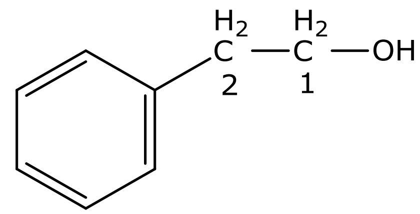
CBSE
Class XII Chemistry
Board Paper - 2016 (Solution)

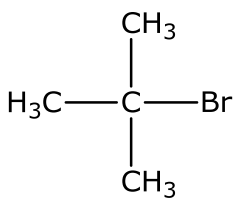
Time: 3 hrs. **Total Marks: 70**

1.



2-phenylethanol

2.



It is the most reactive towards the S_N1 reaction.

3. Reasons for the stability of colloidal sols:

a. Coagulation of the colloidal sol is prevented because of the presence of equal and similar charges on the colloidal particles.

b. Colloidal particles are covered by a sheath of liquid in which they are extensively solvated because of which they acquire stability.

4. Examples of molecular solids are solid ammonia (NH_3) and ice (H_2O).
Examples of ionic solids are NaCl and MgO.

5. $Pb(NO_3)_2$ undergoes a decomposition reaction on heating and produces nitrogen dioxide. It dimerises to give N_2O_4 gas.

$$2Pb(NO_3)_2 \rightarrow 2PbO + 4NO_2 + O_2$$

$$2NO_2 \rightarrow N_2O_4$$

6.

(i) The reaction is a zero order reaction, and the molecularity of this reaction is 2.

(ii) The unit of the rate constant k is mole L^{-1} sec^{-1}.

7.

(i) $H_3C-\overset{\overset{\displaystyle O}{\|}}{C}-NH_2 + Br_2 + 4NaOH \longrightarrow H_3C-NH_2 + Na_2CO_3 + 2NaBr + 2H_2O$

(ii) $CH_3-NH_2 + CHCl_3 + 3KOH \longrightarrow CH_3-NC + 3KCl + 3H_2O$

8.

(i) By Henry's law, solubility of a particular gas is inversely proportional to Henry's constant for that gas. So, gas (B) will show a higher K_H value as it is less soluble.

(ii) It shows negative deviation from Raoult's law.

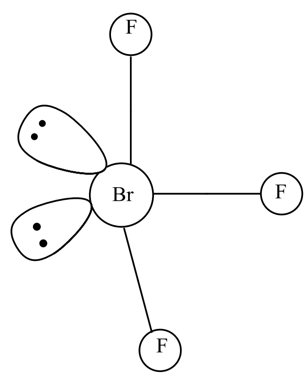
9.

(i) $[Co(NH_3)_6]Cl_3$

(ii) The IUPAC name of the complex is hexamminecobalt(III)chloride.

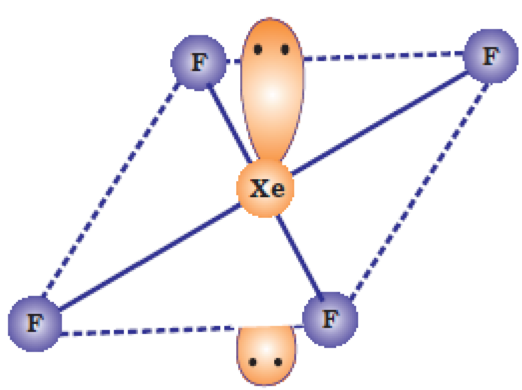
10.

(i) The structure of BrF_3 is bent T-shaped.



(ii) The structure of XeF_4 is square planar.

(iii)



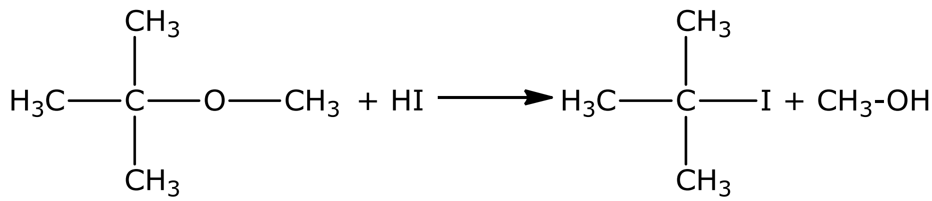
OR

(i) SO_2 is a reducing agent, and it reduces Fe^{3+} to Fe^{2+} and changes the solution from brown-red to green.

