

Organic Chemistry—Some Basic Principles and Techniques

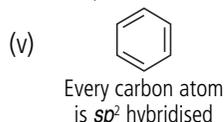
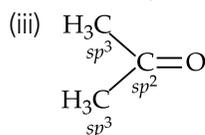
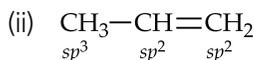
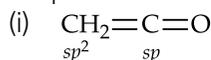
CHAPTER 12



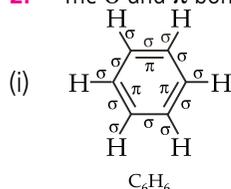
ANSWERS

Topic 1

1. The hybridisation of the carbon atoms in the given compounds are indicated below :



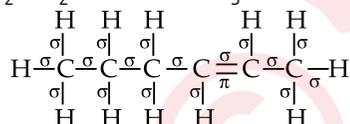
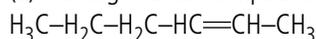
2. The σ and π bonds are indicated below :



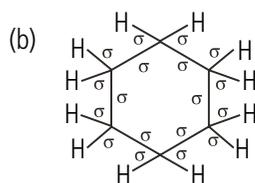
3 π and 12 σ bonds

(ii) C_6H_{12} can be either :

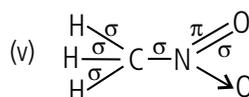
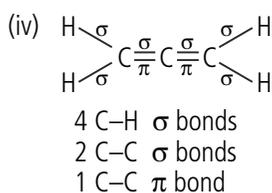
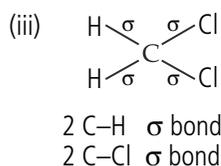
(a) Straight chain compound



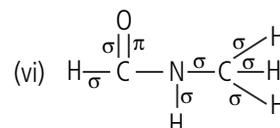
12 C-H σ -bonds } Other straight chain isomers will also have the same number of σ and π bonds.
 5 C-C σ -bonds }
 1 C-C π -bond }



6 C-C σ bonds } Other cyclic isomers will also have same no. of σ and π -bonds.
 12 C-H σ bonds }

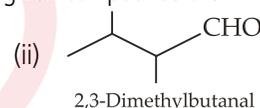
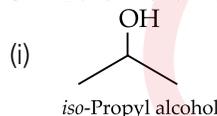


3 C-H σ bonds
 1 C-N σ bond
 2 N-O σ bonds
 1 N-O π bond

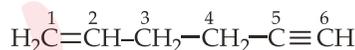


4 C-H σ bonds
 1 N-H σ bond
 1 C-O σ bond
 1 C-O π bond
 2 C-N σ bonds

3. Bond line formula for the given compounds are :

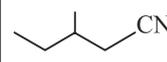
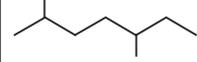
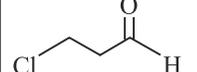


4. (c) : The carbon atom in the given compound may be numbered as :



Thus, C_2-C_3 are bonded by sp^2-sp^3 hybrid orbitals.

Topic 2

	Compound	IUPAC Name
(a)		1-Phenylpropane
(b)		3-Methylpentanenitrile
(c)		2,5-Dimethylheptane
(d)		3-Bromo-3-chloroheptane
(e)		3-Chloropropanal
(f)		2,2-Dichloroethanol

2. The correct IUPAC name out of each set of two compounds is

- (a) 2,2-Dimethylpentane (b) 2,4,7-Trimethyloctane
 (c) 2-Chloro-4-methylpentane (d) But-3-yn-1-ol

3. (a) : HCOOH

The given compound is formic acid (a carboxylic acid) and the first five members of the carboxylic acid series are :

- (1) HCOOH (2) CH₃COOH
 (3) CH₃CH₂COOH (4) CH₃CH₂CH₂COOH
 (5) CH₃CH₂CH₂CH₂COOH

(b) : CH₃COCH₃

The given compound, propanone, is a ketone and the first five members of the ketone series are :

