 33. | (i) | The Arrhenius equation is $k = A.e^{-Ea/RT}$ | 1 | |
| | (ii) | Or, $\log k = \log A - Ea/2.303RT$<br>We know that, $\log k_2/k_1 = \frac{Ea}{2.303\ R}\left[\frac{T_2 - T_1}{T_1.T_2}\right]$<br>Here $T_1 = 298$ K, $T_2 = 308$ K, and $R = 8.314$ J $K^{-1}$ $mol^{-1}$<br>Suppose $k_1 = x$, then $k_2 = 2x$<br>Then,<br>$\log \frac{2x}{x} = \frac{Ea}{2.303 \times 8.314}\left[\frac{308 - 298}{298 \times 308}\right]$<br>$Ea = \frac{0.3010 \times 2.303 \times 8.314 \times 298 \times 308}{10} =$ **52897.78 J $mol^{-1}$** | 2 | 4 |

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| | (iii) | **Order**: It is the sum of the powers of the concentration terms in the rate law expression<br>**Molecularity**: It is the total number of reactant species collide simultaneously in a chemical reaction | 1 | |

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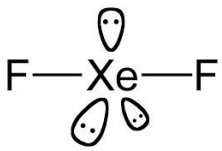
| | | It is an experimental quantity | It is a theoretical quantity | |
| | | It can be zero or fractional | It cannot be zero or fractional | |
| | | ***(Any 2 required)*** | | |
| 34. | (i) | *In lyophilic sols, the force of attraction between dispersed phase and dispersion medium is strong. E.g. Starch solution,* gum, gelatin, starch, rubber etc in suitable dispersion medium.<br>*But in lyophobic sols, the force of attraction between dispersed phase and dispersion medium is weak.* e.g. Arsenic sulphide ($As_2S_3$) sol, sulpher sol and metal sols like gold sol, silver sol etc. | 2 | 4 |
| | (ii) | Emulsions are of two types:<br>I) Oil in water (O/W) type and<br>II) Water in oil (W/O) type<br>In oil in water type emulsion, oil is the dispersed phase and water is the dispersion medium.<br>E.g. milk.<br>In water in oil type emulsion, water is the dispersed phase and oil is the dispersion medium.<br>E.g. butter and cream | 2 | |
| 35. | (i) | **Leaching of alumina from Bauxite:** Here the powdered ore is treated with a concentrated solution of NaOH at 473 – 523 K and 35 – 36 bar pressure. Alumina ($Al_2O_3$) dissolves in NaOH to form sodium aluminate [$2Na[Al(OH)_4]$] leaving behind the impurities.<br>$Al_2O_3$ (s) + 2NaOH(aq) + $3H_2O$(l) → $2Na^*Al(OH)_4$](aq)<br>The aluminate in solution is neutralised by passing $CO_2$ gas and hydrated $Al_2O_3$ is precipitated. The solution is seeded with freshly prepared hydrated $Al_2O_3$ which induces the precipitation.<br>$2Na[Al(OH)_4](aq) + CO_2(g) \rightarrow Al_2O_3.xH_2O(s) + 2NaHCO_3$ (aq)<br>The hydrated alumina is filtered, dried and heated to give back pure alumina ($Al_2O_3$).<br>$Al_2O_3.xH_2O(s) \xrightarrow{1470\ K} Al_2O_3$ (s) + $xH_2O$(g) | 3 | 4 |
| | (ii) | *[Either explanation or equation is required]*<br>Cryolite is added to lower the melting point of alumina and to increase the conductivity. | 1 | |
| 36. | (i) | Excess amount of Xe reacts with $F_2$ at about 673 K and 1 bar pressure to produce $XeF_2$.<br>Or, The equation: Xe (g) + $F_2$ (g) $\xrightarrow{673K,\ 1\ bar}$ $XeF_2$(s)<br>(xenon in excess) Its structure is linear as follows:<br>  <br> | 1<br>1 | 4 |
| | (ii) | (D) $NeF_2$ | 1 | |
| | (iii) | This is because the bond length in ICl is greater than that in $I_2$ /the bond length in inter halogen compounds are greater than that in halogens. | 1 | |

37. (i) The different types of structural isomerism shown by co-ordination compounds are: — 2

1. Ionisation isomerism
2. Linkage isomerism
3. Solvate or hydrate isomerism
4. Co-ordination isomerism

(ii) This is because $[Fe(H_2O)_6]^{3+}$ is an outer orbital complex while $[Fe(CN)_6]^{3-}$ is an inner orbital complex/ $H_2O$ is a weak field ligand and hence electron pairing does not occur while $CN^-$ is a strong field ligand and hence electron pairing occurs/ due to greater number of unpaired electrons in $[Fe(H_2O)_6]^{3+}$ than that in $[Fe(CN)_6]^{3-}$. — 2 — 4

38. (i)

| **$S_N1$ Reaction** | **$S_N2$ Reaction** |
|---|---|
| Proceeds in 2 steps | Proceeds in a single step |
| An intermediate (carbocation) is formed | No intermediate is formed |
| Order of the reaction is 1 | Order is 2 |
| For optically active compounds, the reaction proceeds through retention of configuration. | For optically active compounds, the reaction proceeds through inversion of configuration. |

