CBSE Class 12 Chemistry Paper Sample Paper Solution Set 4

Class XII Chemistry (Theory)
SOLUTIONS

1. High temperature is favourable for adsorption. It increases with the increase of temperature

2. Silver is extracted from the ore-argentite (Ag_2S). This process of extraction of silver is called as cyanide process as sodium cyanide solution is used. The ore is crushed, concentrated and then treated with sodium cyanide solution. This reaction results into sodium argento cyanide $Na[Ag(CN)_2]$. The reaction is as follows:

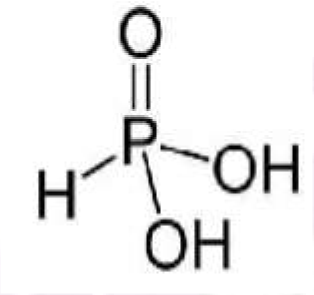
   $$AgS + 4NaCN \rightleftharpoons 2Na[Ag(CN)_2] + Na_2S$$

   The solution of sodium argento cyanide combines with zinc dust. It forms sodium tetra cyanozicate and precipitates silver. This precipitated silver is called as spongy silver. The reaction is as follows:

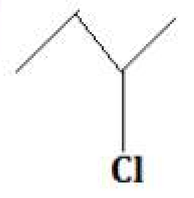
   $$Zn + 2Na[Ag(CN)_2] \rightarrow Na_2[Zn(CN)_4] + 2Ag$$

   The spongy silver is fused with potassium nitrate to get pure silver. This silver obtained is purified by electrolytic process.

3. Basicity of H_3PO_3 is two as there are two replaceable hydrogen atoms. The structure of H_3PO_3 is as follows:



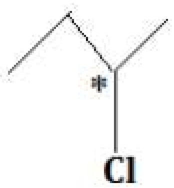
4. The two structures given are as follows:



2-chlorobutane

1-chlorobutane

   The chiral compound is that compound in which at least one carbon atom is attached to four different atoms or groups. Between the two given compounds, 2-chlorobutane contains one carbon atom which is attached to four different entities such as methyl groups, chlorine atom, hydrogen atoms, and ethyl group.



2-chlorobutane with chiral centre

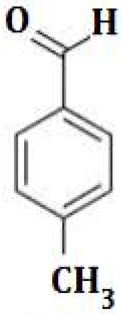
But in 1-chlorobutane, there is no carbon atom which is attached to four different atoms or groups. Hence the chiral compound is 2-chlorobutane.

5. The given three polymers are Buna-S, Protiens, PVC. Among these three polymers, proteins are the natural polymers. They are the long chain of amino acids joined by peptide linkages. Buna-S and PVC are synthetic polymers.

6. The conversion of primary aromatic amines into diazonium salts is known as diazotisation.

7. Sucrose on hydrolysis gives one molecule each of glucose and fructose.

8. The structure of p-methylbenzaldehyde is as follows:



p-methylbenzaldehyde

9. Given:

Density of f.c.c. unit cell = 2.8 g cm^{-3}

Edge length of f.c.c unit cell = 4 x 10^{-8} cm

N^A = 6.022 x 10^{23} mol^{-1}

Molar mass of the element = ?

For f.c.c. unit cell, Z = 4

Substituting the values in the equation:

$$\rho = \frac{Z \times M}{a^3 \times N_0}$$

$$2.8gcm^{-3} = \frac{4 \times M}{\left(4 \times 10^{-8} cm\right)^3 \times 6.022 \times 10^{23} mol^{-1}}$$

$$M = \frac{2.8gcm^{-3} \times \left(4 \times 10^{-8} cm\right)^3 \times 6.022 \times 10^{23} mol^{-1}}{4}$$

M =26.98gmol^{-1}
Therefore, the molar mass of the element is 26.98 gmol^{-1}.

10.

(i) If as a result of the imperfections in the crystal, the ratio of the cations to the anions becomes different from that indicated by the ideal chemical formula, the defects are called non-stoichiometric defects.

LiCl exhibit non-stoichiometric defect due to metal excess by anionic vacancies. A negative ion may be missing from its lattice site, leaving a hole which is occupied by an electron, thereby maintaining the electrical balance. The sites containing the electrons thus trapped in the anion vacancies are called F-centres because they are responsible for imparting colour to the crystals.

