

MARKING SCHEME  
PRACTICE PAPER - 02

1. (i) (b) A large number of atoms or molecules of a substance aggregate together to form species having size in the colloidal range. These species are called macromolecular colloids. (1)
- (ii) (a) Gold sols and sulphur sols are the examples of multimolecular colloids. (1)
- (iii) (b) Macromolecular colloids are quite stable and resemble to the true solutions in many respects. (1)

Or

- (c) The formation of micelles takes place above the particular range of temperature termed as CMC (Critical Micelle Concentration). (1)
- (iv) (b) Soaps and synthetic detergents belong to the class of associated colloids. (1)
2. (i) (d) Assertion incorrect but Reason is correct. Osmosis is a net movement of solvent particles from lower concentration (dilute to concentrated) to higher and from higher to lower i.e. is a bilateral process not unilateral. (1)
- (ii) (d) Assertion is incorrect while Reason is correct. For isotonic solutions, osmotic pressures are equal, but their concentrations are same only when solutes neither dissociate nor-associate. (1)

(iii) (d) Assertion is incorrect but Reason is correct.  $\text{Cu}_2[\text{Fe}(\text{CN})_6]$  is soluble in non-aqueous solutions. (1)

(iv) (c) Assertion is correct but Reason is incorrect. As water will start entering into cell and the concentration of salt content will decrease. (1)

Or

(c) Assertion is correct and Reason is incorrect. The correct reason will be polymer solutions possess very little elevation in boiling point or freezing point depression. (1)

3. (b) The IUPAC nomenclature of sodium nitroprusside is sodium pentacyanonitrosyl ferrate (III) having molecular formula  $\text{Na}_2[\text{Fe}(\text{CN})_5\text{NO}]$ . (1)

4. (d) Cell constant is defined as the ratio of distance between the electrodes and their area of cross-section.

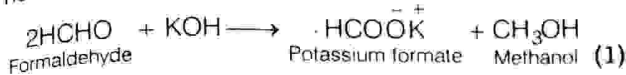
$$G = \frac{l}{A}$$

Since,  $l$  and  $A$  remain constant for any particular cell, hence value of cell constant always remains constant for a cell. (1)

5. (c) Out of the given options only metallic solids are malleable, i.e. can be beaten into sheets. (1)

Or (c) Due to presence of  $e^-$  in anionic vacancies F-centres are produced, which are responsible for colour. (1)

6. (b) When a solution of formaldehyde and KOH is heated, it will give methanol and potassium formate.



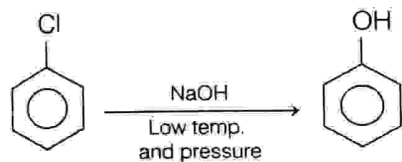
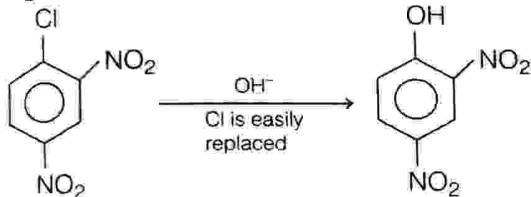
7. (d) Tyrosine is the amino acid which has phenolic  $-\text{OH}$  group as its backbone. (1)

8. (b) Peptisation is the process for converting a precipitate into colloidal solution. (1)

Or (c) The effectiveness in coagulation  $\propto$  charge. So more the charge more will be the coagulation. Here,  $\text{Al}^{3+}$  is having maximum charge and hence answer. (1)

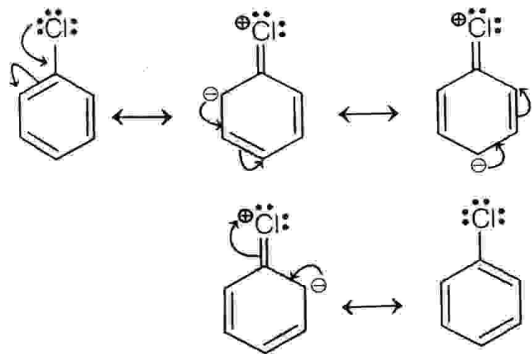
9. (c)  $\text{CO}_2$  has the lowest value of Henry's law constant. (1)

10. (d) Replacement of Cl from chlorobenzene to give phenol requires drastic conditions but chlorine of 2,4-dinitrochlorobenzene is readily replaced because  $\text{NO}_2$  withdraws electron from *ortho* and *para* position.