- (1) CH₃COCH₃ (2) CH₃CH₂COCH₃
 (3) CH₃CH₂CH₂COCH₃ (4) CH₃CH₂CH₂CH₂COCH₃
 (5) CH₃CH₂CH₂CH₂CH₂COCH₃

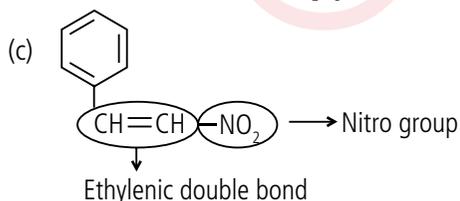
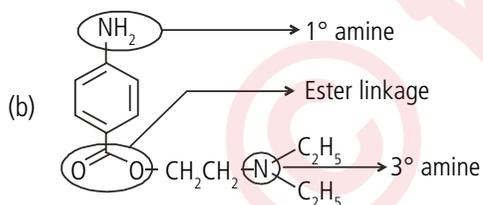
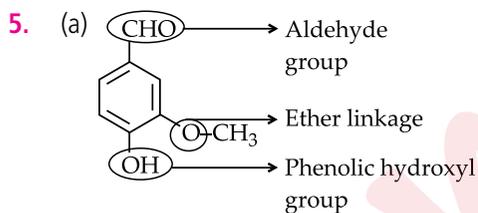
(c) : CH₂=CH₂

Ethene is an alkene and the first five members of the alkene series are :

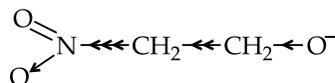
- (1) CH₂=CH₂ (2) CH₃-CH=CH₂
 (3) CH₃CH₂-CH=CH₂ (4) CH₃CH₂CH₂-CH=CH₂
 (5) CH₃CH₂CH₂CH₂-CH=CH₂

4.

	Molecular formula	Bond line structure	Condensed structure	Functional groups
(a)	2,2,4-Trimethyl pentane		(CH ₃) ₃ CCH ₂ CH(CH ₃) ₂	-
(b)	2-Hydroxy-1,2,3-propanetri-carboxylic acid		HOOCCH ₂ C(OH)(COOH)CH ₂ COOH	-OH (hydroxyl) -COOH (carboxyl) group
(c)	Hexanedial		OHC(CH ₂) ₄ CHO	-CHO aldehyde group



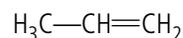
charge is possible in I but not in II. Hence, I is more stable. This dispersal/delocalisation of negative charge happens in I due to the presence of the -NO₂ group which is electron withdrawing in nature. Due to this electron withdrawal, the charge on the oxygen atom disperses (spreads) and the ion becomes more stable.



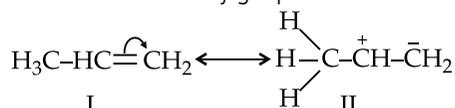
2. Alkyl groups attached to a π-bonded system tend to act as electron donors by virtue of hyperconjugation.

Hyperconjugation is the phenomenon wherein σ-electrons of a C—H bond enter into partial conjugation with the attached π-system.

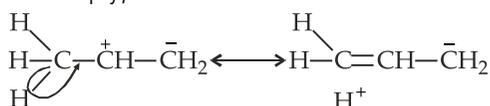
In order to envision this, consider the following π-system :



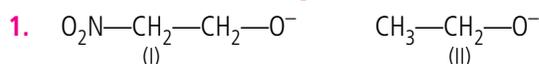
Here, the π-electron cloud may get polarised as :



As soon as state II is achieved an electron pair from one of the C—H bonds from the neighbouring methyl group moves towards the empty p-orbital on C⁺ and leads to bond formation.

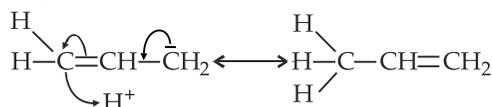


Topic 3

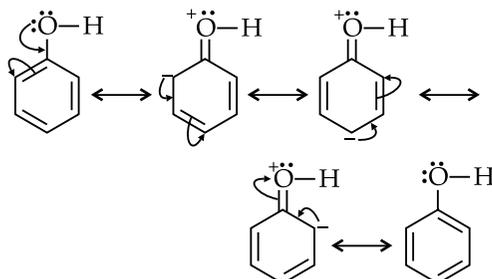


In order to find the more stable one of the two given ions we need to understand that any ion, whether positively charged or negatively charged, is stable if it is somehow able to diminish the charge appearing on it or, is able to delocalise (spread) the charge on more than one atom. Such a delocalisation of