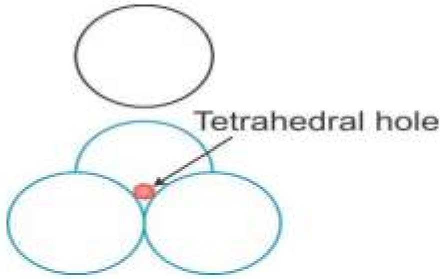
The Li atoms get deposited on the surface of LiCl crystal. Clions then diffuse to the surface where they combine with the Li atoms which become ionize by losing electrons. These electrons diffuse back into the crystal and occupy the vacant sites created by the Clions. These electrons absorb some energy of the white light, giving pink colour to LiCl.

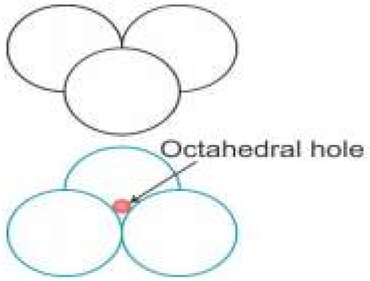
(ii) NaCl exhibit Schottky defect. In this type of defect, if an ionic crystal such as NaCl, equal number of cations and anions are missing from their lattice sites so that the electrical neutrality is maintained. This is basically a vacancy defect.

OR

(i) Tetrahedral voids and octahedral voids:

Tetrahedral voids	Octahedral voids
Tetrahedral void is the name given to the vacant space formed by touching of four spheres, as shown in the figure.	Octahedral voids are formed by combination of voids of two triangular layers of atoms, when one triangular layer is placed above another, as shown in the figure,



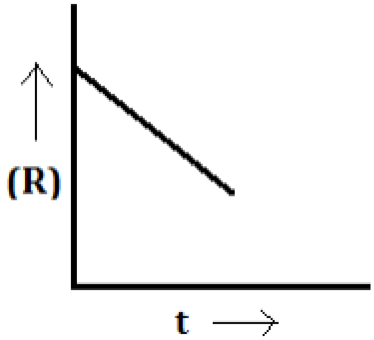


(ii) Crystal lattice and unit cell:

Crystal lattice	Unit cell
The crystal lattice can be defined as a symmetrical three-dimensional arrangement of atoms inside a crystal.	The unit cell can be defined as the smallest three dimensional portion of a complete space lattice which when repeated over and again in different directions produces the complete space lattice is called the unit cell. Or The unit cell can be also be defined as the smallest group of atoms which has the overall symmetry of a crystal, and from which the entire lattice can be built up by repetition in three dimensions.

11. Kohlrausch law states as “The limiting molar conductivity of an electrolyte (i.e. molar conductivity at infinite dilution) is the sum of the limiting ionic conductivities of the cation and the anion each multiplied with the number of ions present in one formula unit of the electrolyte.
On dilution the volume of the solution is increasing but the number of ions that carry charge in a solution remains the same. Hence the number of ions per unit volume that carry charge in a solution decreases. Conductivity through a solution is due to these ions that are present in it. Pure water is not very conductive at all, but salty water is quite conductive. Therefore the more salt or ions dissolved in solution, the higher the conductivity (within limits). As you dilute in solution the concentration of ions goes down, and the ability to pass a current is diminished.

12. For a chemical reaction R→P, the variation in the concentration (R) vs. time (t) plot is given as follows:



(i) The order of the reaction zero.
(ii) Slope = -k

13. Electrolytic refining:
Principle: In this method, an anode of a block of impure metal and a cathode of a thin sheet of pure metal, are suspended in an electrolyte solution which is the solution of a soluble salt of the metal usually a double salt of the metal. For example, the purest copper is obtained by an electrolytic refining method. A slab of impure copper as the anode and a thin sheet of pure copper as the cathode are dipped in the electrolyte which is an acidic solution of copper sulphate. On passing electricity through the cell, copper is dissolved from the anode and deposited on the cathode.
Anode: $Cu(s) \rightarrow Cu^{2+}(aq) + 2e^-$
Cathode: $Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$
The impurities of iron, nickel, zinc and cobalt present in blister copper being more electropositive pass into solution as soluble sulphates. The impurities of antimony, selenium, tellurium, silver, gold and platinum being less electropositive are not affected by $CuSO_4$-H_2SO_4 solution. Therefore, these impurities get settle down under the anode as anode mud or anode sludge.

