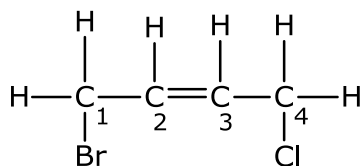


**CBSE**  
**Class XII Chemistry**  
**Board Paper 2017 (Solution)**

- The formula of an oxo-anion of Manganese (Mn) in which it shows the oxidation state equal to its group number is  $\text{MnO}_4^{2-}$ .  
In  $\text{MnO}_4^{2-}$ , the oxidation state of Mn is  
 $\text{Mn} + (-2 \times 4) = -1$   
 $\text{Mn} - 8 = -1$   
 $\text{Mn} = +7$   
The group number of Manganese is 7.
- The IUPAC name of the given compound is N-ethyl-N-methylethanamine.
- The order of the given reaction is first order. The rate of reaction for the first order reaction is independent of the initial concentration of the reaction.
- Structure of 1-bromo-4-chlorobut-2-ene:



- One similarity between physisorption and chemisorption is the rate of adsorption increases with an increase in the surface area of adsorbent.
- The completed reactions are
  - $\text{NH}_3 + 3\text{Cl}_2 (\text{excess}) \longrightarrow \text{NCl}_3 + 3\text{HCl}$
  - $\text{XeF}_6 + 2\text{H}_2\text{O} \longrightarrow \text{XeO}_2\text{F}_2 + 4\text{HF}$

**OR**

- When  $(\text{NH}_4)_2\text{Cr}_2\text{O}_7$  is heated, it decomposes to produce  $\text{Cr}_2\text{O}_3$ ,  $\text{H}_2\text{O}$  and  $\text{N}_2$ .  

$$(\text{NH}_4)_2\text{Cr}_2\text{O}_7 \xrightarrow{\Delta} \text{Cr}_2\text{O}_3 + 4\text{H}_2\text{O} + \text{N}_2$$
- $\text{H}_2\text{PO}_3$  or orthophosphorous acid (or phosphorous acid) on heating dissociates to give orthophosphoric acid or phosphoric acid and phosphine.  

$$4\text{H}_3\text{PO}_3 \xrightarrow{\Delta} 3\text{H}_3\text{PO}_4 + \text{PH}_3$$

7.

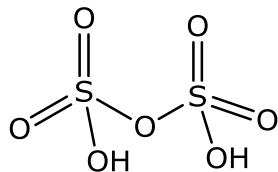
- (i) Colligative properties: Properties of solutions which depend on the number of solute particles and are independent of their chemical identity or their nature relative to the total number of particles present in the solution are called colligative properties.  
Examples: Lowering of vapour pressure, elevation of boiling point, depression of freezing point and osmotic pressure
- (ii) Molality: Molality (m) is the number of moles of the solute per kilogram (kg) of the solvent and is expressed as

$$\text{Molality (m)} = \frac{\text{Moles of solute in kg}}{\text{Moles of solvent in kg}}$$

Example:  $1.00 \text{ mol kg}^{-1}$  (or  $1.00 \text{ m}$ ) solution of KCl means that 1 mol (74.5 g) of KCl is dissolved in 1 kg of water.

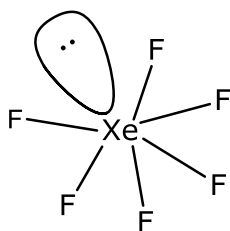
8.

- (i) Structure of  $\text{H}_2\text{S}_2\text{O}_7$ :



Pyrosulphuric acid (Oleum)  
( $\text{H}_2\text{S}_2\text{O}_7$ )

- (ii) Structure of  $\text{XeF}_6$ :



Distorted octahedral  $\text{XeF}_6$

9. Degree of dissociation of a weak electrolyte is given by the relation given below:

$$\alpha = \frac{\wedge_m}{\wedge_m^\circ}$$

Where,

$\alpha$  = degree of dissociation of the electrolyte

$\wedge_m$  = molar conductivity

$\wedge_m^\circ$  = molar conductivity at infinite dilution

Given,

$$\lambda^{\circ}(\text{H}^{+}) = 349.6 \text{ S cm}^2 \text{ mol}^{-1}$$

$$\lambda^{\circ}(\text{CH}_3\text{COO}^{-}) = 40.9 \text{ S cm}^2 \text{ mol}^{-1}$$

$$\text{Molar conductivity } (\Lambda_m) = 39.05 \text{ S cm}^2 \text{ mol}^{-1}$$