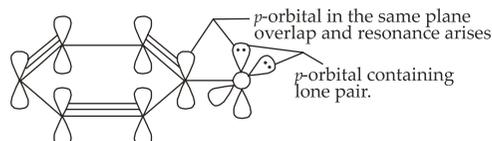
The hydrogen of the C–H bond remains in vicinity and rebonds with the carbon as :



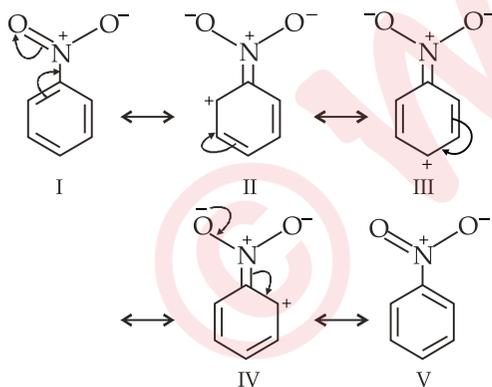
3. (a) Resonance structures of phenol are



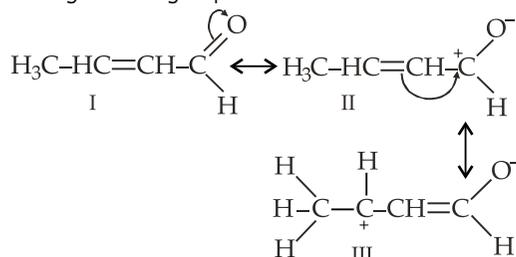
Phenol is a planar molecule. The p -orbitals on each carbon atom lie perpendicular to the plane of the molecule, the oxygen atom lying in its p -orbital is also perpendicular to the molecule. Consequently the p -orbital overlap, between O and C takes place and the resonance structures arise.



(b) $-\text{NO}_2$ is an electron withdrawing group. As a result, it polarises the benzene molecule and resonance occurs as shown :

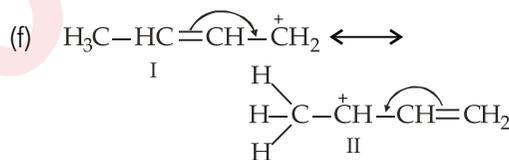
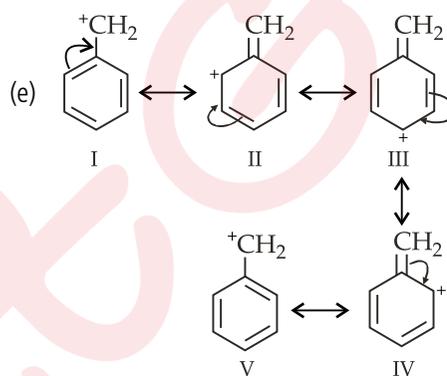
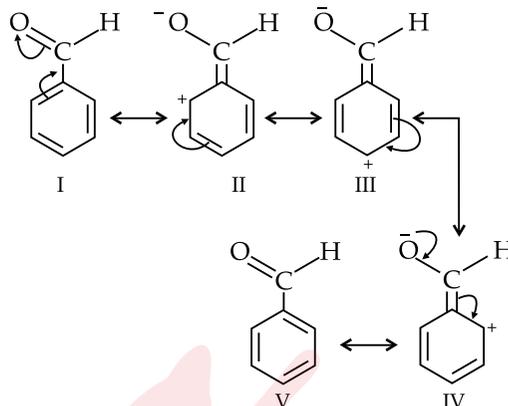


(c) $\text{CH}_3\text{CH}=\text{CHCHO}$ is an α, β -unsaturated aldehyde where the $\text{C}=\text{C}$ gets polarised due to the neighbouring electron withdrawing $-\text{CHO}$ group.



(d) Oxygen being highly electronegative pulls the π -electron cloud of the $\text{C}=\text{O}$ towards itself thereby leaving the carbonyl

carbon with a positive charge. In order to compensate this electron deficiency, the electron cloud from the ring moves towards it and the resonance structures arise.