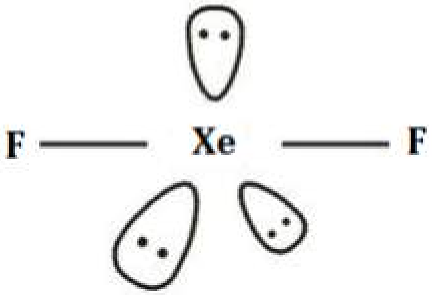
14.

(i) $P_4 + H_2O \rightarrow$
$P_4 + 6H_2O \rightarrow PH_3 + 3H_3PO_2$

(ii) XeF_6 can be prepared by the interaction of XeF_4 and O_2F_2 at 143 K.
$XeF_4 + O_2F_2 \rightarrow XeF_6 + O_2$

15.

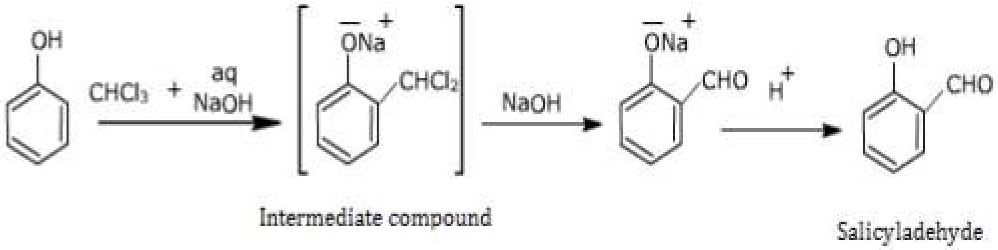
(i) XeF_2(linear)



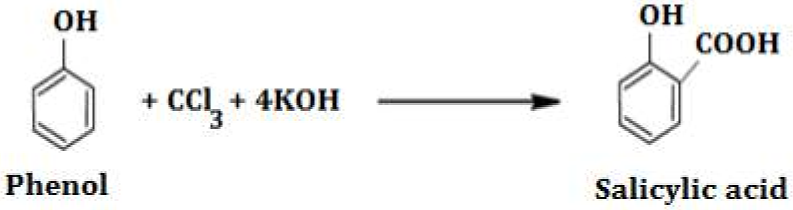
(ii) BrF_3 (bent T – shaped).

16.

(i) Reimer – Tiemann reaction: Treatment of phenol with chloroform in presence of aqueous sodium or potassium hydroxide at 340 K followed by hydrolysis of the resulting product gives 2-hydroxybenzaldehyde or salicylaldehyde as the major product. This reaction is referred as ReimerTiemann formylation reaction.



Reimer-Tiemann carboxylation:



(ii) Williamson synthesis: It involves the treatment of an alkyl halide with a suitable sodium alkoxide. The sodium alkoxide needed for the purpose is prepared by the action of sodium on a suitable alcohol. The reaction invlolves the nucleophillic displacement (substitution) of the halide ion from the alkyl halide by the alkoxide ion by SN_2 mechanism.

$R\text{-}OH + 2Na \rightarrow 2R'\text{-}O\text{-}Na^+ + H_2$

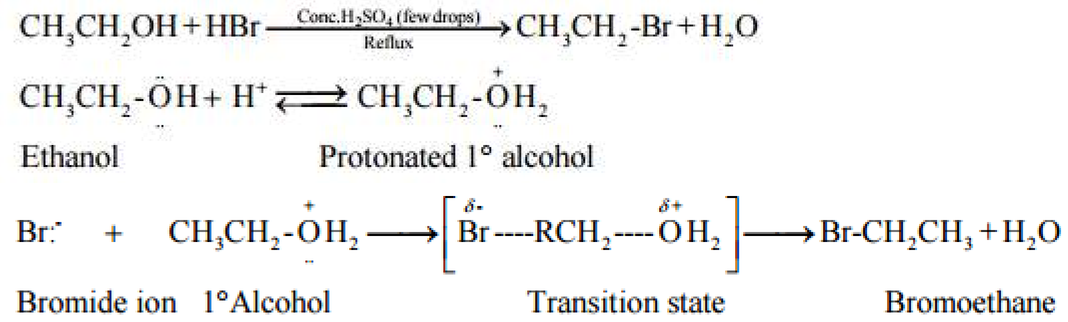
$R'\text{-}O\text{-}Na^+ + R\text{-}X \rightarrow R'\text{-}O\text{-}R + Na^+X^-$

Ether The second reaction is the substitution nucleophillic bimolecular (S_N2) reaction.