Hence, limiting molar conductivity of acetic acid is

$$\Lambda_m^{\circ} \text{ acetic acid} = \lambda^{\circ}(\text{H}^{+}) + \lambda^{\circ}(\text{CH}_3\text{COO}^{-})$$

$$= 40.9 + 349.8$$

$$= 390.7 \text{ cm}^2 \text{ mol}^{-1}$$

Substituting the values in Equation 1,

Degree of dissociation of acetic acid,

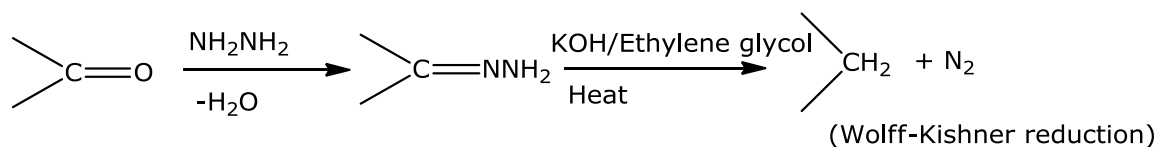
$$\alpha = \Lambda_m / \Lambda_m^{\circ}$$

$$= \frac{39.05}{390.7}$$

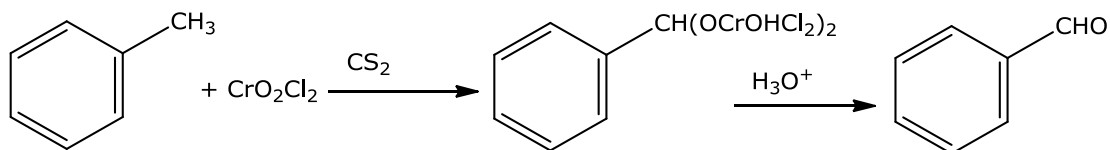
$$= 0.0999 \approx 0.1$$

**10.**

(i) Wolff-Kishner reduction



(ii) Etard reaction



**11.**

Solution :

Molar mass of sugar( $C_{12}H_{22}O_{11}$ ) =  $12 \times 12 + 22 \times 1 + 11 \times 16 = 342 \text{ g mol}^{-1}$

$$\Delta T_f = 273.15 - 269.15 = 4\text{K}$$

10% solution of sucrose means 10g of cane sugar is present =  $100 - 10 = 90\text{g}$  of water

No. of moles of cane sugar =  $10 / 342 = 0.029\text{mol}$

$$\text{molality of the solution} = \frac{0.029 \times 1000}{90} = 0.324 \text{ mol kg}^{-1}$$

We know,

$$\Delta T_f = K_f \times m$$

$$K_f = 4 / 0.324 = 12.334 \text{ K kg mol}^{-1}$$

Molar mass of glucose ( $C_6H_{12}O_6$ ) =  $6 \times 12 + 12 \times 1 + 6 \times 16 = 180 \text{ g mol}^{-1}$

10% solution of glucose means 10g of cane sugar is present =  $100 - 10 = 90\text{g}$  of water

Number of moles of glucose =  $10 / 180 \text{ mol} = 0.055\text{mol}$

$$\text{Molality of the solution} = \frac{0.055 \times 1000}{90} = 0.616 \text{ mol kg}^{-1}$$

Using the relation,

$$\Delta T_f = K_f \times m$$

$$= 12.33 \times 0.616 = 7.6$$

Therefore, the freezing point of 10% glucose solution =  $273.15 - 7.6 = 265.5\text{K}$

**12.**

(i) Solution:

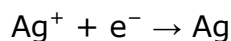
$$t = 15 \text{ min} = 900 \text{ s}$$

Current = 2A

Molar mass of Ag =  $108 \text{ g mol}^{-1}$

$$1 \text{ F} = 96500 \text{ C mol}^{-1}$$

From the reaction,



$$\text{Mass of Ag deposited} = (108 \times 1800) / (1 \times 96500) = 2.01 \text{ g}$$

(ii) A fuel cell is an electrochemical cell which converts chemical energy of a spontaneous redox reaction to electrical energy.

13.

- (i) Coordination isomerism  
 (ii) In  $[\text{Ni}(\text{H}_2\text{O})_6]^{+2}$ ,  $\text{Ni}^{+2}$  ion has two unpaired electrons, and hence, it shows colour.  
 In  $[\text{Ni}(\text{CN})_4]^{-2}$ , there is no unpaired electron, and hence, it is colourless.  
 (iii) Pentaamminecarbonatocobalt(III) chloride

14.