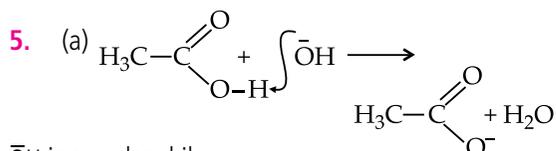


4. (a) **Electrophiles** : The word electrophile is derived from electron + philia. 'Philia' refers to attraction. Thus, any species which has an attraction or affinity for electrons is termed as an electrophile.

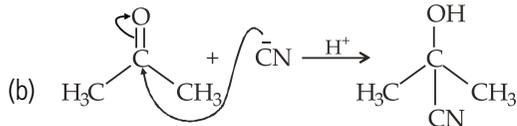
Species that qualify as electrophiles may either be positively charged or without any formal charge, *i.e.*, they are electron deficient species which do not have a complete octet around them. Examples include group 13 halides like BCl_3 , BF_3 , AlCl_3 , etc., or NO_2 , H^+ , CH_3CO^+ , etc.

(b) **Nucleophiles** : 'Nucleo' refers to any positively charged centre. Thus, species that are attached to or have an affinity for a positively charged centre are termed as nucleophiles. (Nucleo + phile = Nucleus loving).

Nucleophiles may either be negatively charged such as Cl^- , Br^- , I^- , F^- , CH_3COO^- , OH^- , CN^- , etc. or be electron rich species without any negative charge. The best example of such a nucleophile is H_2O molecule. Here, the oxygen atom has two lone pairs of electrons and therefore acts as a nucleophile.

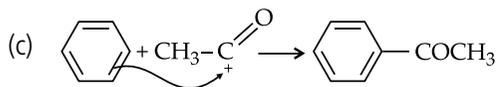


$\bar{\text{O}}\text{H}$ is a nucleophile.



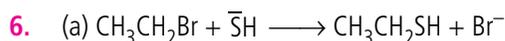
$\bar{\text{C}}\text{N}$ is a nucleophile.

The carbonyl carbon is a positive centre, since the oxygen withdraws the carbonyl electron and leaves the carbon atom electron deficient.

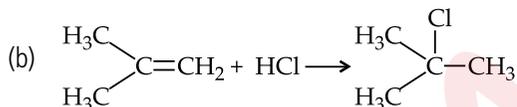


$\text{CH}_3\overset{+}{\text{C}}\text{O}$ is an electrophile.

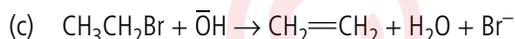
Benzene being an electron rich molecule, is most suitable for an electrophilic attack.



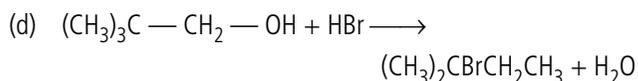
Here, $\bar{\text{S}}\text{H}$, a nucleophile displaces Br^- from the bromoalkane. Since, the reaction is brought about by a nucleophile and substitution occurs thereafter, the reaction will be termed as a nucleophilic substitution reaction.



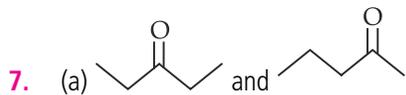
In the given reaction we see that the H^+ and Cl^- reacted with the alkene and thus, produced a haloalkane. However, no atom has been displaced. Thus, the reaction is an electrophilic addition reaction.



Here there is no atom which is displaced or substituted. Although the reaction is brought about by a nucleophile $\bar{\text{O}}\text{H}$ it is not a nucleophilic substitution. An HBr molecule has been removed from the reactant and hence, it is an elimination reaction.

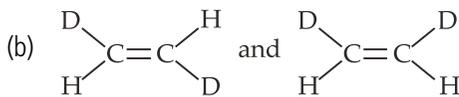


This is an example of a rearrangement followed by nucleophilic substitution. Initially, a 1° carbocation is formed which rearranges to produce a more stable 3° carbocation. Finally, Br^- attacks the carbocation and product is formed.

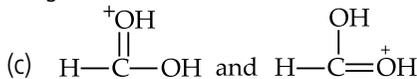


are structural isomers.