For example:

$$C_2H_5-Br + C_2H_5\overset{-}{O}Na^+ \xrightarrow{Heat} C_2H_5-O-C_2H_5 + NaBr$$

17. Primary alcohols such as ethanol react by SN2 mechanism with halogen acid such as HBr as follows:



$$CH_3CH_2OH + HBr \xrightarrow[\text{Reflux}]{\text{Conc.}H_2SO_4\text{ (few drops)}} CH_3CH_2\text{-}Br + H_2O$$

$$CH_3CH_2\text{-}\underset{..}{\ddot{O}}H + H^+ \rightleftharpoons CH_3CH_2\text{-}\underset{..}{\overset{+}{O}}H_2$$

Ethanol Protonated 1° alcohol

$$Br\text{:}^- \quad + \quad CH_3CH_2\text{-}\underset{..}{\overset{+}{O}}H_2 \longrightarrow \left[\overset{\delta-}{Br}\text{----}RCH_2\text{----}\overset{\delta+}{O}H_2\right] \longrightarrow Br\text{-}CH_2CH_3 + H_2O$$

Bromide ion 1°Alcohol Transition state Bromoethane

18.

(i) Monomers of Bakelite are phenol and formaldehyde.

(ii) Monomer of neoprene is 2-chloro-1, 3-butadiene.

19.

a) The reaction given is $Mg(s) + Cu^{2+}(aq) \longrightarrow Mg^{2+}(aq) + Cu(s)$

In the given reaction, the electron transfer is of 2 electrons, hence n = 2

Given, E^0cell - +2.71 V and 1 F = 96500 $Cmol^{-1}$

We know that,

$$-\Delta G^0 = nFE^0 cell$$
$$= 2 \times 96500 \times 2.71$$
$$= 523030 J$$
$$\Delta G^0 = -523030 J$$
$$\Delta G^0 = -5.23 \times 10^5 J = -523.03 kJ$$

b) One of the most successful fuel cells uses the reaction of hydrogen with oxygen to form water. This fuel cell was used for providing electrical power in the Apollo space programme. The water vapours produced during the reaction were condensed and added to the drinking water supply for the astronauts. In the cell, hydrogen and oxygen are bubbled through porous carbon electrodes into concentrated aqueous sodium hydroxide solution. Catalysts like finely divided platinum or palladium metal are incorporated into the electrodes for increasing the rate of electrode reactions. The electrode reactions are given below:

Cathode: $O_2(g) + 2H_2O(l) + 4e^- \rightarrow 4OH–(aq)$

Anode: $2H_2 (g) + 4OH–(aq) \rightarrow 4H_2O(l) + 4e–$

Overall reaction being: $2H_2(g) + O_2(g) \rightarrow 2 H_2O(l)$

20. The given reaction is as follows

$$SO_2Cl_2(g) \longrightarrow SO_2(g) + Cl_2(g)$$

Also given:

Experiment	Time s-1	Total pressure/atm
1	2	0.4
2	100	0.7

The rate constant k can be calculated as follows:

$$k = \frac{2.303}{t}\log\frac{P_0}{2P_0 - P_t}$$

$$when\,t = 100s, k = \frac{2.303}{100s}\log\frac{0.4}{(2\times 0.4) - 0.7}$$

$$k = \frac{2.303}{100s}\log\frac{0.4}{0.1}$$

$$k = \frac{2.303}{100s}\log 4$$

$$k = \frac{2.303}{100s}\times 0.6021$$

$$k = 1.39\times 10^{-2} S^{-1}$$

Therefore, the rate constant is $1.39\times 10^{-2} S^{-1}$

21. An emulsion is a colloidal dispersion in which both the dispersed phase and the dispersion medium are liquids and the two liquids involved are otherwise immiscible.