(1)

Or (a) In chlorobenzene, the lone pairs present on Cl atom get involved in resonance with  $\pi e^-$  of benzene due to which C — Cl bond acquires double bond character and hence reactivity decreases.



(1)

11. (b) Morphine belongs to category of organic compounds of basic nature of plant origin containing at least one nitrogen atom in a ring type structure, acts as analgesics. (1)

Or

(c) Cetyl trimethyl ammonium bromide is a cationic detergent used in hair conditioners due to its germicidal properties (1)

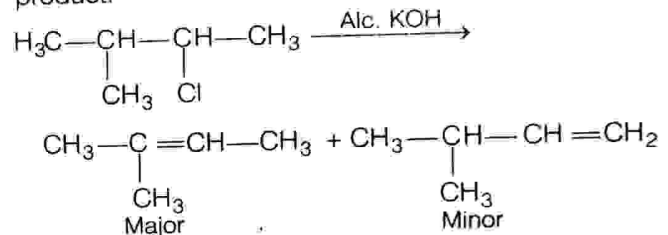
12. (a) Reducing sugars contain a free aldehydic or ketonic group adjacent to a  $>\text{CHOH}$  group and reduce Tollen's reagent, Schiff's reagent or Benedict's solution.

Thus, both Assertion and Reason are correct and Reason is the correct explanation of Assertion. (1)

13. (c) HCN is a weak acid and have low degree of dissociation but in presence of a base (even  $\text{H}_2\text{O}$ ), the dissociation increases appreciably to provide appreciable  $\text{CN}^-$  to attack  $>\text{C}=\text{O}$  bond.

Thus, Assertion is correct but Reason is incorrect. (1)

14. (a) 2-chloro-3-methylbutane on treatment with alcoholic potash gives 2-methyl but-2-ene as major product.



Elimination occurs according to Saytzeff rule, the major product is one which involves elimination of H from less hydrogenated carbon.

Thus, both Assertion and Reason are correct and Reason is the correct explanation of Assertion. (1)

15. (c)  $\text{Cl}_2$  is an oxidising agent. It bleaches the articles by oxidating permanently in presence of moisture. Thus, Assertion is correct but Reason is incorrect. (1)

16. (c) The molecularity is two because two molecules of  $\text{H}_2$  and  $\text{Be}_2$  are involved in the reaction and order is  $3/2$ .

Thus, Assertion is correct but Reason is incorrect. (1)

Or

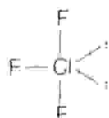
(d) Assertion is incorrect but Reason is correct. Rate of reaction is same in terms of different reactants and products. (1)

17. The correct increasing order of dipole moment is as follows:

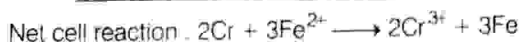


Electronegativity of C, O, N increases in order as  $\text{C} < \text{N} < \text{O}$ . Thus, dipole moment will also increase in same order. (2)

18. In  $\text{ClF}_3$ , central atom Cl has three bond pairs and two lone pairs. According to VSEPR theory, the two lone pairs will occupy the equatorial positions to minimise  $lp-lp$  and  $bp-bp$  repulsions. In addition the axial fluorine atoms will be bent towards the equatorial fluorine in order to minimise the  $lp-lp$  repulsions. Thus, it has T-shaped structure (1)



19. At anode  $[\text{Cr} \rightarrow \text{Cr}^{3+} + 3e^-] \times 2$   
At cathode  $[\text{Fe}^{2+} + 2e^- \rightarrow \text{Fe}] \times 3$



Number of electrons used,  $n = 6$  (1)

Nernst equation for this cell is,

$$E_{\text{cell}} = E_{\text{cell}}^{\circ} - \frac{0.0591}{n} \log \frac{[\text{Cr}^{3+}]^2}{[\text{Fe}^{2+}]^3}$$

$$= (E_{\text{cathode}}^{\circ} - E_{\text{anode}}^{\circ}) - \frac{0.0591}{6} \log \frac{(0.1)^2}{(0.01)^3}$$

$$= [-0.44 - (-0.74)] - \frac{0.0591}{6} \log \frac{10^{-2}}{10^{-6}}$$

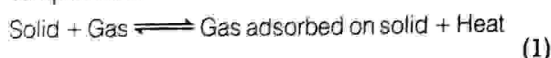
$$= 0.30 - \frac{0.0591}{6} \log 10^4 = 0.30 - 0.039 = 0.261 \text{ V} \quad (1)$$