(i)

Lyophilic sol	Lyophobic sol
Relatively stable as strong forces of interaction exist between colloidal particles and liquid.	Less stable as weak forces of interaction exist between colloidal particles and liquid.

(ii)

Solution	Colloid
Homogeneous in nature.	Heterogeneous in nature.

(iii)

Homogeneous catalysis	Heterogeneous catalysis
The catalyst used is in the same phase as the reactants in the reaction.	The catalyst used is in a different phase in the reaction medium.

15.

(a) Data:

The integral rate law for the first-order reaction is

$$kt = \ln(a_0/at)$$

$$a_0 = 1.6 \times 10^{-2} \text{ mol L}^{-1}$$

Solution:

Case I:

$$t = 300 \text{ s}, at = 0.8 \times 10^{-2} \text{ mol L}^{-1}$$

$$k \times 300 = \ln(1.6 \times 10^{-2})/(0.8 \times 10^{-2})$$

$$k = 0.0023 \text{ s}^{-1}$$

$$t = 600 \text{ s}, at = 0.4 \times 10^{-2} \text{ mol L}^{-1}$$

Case II:

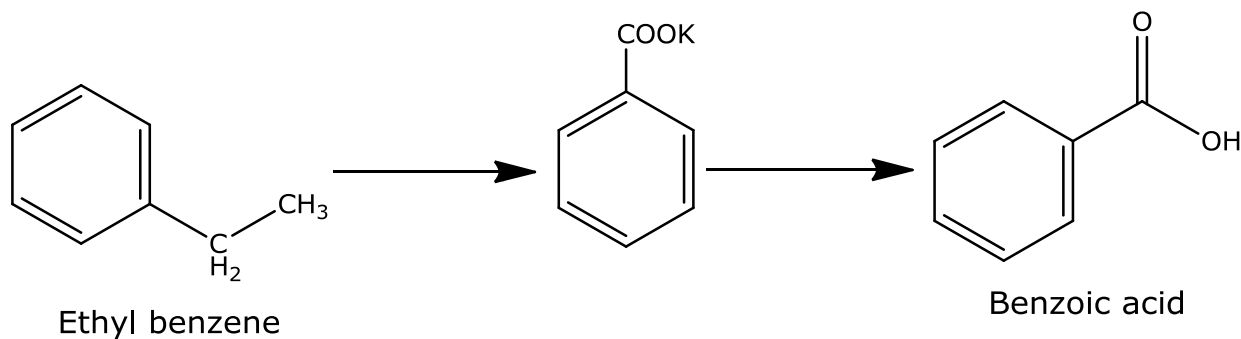
$$k \times 600 = \ln(1.6 \times 10^{-2})/0.4 \times 10^{-2}$$

$$k = 0.0023 \text{ s}^{-1}$$

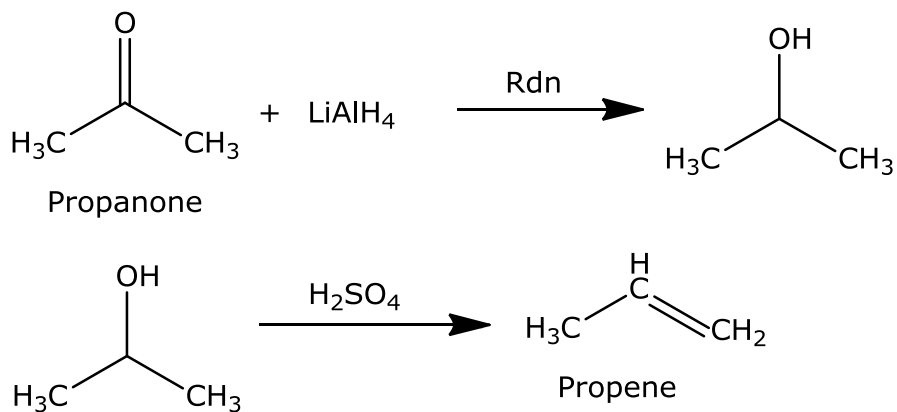
In both cases, the value of  $k$  is constant, and hence, it follows the first-order reaction.