Types of emulsions are as follows:

a) Oil in water in which oil is a dispersed phase and water is the dispersion medium. For example: milk is as emulsion of liquid fat dispersed in water

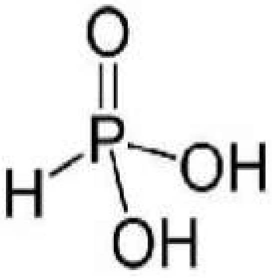
b) Water in oil in which water is the dispersed phases and oil is the dispersion medium. For example: cod liver oil is an emulsion of water in oil in which water is the dispersed phase and oil is the dispersion medium.

22.

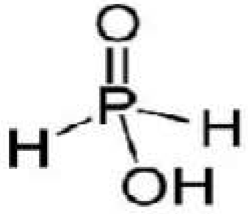
(i) N due to the absence of d – orbitals, cannot form p Π –d Π multiple bonds. As a result, N cannot expand its covalency beyond four but in R3N=O, N has a covalency of 5. Therefore, the compound R3N=O does not exist. In contrst, P due to the presence of d- orbitals forms p Π – d Π multiple bonds and hence can expand its covalency beyond 4. Therefore, P forms R3P=O I n which the covalency of P is 5.

(ii) The elements of group 16 have two electrons less than the nearest noble gas configuration. Therefore, they have a high tendency to accept two additional electrons and hence have large negative electron gain enthalpies next only to the halogens. The electron gain enthalpy of oxygen is however least negative in this group. This is due to its small size. As a result of which, the electron – electron repulsions in the relatively small 2p-subshell are comparatively large and hence the incoming electrons are not accepted with the same ease in case of other elements of this group.

(iii) In case of H_3PO_3, there is only one P-H bond while in case of H_3PO_2, there are two P-H bonds. Hence H_3PO_2 is better reducing agent than H_3PO_3.



H_3PO_3



H_3PO_2

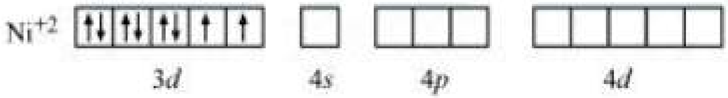
23.

(i) IUPAC name of the complex $[Cr(NH_3)_4 Cl_2]Cl$ is
Tetraamminedichlorochromium (III) ion.

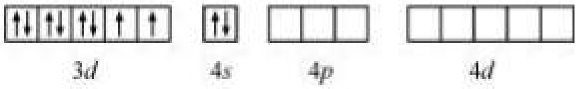
(ii) Optical isomerism is exhibited by the complex $[Co (en)_3]^{3+}$.

(iii) $[NiCl_4]^{2-}$ and $[Ni(CO)_4]$ both are tetrahedral. But their magnetic characters are different. This is due to difference in the nature of ligands.

$Ni^{+2} = [Ar]\ 4s^0 3d^8$



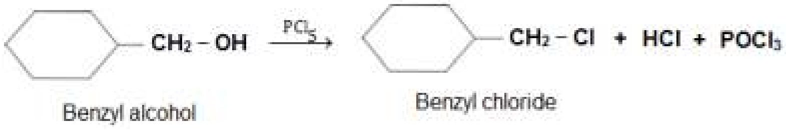
Ni^{+2} has 2 unpaired electrons hence, this complex is paramagnetic.
In $Ni(CO)_4$, Ni is in the zero oxidation state i.e., it has a configuration of $3d^8\ 4s^2$.
[Ni(CO)4]
Ni = $[Ar]\ 4s^2\ 3d^8$



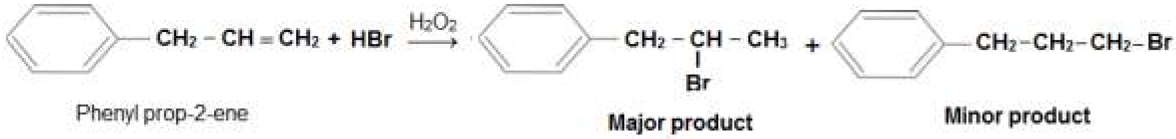
But CO is a strong field ligand. Therefore, it causes the pairing of unpaired 3d electrons. Also, it causes the 4s electrons to shift to the 3d orbital, thereby giving rise to sp^3 hybridization. Since, no unpaired electrons are present in this case, $[Ni(CO)^4]$ is diamagnetic.