Structural isomerism arises when two compounds have the same molecular formula but differ in structure *i.e.*, arrangement of atoms.

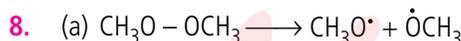


are geometrical isomers.



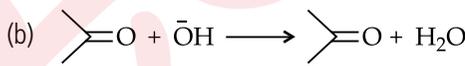
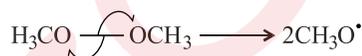
are resonance stabilized structures.

Such structures arise when the arrangement of atoms remains the same but the bonding pattern differs.



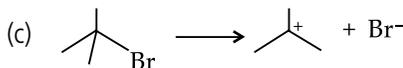
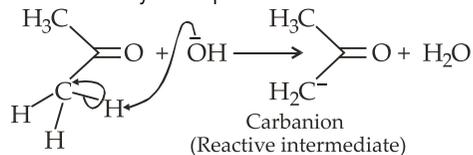
This is an example of homolysis which gives rise to free radicals (the word 'homo' means same and 'lysis' means breakage. The bond breakage which results in species of the same kind *e.g.*, free radicals is called homolysis).

Electron flow :



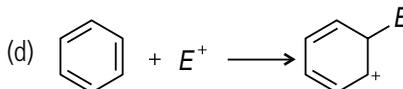
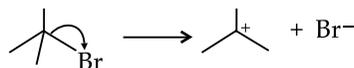
This is an example of heterolysis where bond breakage results in formation of two different species.

The electron flow may be depicted as :



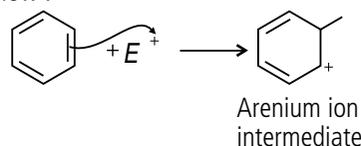
Given reaction is an example of heterolysis where reactive intermediate is a carbocation.

Electron flow :



This is heterolysis where intermediate is the arenium (carbocation) ion.

Electron flow :



9. **Inductive effect** : Polarisation of σ -bond due to the electron donating or withdrawing nature of groups attached is called inductive effect.

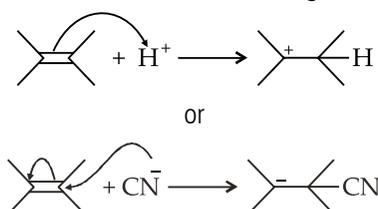
Topic 4

e.g. Attachment of Cl an electronegative atom to an ethane molecule causes the carbons to carry a δ^+ charge.



This induced polarity due to presence of Cl atom is an example of inductive effect.

Electromeric effect : In the presence of an attacking reagent, the π -electron cloud in a multiple bonded compound tends to get polarized. Such an effect is termed as temporary effect and the original condition is restored if the reagent is removed.

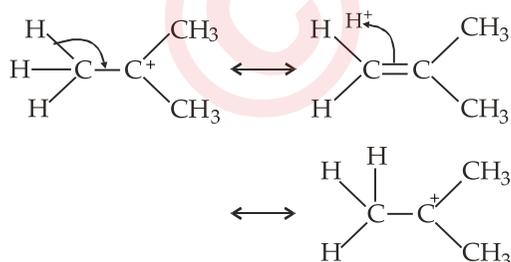


(a) The given order of acidity can be explained by $-I$ effect. Cl is an electronegative atom which withdraws electrons from the adjacent carbon. This in turn pulls electrons from the carboxylic group which results in increased acidity. Thus, more the no. of Cl atoms, higher is the acidic strength.



(b) $-\text{CH}_3$ group is an electron donating group and increases the electron density of the adjacent carbon and this transfers the electron density on the $-\text{COOH}$ group. As a result, the release of H as H^+ becomes difficult and the acidity decreases. So, if the number of such $-\text{CH}_3$ groups is more on the α -carbon, then the acidic strength decreases.

10. (b) : $(\text{CH}_3)_3\overset{+}{\text{C}}$ or *tert*-butyl cation is the most stable of all the given cations. The stability is due to the presence of three methyl groups attached to the carbocation centre. The hydrogens in the methyl group, by hyperconjugation, diminish the electron deficiency (+ve charge) on the carbocation and hence, stabilize it.