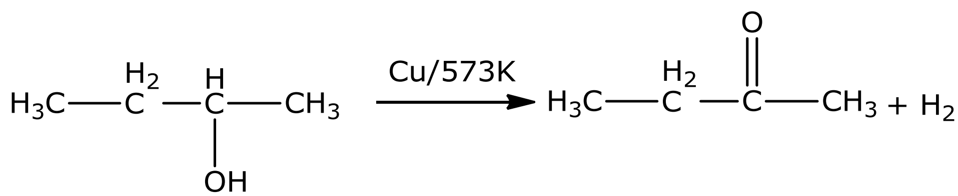
(ii) Xenon fluorides react with fluoride ion acceptors to form cationic species.
$XeF_4 + SbF_5 \rightarrow [XeF_3] + [SbF_6]^-$

11.

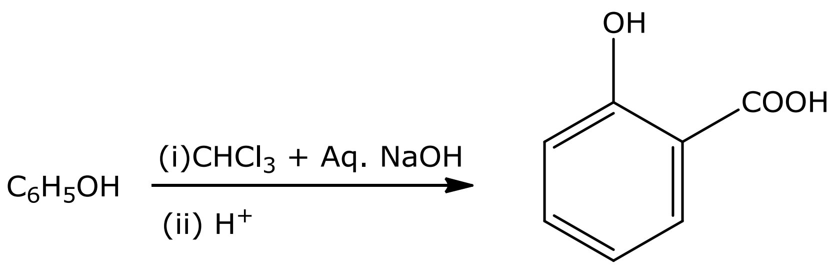
(a)



(b)



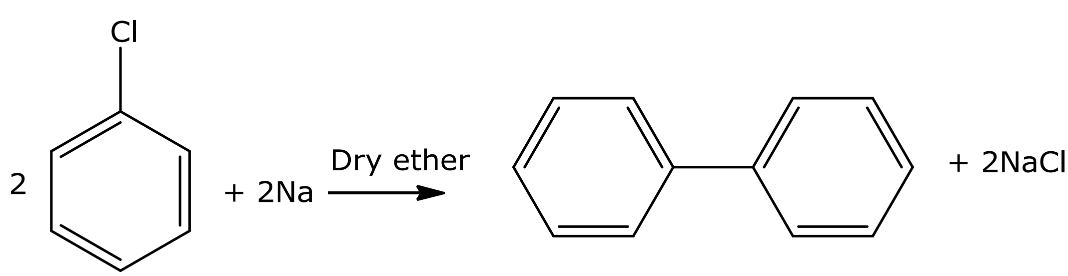
(c)



2-Hydroxybenzoic acid

12.

(i)



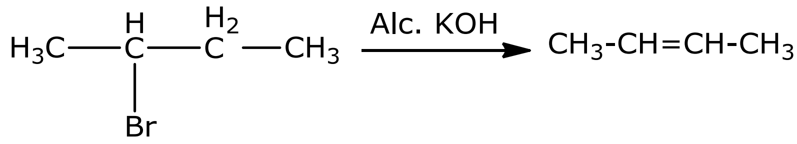
Chlorobenzene

(Biphenyl)

(ii)

$$CH_3CH{=}CH_2 + HBr \xrightarrow{\text{Peroxides}} CH_3CH_2CH_2Br + NaI \xrightarrow[\text{Reflux}]{\text{Acetone}} CH_3CH_2CH_2I + NaBr$$

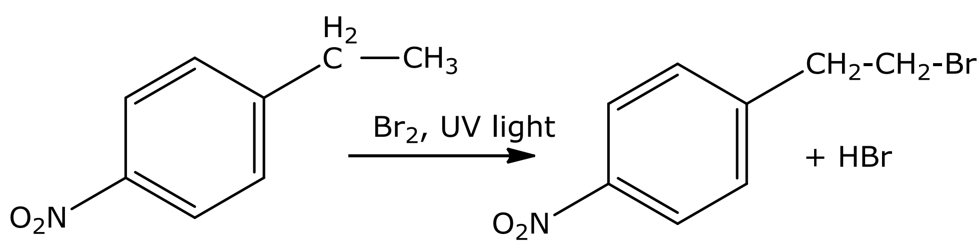
(iii)



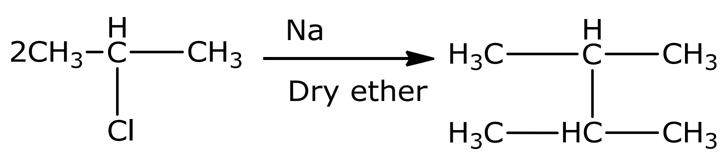
2-Bromobutane (But-2-ene)

OR

(i)



(ii)



(iii)

$$H_3C-CH_2-Br \xrightarrow{AgCN} CH_3 - CH_2 - NC$$

13.