(ii) Ethyl benzene to benzoic acid



(iii) Propanone to propene

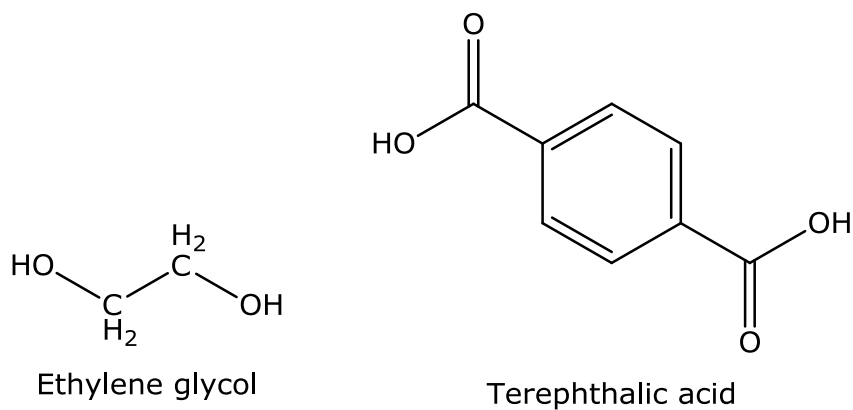


**19.**

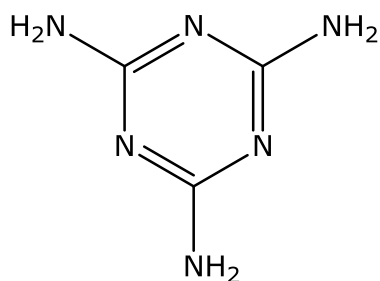
(i) Dacron

Names of monomers: Ethylene glycol and terephthalic acid

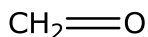
Structure:



- (ii) Melamine-formaldehyde polymer  
Names of monomers: Melamine and formaldehyde

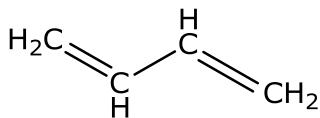


Melamine

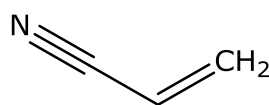


Formaldehyde

- (iii) Buna-N  
Names of monomers: 1, 3-Butadiene and acrylonitrile



1, 3-Butadiene



Acrylonitrile

**20.**

- (i) Anionic detergents:  
Anionic detergents are sodium salts of sulphonated long chain alcohols or hydrocarbons. Alkyl hydrogen sulphates formed by treating long chain alcohols with concentrated sulphuric acid are neutralised with alkali to form anionic detergents.  
Example: Sodium stearyl sulphate
- (ii) Broad spectrum antibiotics:  
These antibiotics are widely used to kill or inhibit Gram-positive and Gram-negative bacteria.  
Example: Chloramphenicol
- (iii) Antiseptics:  
Antiseptics are chemicals which either kill or prevent the growth of microorganisms. Antiseptics are applied to injured tissues, cuts and infected skin surfaces. Antiseptics are not prescribed to be taken orally.  
Examples: Furacin, soframycin

**21.**

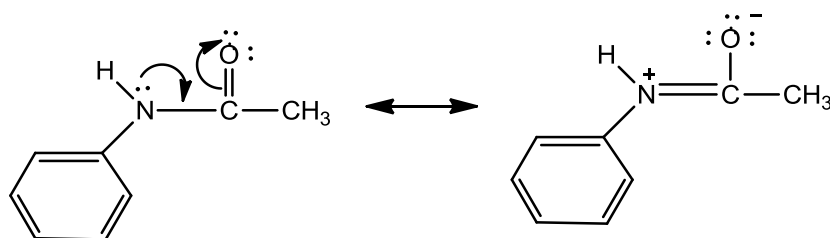
- (i) Thermal stability of hydrides decreases with an increase in molecular weight. The size of the atom (attached to H) increases because of which bond weakening occurs and the bond easily breaks. Because of these reasons, thermal stability decreases from  $\text{H}_2\text{O}$  to  $\text{H}_2\text{Te}$ .