In *tert*-butyl cation the no. of such H atoms which are capable of hyperconjugation is maximum. Thus, it is most stable. In short, greater the no. of α -H more stable will be the carbocation.

11. (b) : $\text{CH}_3\text{CH}_2\text{I} + \text{KOH}_{(aq)} \longrightarrow \text{CH}_3\text{CH}_2\text{OH} + \text{KI}$

In the given reaction, the I^- from the alkyl iodide is replaced by the OH^- ion. Thus, it is substitution reaction.

The substitution is brought about by the OH^- ion which is a nucleophile.

\therefore The reaction is a nucleophilic substitution reaction.

1. (a) Crystallisation : It is based on the difference in solubility of the compound and the impurities in a suitable solvent. While at room temperature, the compound is sparingly soluble and crystallizes out of solution but the impurities do not. As a result, they remain in solution and the compound is obtained as a crystal.

The impure compound is dissolved in a solvent and heated. At elevated temperature the compound dissolves as do the impurities. This solution is then gradually cooled. Being less soluble at room temperature it precipitates out in the form of crystals and pure compound is obtained.

(b) Distillation : This method is used to separate either :

- (i) Volatile liquids from non-volatile impurities; and
- (ii) Two liquids with different boiling points.

The liquid mixture such as that of chloroform and aniline is taken in a round bottom flask fitted with a condenser.

Upon heating, the vapours of lower boiling liquid are formed first and collected through the condenser. The vapours of the higher boiling liquid are formed later. Thus, the two are separated.

(c) Chromatography : (i) It is applicable for the separation of virtually all inorganic and organic materials, except very insoluble polymers.

(ii) In this technique, the mixture of compounds which needs to be separated is applied onto a stationary phase, which may be a solid or a liquid. Another phase which may be a pure solvent, a mixture of solvents or a gas is allowed to move slowly over the stationary phase.

(iii) The components of the mixture which have different solubility in the moving phase, start moving. Since, they have different solubility, they move to different lengths on the stationary phase and become stable there.

(iv) Thus, the different components of the mixture are separated.

2. Crystallization is the process that may be employed to separate two compounds with different solubility in a given solvent at room temperature.

Upon heating such a solution to a sufficiently high temperature the solubility of the compound which is insoluble at room-temperature, increases and it dissolves. However, when this solution is cooled down to room temperature the lesser soluble or insoluble component precipitates out and is obtained as crystals while its soluble counterpart remains in solution. Thus, the separation is complete.

3. Differences between distillation, distillation under reduced pressure and steam distillation may be summarized as :

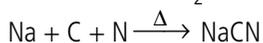
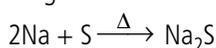
Criterion for difference	Distillation	Distillation under reduced pressure	Steam distillation
Used for	Separation of volatile liquids from non-volatile impurities.	Separation of liquids having very high boiling points or those, which decompose at or below their boiling points.	For a substances which are immiscible in water but are steam volatile.
Difference in b.p. of liquids involved	The liquids involved differ in their b.pt. by 40-50°C.	—	The liquids separated by this method have very high b.pt. e.g., aniline has b.pt. of 184°C.
Method	Simple heating of the mixture in a round bottom flask fitted with condenser allows the lower boiling liquid to be collected first and the higher boiling one is collected later.	Since, one of the component decomposes before reaching its boiling point the heating is carried out under reduced pressure so that boiling occurs at a lower temperature and the component is collected in pure form.	Mixture of steam and volatile organic compound is condensed and collected. The compound is separated from water using a separating funnel.
Example	A mixture of chloroform (b.pt. 334 K and aniline b.pt. 457 K).	Separation of glycerol from spent - lye in soap industry.	Separation of aniline from aniline-water mixture.

4. The underlying principle of paper chromatography is that of partition chromatography which is based on continuous differential partitioning of components of mixture between stationary and mobile phases. In paper chromatography, the paper used has water trapped in it which acts as the stationary phase while a suitable solvent or a mixture of solvents is used as a mobile phase. A strip of chromatography paper spotted at the base with the solution of the mixture is suspended in a suitable solvent or a mixture of solvents. As the mobile phase moves over the paper, it carries the mixture with it. Since the different components have different solubility, they travel to different extents on the paper and become stationary at different lengths on the paper and are thus, separated.