24.

(i)



(ii)



Addition in presence of peroxide yields product according to anti-Markovnikov rule of addition.

(b)

(i) CH_3I

(ii) CH_3Cl

25.

(i) Due to maximum intermolecular hydrogen bonding in primary amines (that is, due to presence of more number of H-atoms) primary amines have high boiling point in comparison to tertiary amines.

(ii) Aniline does not undergo Friedel-Crafts reaction due to Acid-Base reaction between Basic compound. Aniline and Lewis acid/Protic acid, which is use in Friedel-crafts reaction.

(iii) 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 +I effect is less, since there are two methyl group; dimethyl amine is still a stronger base than tri-methyl amine.

OR

(i)

$$C_6H_5NO_2 \xrightarrow{Sn+HCl} \underset{(A)}{C_6H_5NH_2} \xrightarrow[273\,K]{NaNO_2+HCl} \underset{(B)}{C_6H_5N_2Cl} \xrightarrow{H_2O} \underset{(c)}{C_6H_5OH}$$

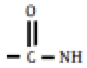
(ii)

$$CH_3\text{–}CN \xrightarrow{H_2O/H^+} \underset{(A)}{CH_3-COOH} \xrightarrow{NH_3} \underset{(B)}{CH_3-CONH_2} \xrightarrow{Br_2+KOH} \underset{(C)}{CH_3-NH_2}$$

26.

(i) Peptide linkage:

Peptide bond or peptide linkage is an amide formed between –COOH and NH_2 group by the elimination of a water molecule. The peptide bond or linkage is



$$-\overset{\overset{\displaystyle O}{\|}}{C}-NH$$

(ii) Primary structure:

The primary structure of proteins refers to the sequence of amino acids held together by peptide bonds

(iii) Denaturation:

It is a process in which proteins get easily precipitated and the change is irreversible.

27.

(i) (a) Dr. Satpal distributed free medicines to them.

(b) Dr. Satpal immediately reported the matter to the National Human Rights Commission.

(ii) Aspirin

(iii) Aspartame

28.

a) (i) Molarity (M): Molarity can be defined as number of moles of solute dissolved per liter of solution.

$$\text{Molarity M} = \frac{\text{Moles of solute}}{\text{Vol. of solution (litre)}}$$

(ii) Molal elevation constant (K_b):

When 1 molal solution is prepared, the elevation in boiling point is called as molal boiling point elevation constant.

b) For isotonic solution

$\pi_1 = \pi_2$

$C_1 = C_2$ (at same temperature)

or $n_1 = n_2$ (is same volume)

$$\frac{15}{60} = \frac{x}{180}$$

x = 45 g, mass of glucose per liter of solution.

OR

a) Ethanol and acetone shows +ve deviation because both are non polar compounds and after mixing force of attraction decreases

Like particle force of attraction > unlike particle force of attraction.

b)

$$\text{Molarity M} = \frac{\%\text{Mass} \times 10 \times \text{density}}{\text{Mol. mass of solute}}$$

$$= \frac{10 \times 10 \times 12}{180} = 0.66M$$

$$\text{Molality} = \frac{\%\text{Mass}}{\text{Mol. mass of solute}} \times \frac{1000}{100 - \%Mass}$$

$$= \frac{10}{180} \times \frac{1000}{90} = 0.617m$$

29.

a)

(i) $Cr_2O_7^{2-} + 2OH^- \rightarrow 2CrO_4^{2-} + H_2O$

(ii) $MnO_{4-} + 4H^+ + 3e^- \rightarrow MnO_2 + 2H_2O$

b)

(i) Zinc is not considered a transition element because it does not have partly filled(or incomplete) d-subshell. It has 3d-subshell full filled.

(ii) The transition elements form complexes because of the following reasons:

- Comparitively smaller size of their metal ions.
- Their high ionic charges.
- Availability of vacant d-orbitals so that these orbitals can accept lone pairs of electrons donated by the ligands.

(iii) In case of Mn '+2' oxidation state is more stable than '+3' oxidation state and in case of Cr '+3' oxidation state is more stable than '+2' oxidation state.