20. In all the given complexes, the metal ion is  $\text{Ni}^{2+}$ . The increasing field strengths of the ligands present as per spectrochemical series  $[\text{Ni}(\text{H}_2\text{O})_6]^{2+} < [\text{Ni}(\text{NH}_3)_6]^{2+} < [\text{Ni}(\text{NO}_2)_6]^{4-}$ . But  $E = hc/\lambda$ , so, order of wavelength is  $[\text{Ni}(\text{H}_2\text{O})_6]^{2+} > [\text{Ni}(\text{NH}_3)_6]^{2+} > [\text{Ni}(\text{NO}_2)_6]^{4-}$  (2)

Or

Formation of white precipitate with  $\text{AgNO}_3$  shows that atleast one  $\text{Cl}^-$  ion is present outside the coordination sphere. Moreover, only two ions are obtained in solution, so only one  $\text{Cl}^-$  is present outside the sphere. Thus, the formula of the complex is  $[\text{Co}(\text{H}_2\text{O})_4\text{Cl}_2]\text{Cl}$ . Its IUPAC name is tetraaquadichloridocobalt (III) chloride. (2)

21. (i) Since, adsorption is exothermic and according to Le-Chatelier's principle, low temperature is favourable for physical adsorption. Hence, physisorption decreases with increase in temperature.



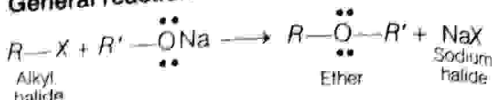
- (ii) In ester hydrolysis, an acid and an alcohol are formed as products.



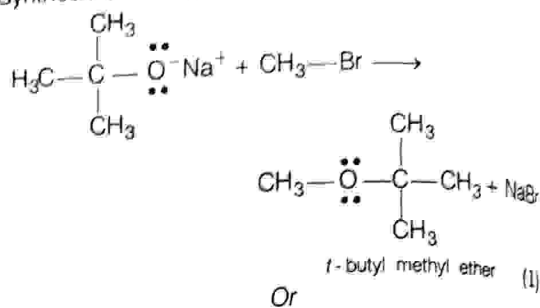
Acid will release  $\text{H}^+$  ions in solution which act as catalyst (auto-catalysis) for the reaction. Therefore, the hydrolysis is slow in the beginning and becomes faster later on. (1)

22. **Williamson's ether synthesis** The reaction of alkyl halides with sodium alkoxide or sodium phenoxide to form ether is called Williamson's synthesis. (1)

**General reaction**



Synthesis of tertiary butyl methyl ether

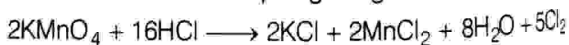


The reaction of alcohols with Lucas reagent (conc.  $\text{HCl}$  and  $\text{ZnCl}_2$ ) follows  $\text{S}_{\text{N}}1$  mechanism.  $\text{S}_{\text{N}}1$  mechanism depends upon the stability of carbocations (intermediate). More stable the intermediate carbocation, more reactive is the alcohol. Tertiary carbocation is most stable among the three classes of carbocations and the order of the stability of carbocation is  $3^\circ > 2^\circ > 1^\circ$ . This order, in turn, reflects the order of reactivity of three classes of alcohols, i.e.  $3^\circ > 2^\circ > 1^\circ$ . Thus, as the stability of carbocations are different, so the reactivity of all three classes of alcohols with Lucas reagent is different. (2)

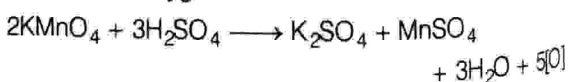
23. The solution turns dark blue in colour. It is because of the formation of a complex compound,  $[\text{Cu}(\text{NH}_3)_4]\text{SO}_4$ . Complete reaction is as follows :  
 $\text{CuSO}_4 + 4\text{NH}_4\text{OH} \rightarrow [\text{Cu}(\text{NH}_3)_4]\text{SO}_4 + 4\text{H}_2\text{O}$  (2)