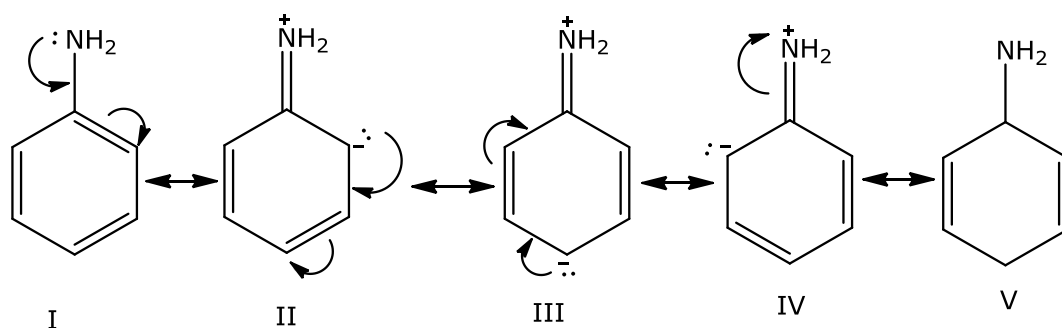
- (ii) The fluoride ion is smaller than the chloride ion. A smaller ion with the same charge has a higher charge density because of which the negative charge on the ion attracts the  $\delta^+$  H of water more strongly. Thus, the fluoride ion has higher hydration enthalpy than the chloride ion.
- (iii) Nitrogen belongs to the second period. As nitrogen has no d-orbitals in its valence shell, it cannot undergo  $sp^3d$  hybridisation and hence cannot form pentahalides.

**22.**

- (i) Acetylation of aniline reduces its activation effect.  
The lone pair of nitrogen atoms will get involved in resonance with the carbonyl group. Hence, it will reduce the negative charge or electron density on the nitrogen atom of aniline.  
Resonance involved in this reaction is

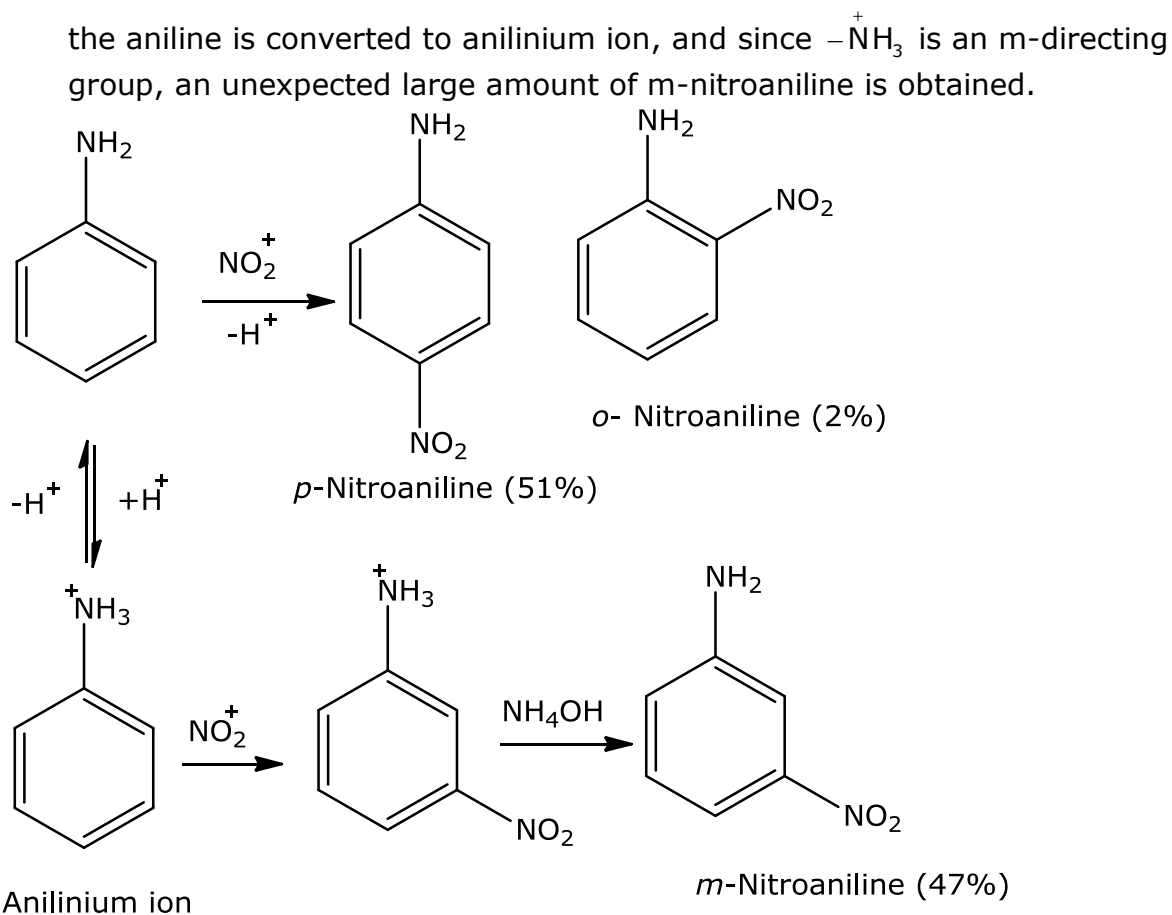


- (ii) Aromatic amines are far less basic than aliphatic amines.  
Resonance stabilisation is observed in aniline. It is a resonance hybrid.