(i) Structural difference between starch and cellulose:

Starch	Cellulose
Starch is made of α-1, 4 linkages.	Cellulose is made of β-1, 4 linkages.
Starch is found in both linear and branched chains.	Cellulose is mostly linear chains of glucose molecules.
Starch occurs in two forms—amylase and amylopectin.	Cellulose occurs in nature as pure cellulose, hemicellulose or lignin.
Starch functions as a storage polysaccharide	Cellulose functions as a structural polysaccharide.

(ii) Nucleic acid shows phosphodiester linkages.
(iii) Fibrous protein: Collagen
Globular protein: Egg albumin

14.

(i) Mond process

(ii) The function of the cryolite is to lower the fusion temperature from 2050°C to 950°C and to enhance conductivity.

(iii) Limestone decomposes to form CaO which reacts with silicate impurity in the blast furnace to form slag.

$CaCO_3 \rightarrow CaO + CO_2$

$CaO + SiO_2 \rightarrow CaSiO_3$ (slag)

15.

(i) In case of sulphur, because of the presence of empty d-orbital, it can expand its oxidation state from the + 4 to the +6 oxidation state. Hence, it acts as a reducing agent.

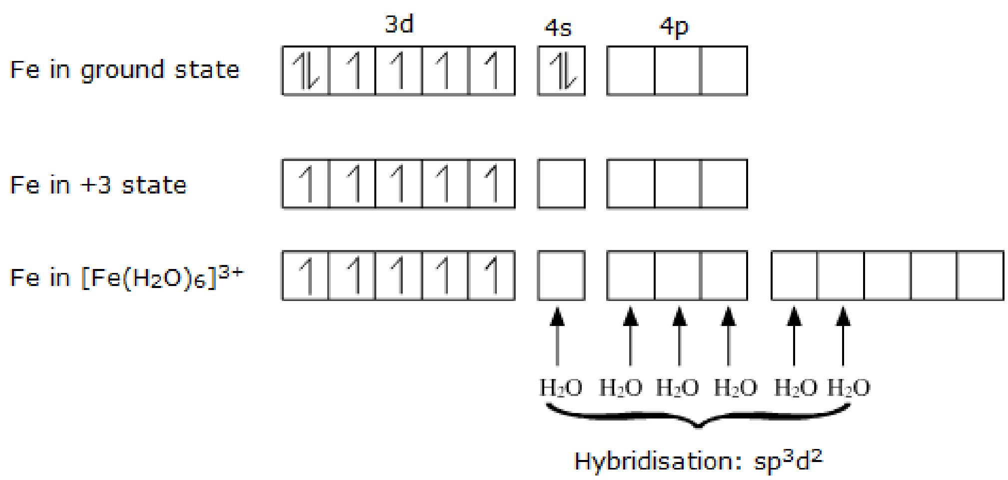
Te is a heavy element and so because of the inert pair effect, the lower oxidation state is more stable. Hence, it acts as an oxidising agent.

(ii) Nitrogen does not form a pentahalide because of the non-availability of the d orbitals in its valence shell.

(iii) The I–Cl bond in ICl is weaker than the I–I bond in I_2. Therefore, ICl is more reactive than I_2.

16.

(a)

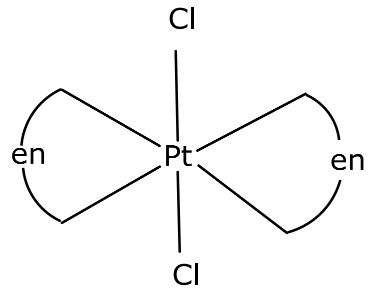


Hybridisation: sp^3d^2

Magnetic character: Paramagnetic

Spin of complex: High spin complex

(b) trans isomer of $[Pt(en)_2Cl_2]^{2+}$ is optically inactive.