Or

When  $\text{KMnO}_4$  is being used as an oxidising agent  $\text{H}^+$  are required and that is why the oxidising reaction takes place in acidic medium. For providing acidic medium,  $\text{H}_2\text{SO}_4$  is used but  $\text{HCl}$  is not. It is because, if we use  $\text{HCl}$  will end up in getting  $\text{KCl}$  and  $\text{Cl}_2$  :



While with  $\text{H}_2\text{SO}_4$  following reaction takes place with liberation of oxygen :



24. (i) Given,  $\Lambda_{\text{HCl}}^{\circ} = 425.1 \Omega^{-1} \text{ cm}^2 \text{ mol}^{-1}$

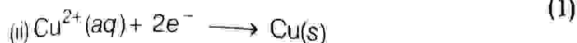
$$\Lambda_{\text{KCl}}^{\circ} = 121.3 \Omega^{-1} \text{ cm}^2 \text{ mol}^{-1}$$

$$\Lambda_{\text{CH}_3\text{COOK}}^{\circ} = 94.0 \Omega^{-1} \text{ cm}^2 \text{ mol}^{-1}$$



The value of  $\Lambda^\circ$  for acetic acid is

$$\begin{aligned}\Lambda^\circ_{\text{CH}_3\text{COOH}} &= \Lambda^\circ_{\text{CH}_3\text{COO}^-} + \Lambda^\circ_{\text{H}^+} - \Lambda^\circ_{\text{KCl}} \\ &= 94 + 425.1 - 121.3 \\ &= 397.8 \Omega^{-1} \text{cm}^2 \text{mol}^{-1} \\ &= 397.8 \text{ S cm}^2 \text{mol}^{-1}\end{aligned}$$



Charge required to reduce one mole of  $\text{Cu}^{2+}$ .  
 $= 2F = 2 \times 96500 \text{ C} = 193000 \text{ C}$  (1)

25.

**Molality ( $m$ )**

Weight of KI in 100 g of water = 20 g

Weight of water in the solution

$$= 100 - 20 \text{ g} = 80 \text{ g} = 0.08 \text{ kg}$$

Molar mass of KI = 39 + 127 = 166 g mol<sup>-1</sup>

Molality of the solution ( $m$ )

$$= \frac{\text{No. of moles of KI}}{\text{Mass of water (in kg)}} = \frac{(20 \text{ g}) / (166 \text{ g mol}^{-1})}{(0.080 \text{ kg})}$$

$$= 1.506 \text{ mol kg}^{-1} = 1.506 \text{ m}$$
 (1)

**Molarity ( $M$ )**

Weight of the solution = 100 g

Density of the solution = 1.202 g mL<sup>-1</sup>

$$\text{Volume of the solution} = \frac{\text{Weight of solution}}{\text{Density}}$$

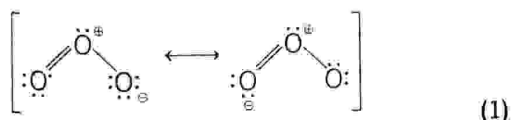
$$= \frac{(100 \text{ g})}{(1.202 \text{ g mL}^{-1})} = 88.19 \text{ mL} = 0.088 \text{ L}$$

$$\begin{aligned}\text{Molarity of solution} &= \frac{\text{No. of gram moles of KI}}{\text{Volume of solution in (L)}} \\ &= \frac{(20 \text{ g}) / 0.66 \text{ g mol}^{-1}}{(0.088 \text{ L})} \\ &= 1.45 \text{ mol L}^{-1} = 1.45 \text{ M}\end{aligned}$$
 (1)

26. (i) In fluorine, due to absence of  $d$ -orbitals, it shows only +1 oxidation state and forms only one oxoacid, HOF. It does not exhibit +3, +5 or +7.

Hence, fluorine does not form higher oxoacids, like HOFO, HOFO<sub>2</sub>, HOFO<sub>3</sub>, etc. (1)

(ii) The two O—O bond lengths in ozone molecule are equal, because of the resonance.