5. Camphor is sublimable compound while CaSO_4 being ionic is not. Therefore, the two can be separated by the method of sublimation. If a mixture of the two is heated in a China dish covered with a porous paper and an inverted funnel over it, we will find the crystals of camphor forming on the inside walls of the inverted funnel. Thus, pure CaSO_4 will be left in the China dish.

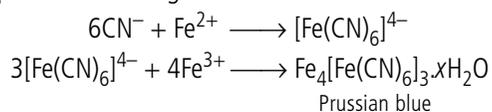
6. (d)

7. The elements nitrogen, sulphur and halogens are tested in an organic compound by Lassaigne's test. The organic compound (N, S or halogens) is fused with sodium metal as to convert these elements into ionisable inorganic substances, i.e., nitrogen into sodium cyanide, sulphur into sodium sulphide and halogens into sodium halides.

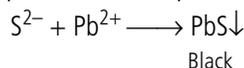


Once the ions are formed, the inorganic tests can be applied to them and the compound can be analysed.

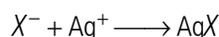
(i) **Test for Nitrogen** : The sodium fusion extract is boiled with iron(II) sulphate and then acidified with concentrated sulphuric acid. The formation of Prussian blue colour confirms the presence of nitrogen.



(ii) **Test for Sulphur** : The sodium fusion extract is acidified with acetic acid and lead acetate is added to it. A black precipitate of lead sulphide indicates the presence of sulphur.



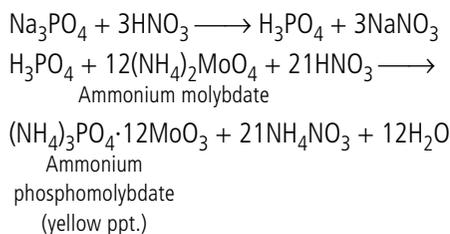
(iii) **Test for Halogens** : The sodium fusion extract is acidified with nitric acid and then treated with silver nitrate. A white precipitate, soluble in ammonium hydroxide shows the presence of chlorine, a yellowish precipitate, sparingly soluble in ammonium hydroxide shows the presence of bromine and a yellow precipitate, insoluble in ammonium hydroxide shows the presence of iodine.



X represents a halogen – Cl, Br or I.

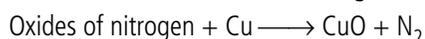
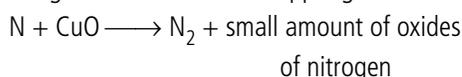
(iv) **Test for Phosphorus** : The compound is heated with an oxidising agent (sodium peroxide). The phosphorus present in the compound is oxidised to phosphate. The solution is boiled with nitric acid and then treated with ammonium molybdate.

A yellow colouration or precipitate indicates the presence of phosphorus.



8. The principle of estimation of nitrogen by Dumas method and that by Kjeldahl's method may be summarized as :

(i) **Duma's method** : The weighed amount of organic compound is heated with cupric oxide in the atmosphere of CO_2 to get free nitrogen along with CO_2 and H_2O . Some oxides of nitrogen are also formed which are reduced to free nitrogen by passing over a hot reduced copper gauze.



Nitrogen gas thus formed is collected over conc. KOH solution which absorbs all other gases except N_2 . Volume of nitrogen collected can be noted and thus percentage of nitrogen can be calculated.

Percentage of nitrogen

$$= \frac{28}{22400} \times \frac{\text{Volume of N}_2 \text{ at NTP}}{\text{Weight of organic compound taken}} \times 100$$

Volume of N_2 collected at room temperature must be converted to volume at NTP.

(ii) **Kjeldahl's method** : In this method the weighed compound is heated with conc. H_2SO_4 in presence of K_2SO_4 and CuSO_4 (catalyst), so that nitrogen is quantitatively converted into ammonium sulphate. Ammonium sulphate thus obtained is boiled with excess NaOH solution to liberate ammonia gas, which is absorbed in a known excess of a standard acid like H_2SO_4 or HCl. The amount of ammonia produced is determined by estimating the amount of sulphuric acid consumed in the reaction. It is done by estimating unreacted sulphuric acid left after the absorption of ammonia by titrating it with standard alkali solution. The difference between the initial amount of acid taken and that left after the reaction gives the amount of acid reacted with ammonia.