17.

$a = 500 \text{ pm} = 500 \times 10^{-10} \text{ cm}$

$z = 2$

$m = 300 \text{ g}$

$$\text{Density (d)} = \frac{zM}{a^2 \, N_A}$$

$$7.5 = \frac{2 \times M}{(500)^3 \times 10^{-30} \times 6.02 \times 10^{23}}$$

$$M = \frac{7.5 \times (500)^3 \times 10^{-30} \times 6.02 \times 10^{23}}{2}$$

$$M = 282.18 \text{ g / mol}$$

$$\text{Molar mass (M)} = \frac{\text{Mass of compound} \times N_A}{\text{Number of atoms}}$$

$$282.18 = \frac{300 \times 6.02 \times 10^{23}}{\text{Number of atoms}}$$

$$\text{Number of atoms} = 6.4 \times 10^{23}$$

18.

(i) Rubber is made of hydrocarbon chains, basically carbon and hydrogen. These chains slide over one another and get tied to one another which leads to natural rubber being sticky. When sulphur is used in the vulcanisation process, it reacts with these chains and forms disulphide (or similar) bonds. Sulphur forms cross linkages at the reactive sites of the double bonds because of which rubber gets stiffened.

(ii) Monomers:
(a) Ethylene glycol
(b) Phthalic acid

(iii) Increasing order of intermolecular forces:
Neoprene < Polythene < Terylene

19.

Given :

$P_i = 0.30$ atm

$P_t = 0.50$ atm

$$C_2H_5Cl_{(g)} \rightarrow C_2H_{4(g)} + HCl_{(g)}$$

P_i	0	0	(At t = 0 sec)
$P_i - x$	x	x	(At t = 300 sec)

So,

$P_i - x + x + x = P_t$

$0.3 + x = 0.5$

$x = 0.2$

Then, $P_i - x = 0.3 - 0.2 = 0.1$ atm

For first order reaction,

$$k = \frac{2.303}{t}\log\left(\frac{P_i}{P_i - x}\right)$$

$$= \frac{2.303}{t}\log\left(\frac{0.3}{0.1}\right)$$

$$= \frac{2.303 \times \log 3}{300} = \frac{2.303 \times 0.4771}{300}$$

$k = 0.0037\ s^{-1}$

20.

(i) $AlCl_3$ is acidic and aniline is basic in nature. They react with each other to form a salt. As a result, a positive charge is developed on the N-atom and electrophilic substitution in the benzene ring is deactivated. Hence, aniline does not undergo Friedel–Crafts reaction.

(ii) In $(CH_3)_3N$, there is maximum steric hindrance and least solvation, but in $(CH_3)_2NH$, the solvation is more and the steric hindrance is less than in $(CH_3)_3N$. Although the +I effect is less because there are two methyl groups, di-methyl amine is still a stronger base than tri-methyl amine.

(iii) Because of maximum intermolecular hydrogen bonding in primary amines (which is due to the presence of more H atoms), primary amines have high boiling points compared to tertiary amines.

21.

(i) Colloidal sols directly formed by mixing substances such as gum, gelatine, starch and rubber with a suitable liquid (the dispersion medium) are called lyophilic sols.

(ii) The potential difference between the fixed layer and the diffused layer of opposite charges is called the electrokinetic potential or zeta potential.

(iii) Substances which at low concentrations behave as normal strong electrolytes but at higher concentrations exhibit colloidal behaviour because of the formation of aggregates or micelles are known as associated colloids.

22.

Given :

$K_b = 0.52 \text{ K kg mol}^{-1}$

Mass of $MgSO_4$ (solute) $= 4$ g

Mass of Water (Solvent) $= 100$ g

$$\text{Molarity of solution} = \frac{\frac{4}{120}}{\frac{100}{1000}} = 0.33 \text{ mol/L}$$

$MgSO_4$ undergoes complete ionisation,

So, $i = 2$

Elevation in boiling point is given as,

$\Delta T_b = i \times K_b \times m$

$= 2 \times 0.52 \times 0.33 = 0.34$ K

$T_f = 373.15 + 0.34$

$= 373.49$ K

Boiling point of the solution is 373.49 K.

23.

(i) Carefulness, honesty and thoughtfulness are the values which are displayed by Mr Deepak as he advised Mr Angad to stop taking pills and suggested an alternative option to reduce tension and anxiety.