(iii) In SF<sub>6</sub>, the six F atoms sterically protect the sulphur atom from attack by water due to steric hinderance. Further, F does not have orbitals to accept the electrons donated by H<sub>2</sub>O molecule. As a result, SF<sub>6</sub> does not undergo hydrolysis. (1)

27. (i) (a) Hexaammine cobalt (III) chloride. (1/2)  
 (b) Diammine chloro (methylamine) platinum (II) chloride. (1/2)

(ii) (a) Na[Co(NO<sub>2</sub>)<sub>6</sub>] (1/2)

(b) [CrCl<sub>2</sub>(H<sub>2</sub>O)<sub>4</sub>] Cl (1/2)

(iii) Oxidation state of Cu in [Cu(NH<sub>3</sub>)<sub>4</sub>] SO<sub>4</sub> is calculated as,

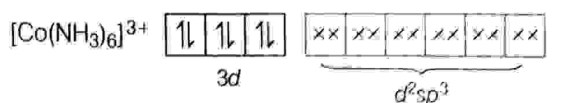
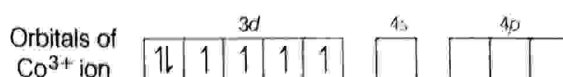
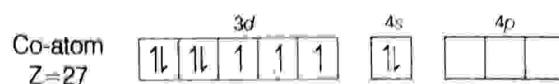
Let oxidation state of Cu =  $x$

$$x + (0 \times 4) \times -2 = 0$$

$$x = +2$$

Or

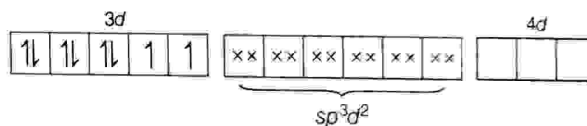
In [Co(NH<sub>3</sub>)<sub>6</sub>]<sup>3+</sup>, cobalt is in +3 oxidation state having electronic configuration [Ar] 3d<sup>6</sup>.



(1 1/2)

Complex has octahedral ( $d^2sp^3$ ) geometry and is diamagnetic and forms inner orbital complex.

In [Ni(NH<sub>3</sub>)<sub>6</sub>]<sup>2+</sup>,



Since,  $(n-1)d$  orbitals are not available so, the  $nd$ -orbitals are used in bond formation and form outer orbital complex. (1 1/2)

28. Given, molar mass of the given element

$$M = 27 \text{ g mol}^{-1}$$

Edge length ( $a$ ) =  $4.05 \times 10^{-8} \text{ cm}$

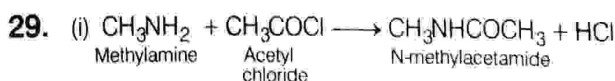
Density,  $d = 2.7 \text{ g cm}^{-3}$

Apply the relation,  $d = \frac{Z \times M}{a^3 \times N_A}$

So,  $Z = \frac{d \times a^3 \times N_A}{M}$

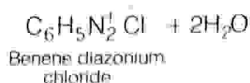
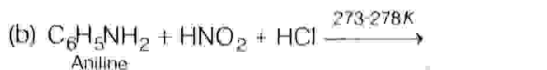
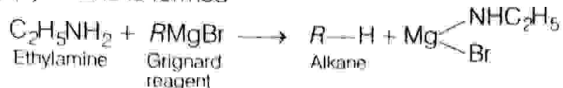
$$\begin{aligned} &= \frac{2.7 \text{ g cm}^{-3} \times (4.05 \times 10^{-8} \text{ cm})^3}{27 \text{ g mol}^{-1}} \times 6.022 \times 10^{23} \text{ mol}^{-1} = 4 \end{aligned}$$

Since, the number of atoms in the unit cell is four, the given cubic cell has a face-centred cubic (fcc) or cubic closed packed (ccp) structure. (3)

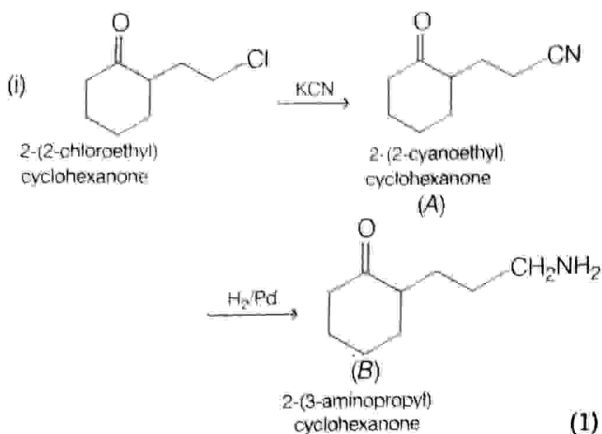


(1)