Hence, the lone pair of electrons on the nitrogen atom gets delocalised over the benzene ring and thus becomes unavailable for the reaction. In alkyl amine, the electron density on the nitrogen atom is increased because of an electron-donating inductive effect of the alkyl group. Thus, alkyl amines are far more basic than aryl amines.

- (iii) Nitration is usually performed with a mixture of concentrated  $\text{HNO}_3$  and concentrated  $\text{H}_2\text{SO}_4$ . Under strongly acidic conditions of nitration, most of



**23.**

- (i) Values displayed by Ritu:
  - (a) She pays special attention to any kind of threat around her.
  - (b) She fulfilled her ethical responsibility by making others aware of the adverse effects.
- (ii) Starch is the polysaccharide component of carbohydrates commonly present in bread.
- (iii)  $\alpha$ -helix and  $\beta$ -pleated sheet are two types of secondary protein structures.
- (iv) Vitamin B-complex group and Vitamin C are water-soluble vitamins.

**24.**

(a)

- (i) Transition elements form complexes mainly because of the following reasons:
- Comparatively smaller size of metal ions
  - Availability of vacant d-orbitals so that these orbitals can accept lone pairs of electrons donated by ligands
  - High ionic charges
- (ii) Because the oxidation state of the transition metal is low, the lowest oxide of the transition metal is basic.  
As the oxidation number of the metal increases, the ionic character decreases. So, the highest oxide is amphoteric or acidic.
- (iii) For Mn, the '+2' oxidation state is more stable than the '+3' oxidation state, whereas for Cr, the '+3' oxidation state is more stable than the '+2' oxidation state.

(b) Similarity between the chemistry of lanthanides and actinoids:

They both have oxidation state of +3.

Differences between the chemistry of lanthanides and actinoids:

Lanthanoids have the common electronic configuration of  $6s^2$  and electrons occupy the 4f level variably.

All the actinoids have common  $7s^2$  configuration, and filling of the 5f and 6d subshells is variable.

**OR**

(a)

- (i) In transition elements, the variable oxidation states differ by 1. In p-block elements, the variable oxidation states differ by 2.
- (ii) In an aqueous medium,  $\text{Cu}^{2+}$  is more stable than  $\text{Cu}^+$ . This is because although energy is required to remove one electron from  $\text{Cu}^+$  to  $\text{Cu}^{2+}$ , high hydration energy of  $\text{Cu}^{2+}$  compensates for it. Therefore,  $\text{Cu}^+$  ion in an aqueous solution is unstable. It dissociates to give  $\text{Cu}^{2+}$  and Cu.
- (iii) In alkaline medium, the colour changes to yellow because of the conversion of dichromate ions to chromate ions.

(b) Two reasons are as follows:

There is a considerable variation observed in the chemistry of actinoids because of a very small energy difference between 5f and 5d subshells. All the elements of the actinoid series are radioactive.

25.

(a)

(i)

Data :

$$M = 93 \text{ g/mol}^{-1}$$

$$d = 11.5 \text{ g/cm}^{-3}$$

$$a = 300 \text{ pm} = 3 \times 10^{-8} \text{ cm}$$

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

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

$$= \frac{11.5 \times 6.022 \times 10^{23} \times (3 \times 10^{-8})^3}{93}$$

$$= 2.010 \cong 2$$

Number of atoms present in given unit cell = 2

So, the given unit cell is BCC.