(ii) Sleeping pills should not be taken without consulting the doctor because they have several side effects like slowing down the functioning of the brain and the nervous system.

(iii) Tranquillisers are drugs which are used to reduce anxiety, fear, tension, agitation and related states of mental disturbance. They perform their function by inhibiting the message transfer mechanism from the nerve to the receptor.
Examples: Phenelzine, equanil

24.

(a)

(i) $CH_3COCl \xrightarrow{H_2, Pd-BaSO_4} \underset{A}{CH_3CHO} \xrightarrow{H_2N-OH} \underset{B}{CH_3CH=N-OH}$

(ii) $CH_3MgBr \xrightarrow[2.H_3O^+]{1.CO_2} \underset{A}{CH_3COOH} \xrightarrow{PCl_5} \underset{B}{CH_3COCl}$

(b)

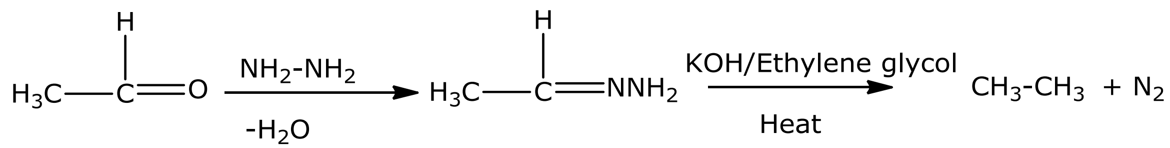
(i) Acetophenone ($C_6H_5COCH_3$) gives the iodoform test. Benzaldehyde gives the silver mirror test with Tollens' reagent, whereas acetophenone does not react.

(ii) Formic acid gives the silver mirror test on treating with ammoniacal silver nitrate. Acetic acid does not give this test.
$HCOOH + 2[Ag(NH_3)_2]NO_3 \rightarrow 2Ag + CO_2 + 2NH_4NO_3 + 2NH_3$

(c) The boiling point of a compound depends on intermolecular hydrogen bonding. It is the most in acetic acid, followed by ethanol and then acetaldehyde.
$CH_3CHO < CH_3CH_2OH < CH_3COOH$

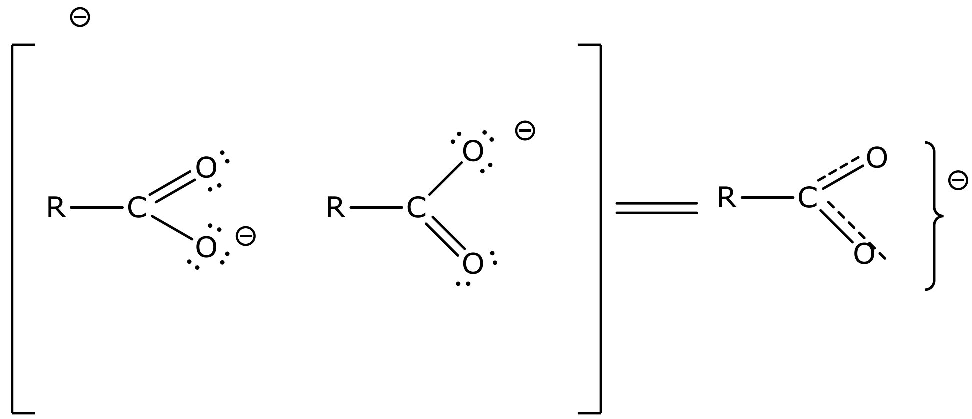
OR

(a)



(b) Aldehydes are generally more reactive than ketones in nucleophilic addition reactions because of steric and electronic reasons. In case of ketones, aromatic ketones are more susceptible to nucleophilic attack than aliphatic ketones.
$CH_3COCH_3 < C_6H_5COCH_3 < CH_3CHO$

(c) In carboxylate anion, the carbon atom is joined to each oxygen atom by one and a half bond and the negative charge is distributed over both oxygen atoms. Thus, the carbonyl group in carboxylic acids is not a true carbonyl group as in aldehydes and ketones. Therefore, carboxylic acids do not give reactions of the carbonyl group.