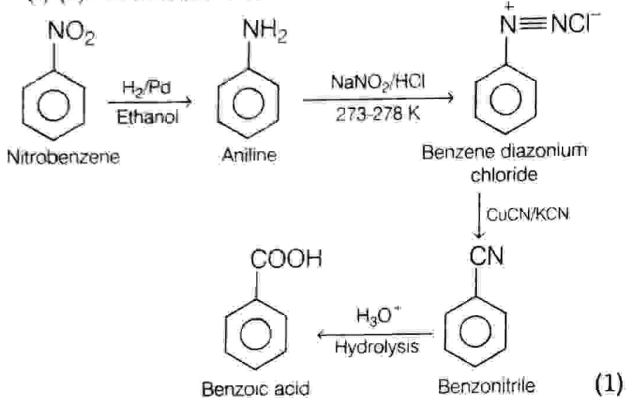
(ii) (a) Alkane is formed



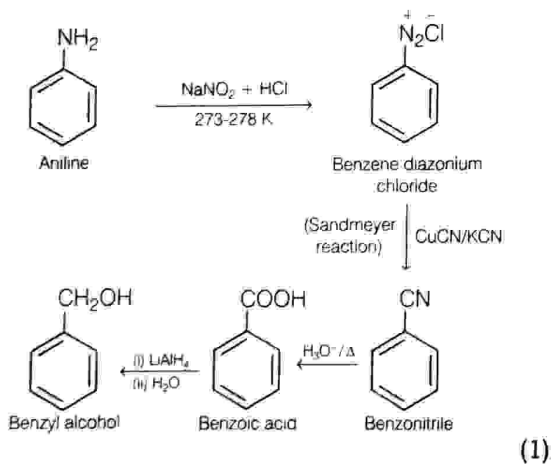
Or



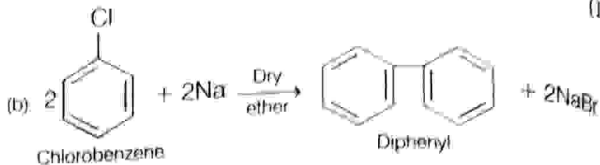
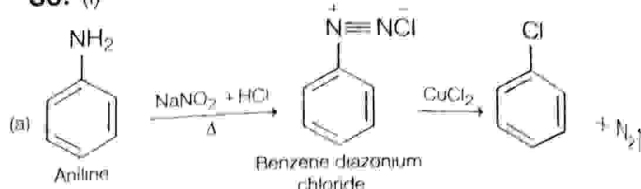
(ii) (a) Nitrobenzene to benzoic acid



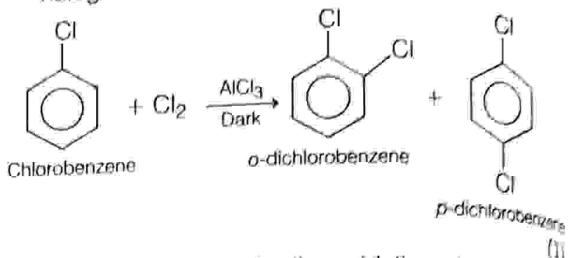
(b) Aniline to benzyl alcohol



30. (i)



(ii) Halogenation of chlorobenzene in presence of halogen carrier occurs as follows :



31. (i) In transition elements, the oxidation states vary by unity (due to incomplete filling of *d*-orbitals), e.g. Mn exhibits + 2, + 3, + 4, + 5, + 6 and + 7 all differing by 1.

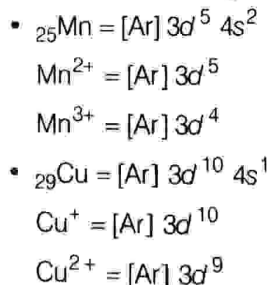
In non-transition elements, this variation is selective, always differing by 2. e.g. S exhibits + 3, + 4, + 6 oxidation states and N exhibits + 3.