OR

a)

(i)

Lanthanoids	Actinoids
Their magnetic properties can be explained easily.	Their magnetic properties cannot be explained easily, as they are more complex.
Except promethium, they are nonradioactive.	They are radioactive.
Besides +3 oxidation state, they show +2 and +4 oxidation states only in few cases	Besides +3 oxidation state, they show higher oxidation states of +4, +5, +6, +7 also.
Lanthanoid compounds are less basic	Actinoid compounds are more basic.

(ii) Ce

(iii) $MnO_{4-} + 8H^+ + 5e^- \rightarrow Mn^{+2} + 4H_2O$

(iv) Mn^{+3} = [Ar] $4s^0$ $3d^4$ (4 unpaired e-)

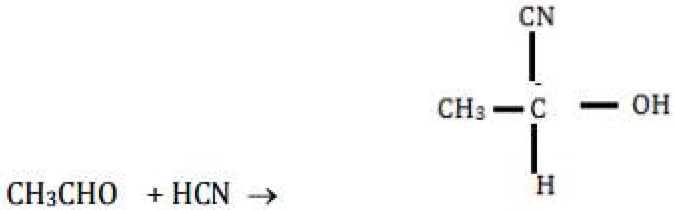
(v) Cr^{+3} = [Ar] $4s^0$ $3d^3$ (3 unpaired e-)

(vi) Mn^{+3} has more no. of unpaired e- than Cr^{+3}

30.

a)

(i) Acetaldehyde add a molecule of hydrogen to form acetaldehyde cyanohydrin.



$$CH_3CHO + HCN \rightarrow CH_3-\overset{CN}{\underset{H}{C}}-OH$$

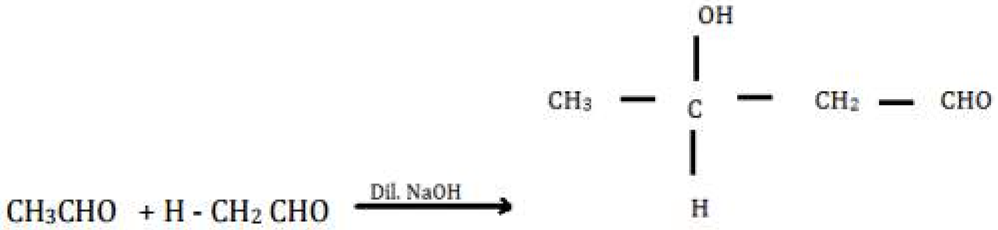
(Acetaldehyde cyanohydrin)

(ii) Ethanal reacts with hydroxylamine to form Ethanal oxime.

$$CH_3CHO + H_2NOH \rightarrow CH_3-C=NOH + H_2O$$

Ethanal oxime

(iii) Two molecules of ethanal condense in presence of a dilute NaOH to form 3- hydroxybutanal.



$$CH_3CHO + H-CH_2CHO \xrightarrow{\text{Dil. NaOH}} CH_3-\overset{OH}{\underset{H}{C}}-CH_2-CHO$$

3-hydroxybutanal

b)

(i) When treated with sodium bicarbonate, benzoic acid gives brisk effervescence due to evolution of carbon dioxide gas. No reaction takes place when phenol is treated with $NaHCO_3$.

$$C_6H_5COOH + NaHCO_3 \rightarrow C_6H_5COONa + H_2O + CO_2$$

(ii) Propanal gives Tollen’s test while propanone does not give Tollen’s test.

$$CH_3CH_2CHO + 2[Ag(NH_3)_2]^+ + 3OH^- \rightarrow CH_3CH_2COO^- + 2Ag + 4NH_3 + 2H_2O$$

OR

a)

(i) Monochloroacetic acid is stronger than acetic acid. This is due to –Cl as a – I group.

(ii) Carboxylic acids do not give reactions of carbonyl group because the lone pairs on oxygen attaché to hydrogen in the –COOH group are involved in resonance which makes the carbon less electrophilic.

b)

(i) Rosemund reaction:

$$CH_3COCl \xrightarrow{H_2, Pd / BaSO_4} CH_3CHO + HCl$$

(ii) Cannizzario's reaction:

$2HCHO$	$+ NaOH$	$\rightarrow$	CH_3OH	$+$	$HCOONa$
Formaldehyde			Methyl alcohol		Sodium formate

c) $CH_3CH_2 - CH_2 - CO - CH_3$