(b)

Crystalline solids	Amorphous solids
They have regular distribution of molecules over a long distance.	They have regular distribution of molecules over a short distance.
They are anisotropic.	They are isotropic.
Example: Copper sulphate	Example: Coal

OR

(a)

Data :

Mass of aluminium = 8.1 g

Atomic mass of aluminium = 27 g / mol<sup>-1</sup>

Number of moles of Al =  $\frac{8.1}{27}$

Number of atoms =  $\frac{8.1}{27} \times 6.022 \times 10^{23} = 1.8066 \times 10^{23}$

FCC unit cell = 4 atoms

So, number of unit cells having  $1.8066 \times 10^{23}$  atoms =  $\frac{1.8066 \times 10^{23}}{4}$   
=  $4.51 \times 10^{22}$  unit cells

(b)

(i)

Schottky defect is shown by ionic solids with a very small difference in the size of their cations and anions. Frenkel defect is shown by ionic solids with a large difference in their cationic and anionic radii. In NaCl, there is a small difference in the radii of cation (Na<sup>+</sup>) and anion (Cl<sup>-</sup>). Hence, NaCl will show Schottky defect and not Frenkel defect.

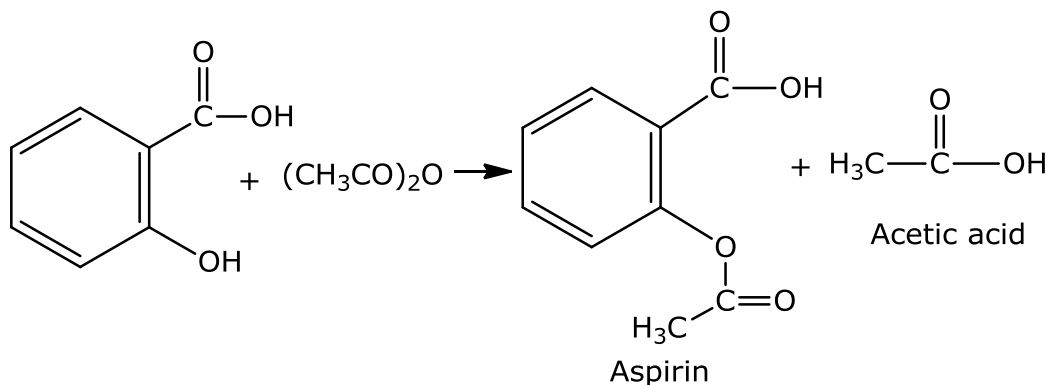
(ii) Phosphorus is an electron-rich impurity as it is an element of Group 15. When it is doped with an element of Group 14 such as silicon or germanium (Group 14 elements) which has 4 valence electrons, after forming four covalent bonds, the fifth extra electron is free and gets delocalised. These delocalised electrons increase the conductivity of Group 14 elements. As the increase in conductivity is due to negatively charged electrons, it is called an n-type semiconductor.

(iii) In ferromagnetic substances, magnetic moments are aligned in an anti-parallel arrangement such that the moments do not completely cancel out and a net magnetisation remains even when there is no applied field. While in anti-ferromagnetic substances, magnetic moments cancel out causing zero net magnetisation.

26.

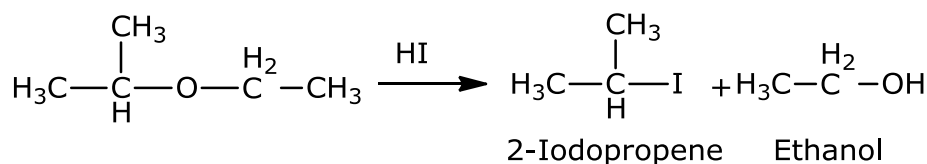
(a)

(i) Acetylation of salicylic acid:



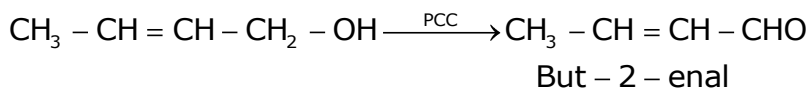
Thus, the products are aspirin and acetic acid.

(ii)



Thus, the products are 2-iodopropane and ethanol.

(iii)



Thus, the product is but-2-enal.

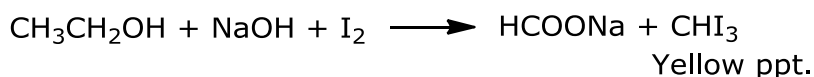
(b)

(i) Ethanol and Phenol

There are two distinguishing tests.