(d) $CH_3CH_2CH=CH-CH_2CN \xrightarrow[2.H_2O]{1.(i-Bu)_2AlH} CH_3CH_2CH=CH-CH-CHO$

(e)

$A = H_3C-\overset{H_2}{C}-CHO$

$B = CH_3-\overset{O}{\overset{\|}{C}}-CH_3$

Methyl ketone gives the iodoform test.

$CH_3COCH_3 \xrightarrow{NaOH+I_2/\Delta} CH_3COOH + CHI_3$

25.

(a)

Given :

$E_{cell} = 1.98\ V$

$$E_{cell} = E^o_{cell} - \frac{0.0591}{n}\log\frac{[Al]^2}{[Cu]^3}$$

$$E^o_{cell} = E_{cell} + \frac{0.0591}{6}\log\frac{[0.01]^2}{[0.01]^3}$$

$$E^o_{cell} = 1.98 + 0.00985\log 100$$

$$E^o_{cell} = 1.98 + 0.0197$$

$$E^o_{cell} = 1.99\ V$$

(b)

Given :

$E^\circ\left(A^{+2}/A\right) = -2.37\ V$

$E^\circ\left(B^{+2}/B\right) = -0.14V$

$E^o_{cell} = E^o_{cathode} - E^o_{anode}$

In 1st case :

$E^o_{cell} = E^o\ (A^{2+}/A) - E^o\ (Fe^{2+}/Fe)$

$= (-2.37 + 0.44) = -1.93\ V$

In 2nd case :

$E^o_{cell} = E^o\ (B^{2+}/B) - E^o\ (Fe^{2+}/Fe)$

$= (-0.14 + 0.44) = 0.3\ V$

As B has a positive value, it will be our choice for electroplating.

(c)

Given :

Conductivity (k) = $3.905 \times 10^{-5} S\ cm^{-1}$

Concentration ofelectrolyte (c) = $0.001\ mol\ L^{-1}$

$\Lambda_m = \frac{k}{c} \times 1000 = 39.05\ S\ cm^2\ mol^{-1}$

$\Lambda^o_m = \lambda^o_{CH_3COO^-} + \lambda^o_{H^+}$

$= 40.9 + 349.6$

$= 390.5\ S\ cm^2\ mol^{-1}$

Degree of dissociation $= \frac{39.05}{390.5} = 0.1$

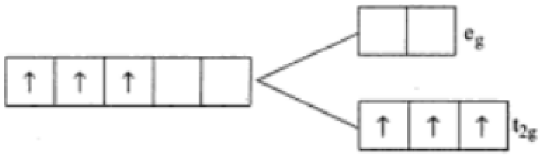
(d) An electrochemical cell is a device capable of either deriving electrical energy from chemical reactions or facilitating chemical reactions through the introduction of electrical energy. When the external potential is higher than E^o_{cell}, the flow of the current is reversed and the cell gets recharged.

26.

(a)

(i) In case of oxygen, Mn shows the highest oxidation state of +7. This is because Mn forms pπ–dπ multiple bonds using 2p orbitals of oxygen and 3d orbitals of Mn. With F, Mn displays an oxidation state of +4 because of the single bond formation caused by the unavailability of 2p orbitals in F for multiple bonding.

(ii) Cr^{2+} is strongly reducing in nature. It has a d^4 configuration. While acting as a reducing agent, it gets oxidised to Cr^{3+} (with electronic configuration d^3). This d^3 configuration can be written as t^3_{2g} configuration, which is a more stable configuration.



(iii) Zn^{2+} salts have a completely filled set of d-orbitals ($3d^{10}$), while Cu^{2+} has an incompletely filled set of d-orbitals ($3d^9$), and therefore, d–d transition is possible in Cu^{2+}, leading to blue colour.

(b)

(i) $2MnO_2 + 4KOH + O_2 \xrightarrow{\Delta} 2K_2MnO_4 + 2H_2O$

(ii) $Cr_2O_7^{2-} + 14H^+ + 6I^- \longrightarrow 2Cr^{+3} + 3I_2 + 7H_2O$

OR

(i) Mn shows the maximum oxidation state of +7. Mn ($3d^5 4s^2$) has half-filled d orbitals and can lose all seven valence electrons.
(ii) Cr has the highest melting point.
(iii) Sc shows only the +3 oxidation state.
(iv) Mn is a strong oxidising agent in the +3 oxidation state because it achieves the stable $3d^5$ configuration in the +2 oxidation state.