(ii) (a) Separation of Zr and Hf are quite difficult because of lanthanoid contraction. Due to lanthanoid contraction.

They have almost same size and, thus similar chemical properties. That's why, it is very difficult to separate them by chemical methods.

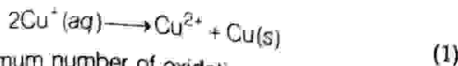
(b) The electronic configuration of Fe<sup>2+</sup> and Fe<sup>3+</sup> are 3d<sup>6</sup> and 3d<sup>5</sup> respectively. Here, the electronic configuration of Fe<sup>3+</sup> is more stable (3d-orbitals are all half-filled). Hence, Fe<sup>3+</sup> more stable than Fe<sup>2+</sup>.

Or (i) If orbital is half-filled or completely filled, it imparts to an atom or ion. e.g.



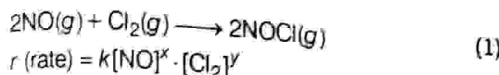
In manganese,  $Mn^{2+}$  ion is more stable due to symmetry and half filled  $d$ -orbitals. In the same way, in copper,  $Cu^+$  ion is more stable due to symmetry and completely filled  $d$ -orbitals.

(a)  $Cu^+$  ion is not stable in aqueous because it undergoes disproportionation to give more stable  $Cu^{2+}$  and  $Cu$ .



(b) Maximum number of oxidation states are shown by Mn because it has maximum number of unpaired electrons. It shows 6 oxidation states i.e. +2, +3, +4, +5, +6 and +7.

32. For the reaction,



(i) Comparing experiment number (1) and (2)

$$r_1 = k[0.15]^x \cdot [0.15]^y = 0.60 \quad \dots (i)$$

$$r_2 = k[0.15]^x [0.30]^y = 1.20 \quad \dots (ii)$$

On dividing Eq. (ii) by Eq. (i),

$$\frac{r_2}{r_1} = \frac{k[0.15]^x \cdot [0.30]^y}{k[0.15]^x \cdot [0.15]^y}$$

$$= \frac{1.20}{0.60}$$

$$\Rightarrow 2^y = 2^1$$

$$\therefore y = 1 \quad \text{[On comparing the powers]}$$

Comparing experiment number (1) and (3)

$$r_1 = k[0.15]^x \cdot [0.15]^y = 0.60 \quad \dots (i)$$

$$r_3 = k[0.30]^x \cdot [0.15]^y = 2.40 \quad \dots (iii)$$

On dividing Eq. (iii) by Eq. (i),

$$\frac{r_3}{r_1} = \frac{k[0.30]^x \cdot [0.15]^y}{k[0.15]^x \cdot [0.15]^y} = \frac{2.40}{0.60}$$

$$2^x = 2^2$$

$$\therefore x = 2 \quad \text{[On comparing the powers]}$$

$$\text{Hence, rate law, } r = k \cdot [NO]^2 \cdot [Cl_2]^1 \quad (2)$$

(ii) From rate law,

$$k = \frac{\text{Rate}}{[NO]^2 \cdot [Cl_2]}$$

$$= \frac{0.60}{(0.15)^2(0.15)}$$

$$k = 177.77 \text{ mol}^{-2} \text{ L}^2 \text{ min}^{-1} \quad (1)$$

(iii) Initial rate of disappearance of  $Cl_2$  in experiment number four.

$$r = k \cdot [0.25]^2 [0.25]$$

$$= 177.77(0.25)^2(0.25)$$

$$r = 2.78 \text{ mol/min} \quad (1)$$

Or

(i) Factors that affect the rate of a chemical reaction are

(a) **Nature of reactants** Ionic substances react more rapidly than covalent compounds because ions produced after dissociation are immediately available for reaction.

(b) **Concentration of reactants** Rate of a reaction increases, when concentration of reactants is increased.

(c) **Temperature** Generally, rate of a reaction increases on increasing the temperature due to increase in number of collisions.

(d) **Surface area of the reactants** Rate of a reaction increases with increase in surface area of the reactants. That is why, powdered form of reactants is preferred than their granular form.