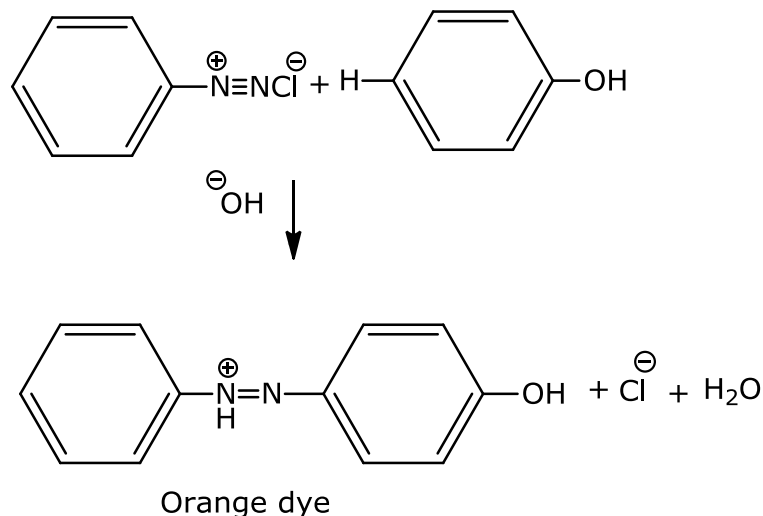
1. Iodoform test: Ethanol gives a positive result, while phenol gives a negative response to the iodoform test.

Reaction of ethanol:



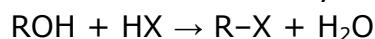
2. Coupling test: Ethanol gives a negative response, while phenol gives a positive response to the coupling test.

Reaction of phenol:

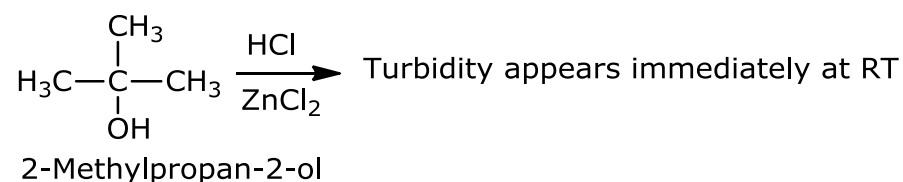


- (ii) Distinguishing test between propanol and 2-methylpropan-2-ol  
Lucas test: Difference in reactivity of three classes of alcohols with HCl distinguishes them from one another.

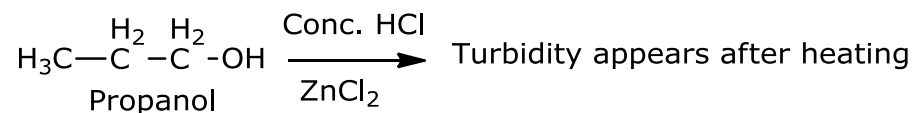
Alcohols react with hydrogen halides to form alkyl halides.



Alcohols are soluble in Lucas reagent (conc. HCl and  $\text{ZnCl}_2$ ), while their halides are immiscible and produce turbidity in solution. Because 2-methylpropan-2-ol is a tertiary alcohol, turbidity is produced immediately.



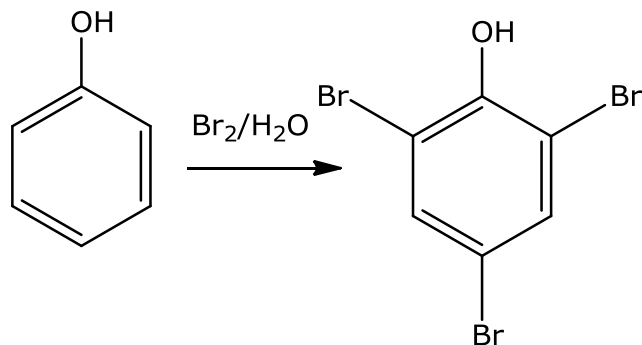
Propanol is a primary alcohol which does not produce turbidity at room temperature.



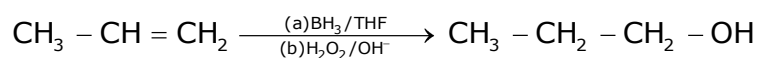
**OR**

(a)

- (i) Bromination of phenol to 2,4,6-tribromophenol  
Formulae of reagents used in the above reaction are  $\text{Br}_2/\text{H}_2\text{O}$ .



- (ii) Hydroboration of propene and then oxidation to propanol  
Formulae of reagents used in the above reaction are  $\text{BH}_3/\text{THF}$ ,  $\text{H}_2\text{O}_2/\text{OH}^-$ .



(b)

- (i) Increasing order of acidic character:  
p-nitrophenol > phenol > ethanol  
(ii) Increasing order of boiling point:  
propanol > propanal > ethanol

(c)