— 2

The order of reactivity of alkyl halide is $3^0 > 2^0 > 1^0$

The order of reactivity of alkyl halide is $1^0 > 2^0 > 3^0$

— 4

(ii) ***[Any 2 differences are required]*** — 1

(iii) 2-chloropropane < 1-chloropropane < 1-chlorobutane — 1

Chloroform is used as a solvent, for the production of freon refrigerant, as an anaesthetic. [Any 1 use is required]

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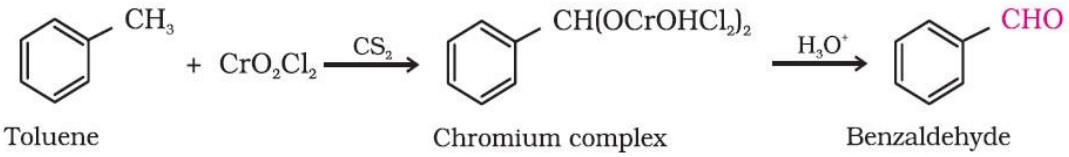
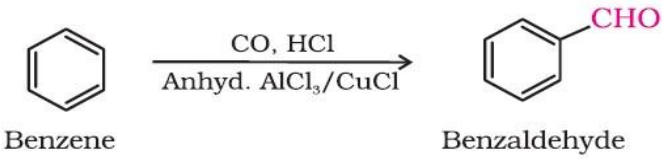
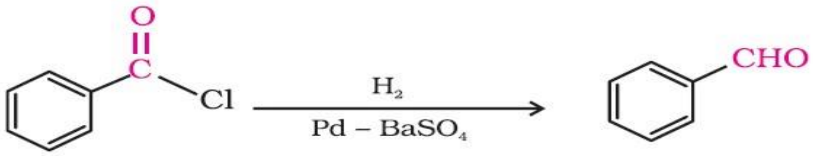
| 39. | (i) | A. Toluene when oxidised by using chromyl chloride ($CrO_2Cl_2$) in $CS_2$ followed by acidification, we get benzaldehyde. The reaction is known as Etards reaction.<br>***Or the equation:***<br>  <br><br>Toluene Chromium complex Benzaldehyde<br>B.<br>When benzene is treated with carbon monoxide and hydrogen chloride in the presence of anhydrous aluminium chloride or cuprous chloride, we get benzaldehyde.<br>This reaction is known as Gatterman-Koch reaction. ***Or the equation:***<br>  <br><br>Benzene Benzaldehyde<br>C. Benzoyl chloride react with hydrogen in presence of Pd supported on $BaSO_4$, we get aldehydes. This reaction is called Rosenmund's reduction. ***Or the equation:*** | 1<br>1<br>1 | 4 |
| | (ii) |  <br><br>Ethanoic anhydride or acetic anhydride or $(CH_3\text{-}CO)_2O$ | 1<br>1 | |

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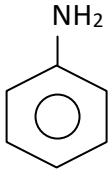
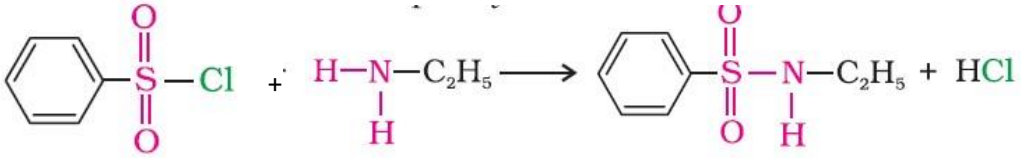
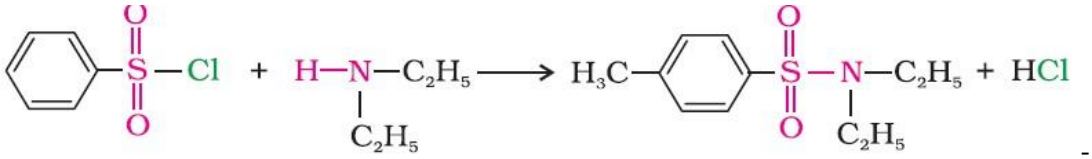
| 40. | (i) | (B)  | 1 | |
| | (ii) | The three types of amines are distinguished by Hinsberg test. Hinsberg's reagent is Benzenesulphonyl chloride ($C_6H_5SO_2Cl$).<br>a) Primary amines react with benzenesulphonyl chloride (Hinsberg's reagent) to  form a precipitate which is soluble in alkali.<br>Benzene sulphonylchloride ethanamine N-ethylbenzenesulphonamide<br>b) Secondary amines react with benzene sulphonyl chloride (Hinsberg's reagent) to give a precipitate, which is insoluble in alkali.<br>Benzene sulphonylchloride N  <br>ethylethanamine N,N-diethylbenzenesulphonamide<br>c) Tertiary amines do not react with benzenesulphonyl chloride (Hinsberg's reagent).<br>%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%% | 3 | 4 |