(e) **Catalyst** Presence of catalyst also affects the rate of a reaction. It forms reaction intermediate and follow a different path with lower activation energy. So, rate of a reaction increases. (2)

(ii) For a reaction,  $A \longrightarrow \text{Products}$

$$\text{Rate} = k[A]^2 = ka^2$$

(a) When concentration of A is doubled.

$$\text{i.e. } [A] = 2a \Rightarrow R' = k(2a)^2 = 4ka^2$$

Rate of a reaction becomes 4 times.

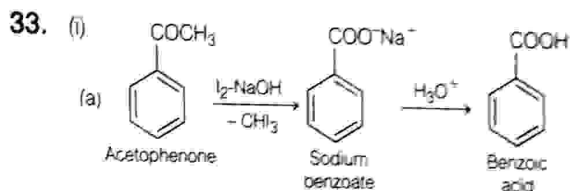
(b) When concentration of A is reduced to half.

$$\text{i.e. } [A] = \frac{1}{2}a \Rightarrow R'' = k\left(\frac{a}{2}\right)^2 = \frac{1}{4}ka^2$$

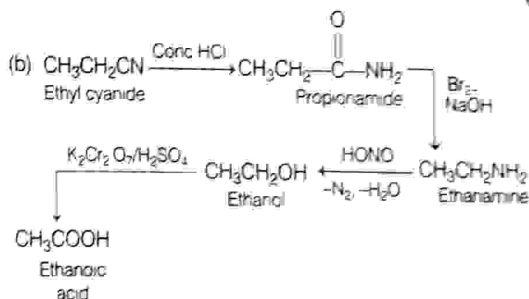
Rate of a reaction becomes 1/4 times.

i.e. reduced to one fourth. (2)

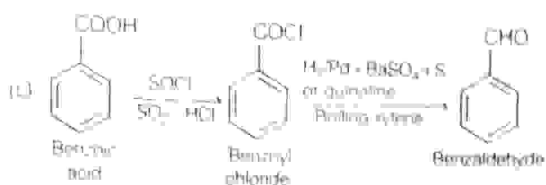
(iii) The rate constant of a reaction increases with increase in temperature and becomes nearly double for every  $10^\circ$  rise in temperature. (1)



(1)



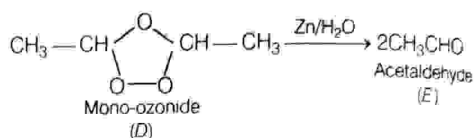
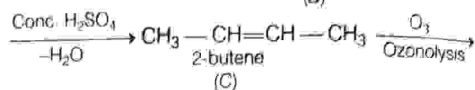
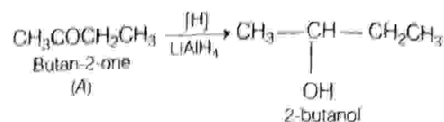
(1)



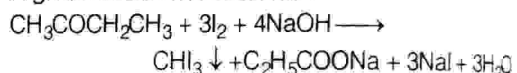
Or Since, A gives haloform test, it must contain - COCH<sub>3</sub> group. Thus, its possible formula is C<sub>7</sub>H<sub>5</sub>COCH<sub>3</sub>.

On reduction, it gives 2-butanol, i.e. compound B which on dehydration with sulphuric acid gives 2-butene (C). Ozonolysis of 2-butene gives only acetaldehyde (E).

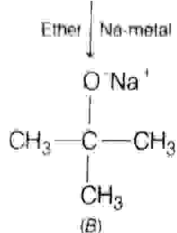
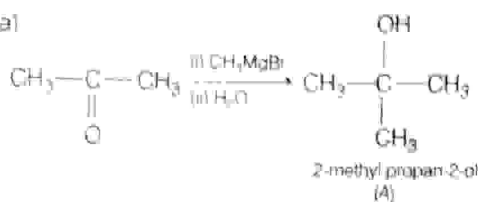
The equations involved are :



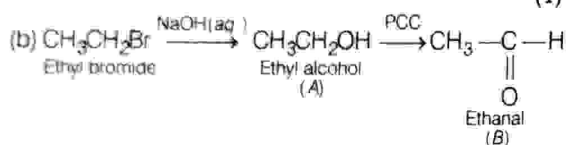
A gives iodoform reaction as :



(ii) (a)



(1)



(1)