Percentage of nitrogen

$$= \frac{1.4 \times \text{Volume of acid used (mL)} \times \text{Normality of acid}}{\text{Weight of organic compound taken}}$$

or in general

$$\text{Percentage of nitrogen} = \frac{1.4 \times \text{milliequivalent of acid}}{\text{Weight of organic compound taken}}$$

This is a simple and convenient method and used in estimation of nitrogen in food stuff, fertilizers, drugs, etc. But this method fails to the compounds containing nitrogen in the ring (e.g., pyridine) and compounds containing nitrogen directly linked to oxygen atom (e.g., NO_2 , NO, etc.) or another nitrogen atom like —N=N— (azo), azoxy, diazo, hydrazones, oximes, etc.

9. Principles of estimation

(1) **Estimation of halogens by Carius method** : Upon heating an organic compound with fuming HNO_3 in the presence of AgNO_3 , the halogen present in the compound forms the corresponding silver halide which is collected filtered; washed, dried and weighed. This is the amount of halogen present in the compound.

Let the mass of organic compound taken = m g

Mass of AgX formed = m_1 g

1 mol of AgX contains 1 mol of X

$$\text{Mass of halogen in } m_1 \text{ g of AgX} = \frac{\text{atomic mass of X} \times m_1 \text{g}}{\text{molecular mass of AgX}}$$

$$\text{Percentage of halogen} = \frac{\text{atomic mass of X} \times m_1 \times 100}{\text{molecular mass of AgX} \times m}$$

(2) **Estimation of sulphur** : An organic compound containing sulphur is heated with fuming nitric acid. This oxidises the sulphur to sulphuric acid which is precipitated as BaSO_4 upon reaction with Ba(OH)_2 . The mass of BaSO_4 tells the % of sulphur present in the compound.

Let the mass of organic compound taken = m g

and the mass of barium sulphate formed = m_1 g

1 mol of $\text{BaSO}_4 = 233$ g $\text{BaSO}_4 = 32$ g sulphur

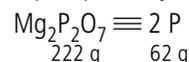
m_1 g BaSO_4 contains $\frac{32 \times m_1}{233}$ g sulphur

$$\text{Percentage of sulphur} = \frac{32 \times m_1 \times 100}{233 \times m}$$

(3) **Estimation of phosphorus** : A known mass of an organic compound is heated with fuming nitric acid and phosphorus present in the compound is oxidised to phosphoric acid. It is precipitated as ammonium phosphomolybdate, $(\text{NH}_4)_3\text{PO}_4 \cdot 12\text{MoO}_3$, by adding ammonia and ammonium molybdate. Alternatively, phosphoric acid may be precipitated as MgNH_4PO_4 by adding magnesia mixture which on ignition yields $\text{Mg}_2\text{P}_2\text{O}_7$.

Let the mass of organic compound taken = m g

and mass of ammonium phosphomolybdate = m_1 g



$$\text{Percentage of phosphorus} = \frac{62 \times m_1 \times 100}{222 \times m}$$

10. Halogens are detected by AgNO_3 due to the formation of AgX ppt. But, if the Lassaigne's extract contains S^{2-} or CN^- ions, then they may interfere in the test for halogens.

CN^- and S^{2-} form AgCN and Ag_2S with AgNO_3 and may produce erroneous results. Therefore, the Lassaigne's extract is treated with HNO_3 to decompose them to HCN and H_2S (vapours) so as to prevent interference.

11. Lassaigne's test is used for the detection of extra elements such as N, S and X by applying the inorganic tests of analysis to these. Since, in organic compounds, the elements are present in covalent form and inorganic tests can be applied only to ions, therefore these extra elements are first converted into their inorganic (ionic) forms by fusing with sodium metal.

12. We know that any liquid boils when its vapour pressure is equal to the atmospheric pressure. There are certain liquids such as aniline which need very high temperature in order to start boiling. It is quite likely that at such elevated temperatures the molecules may just disintegrate. Therefore, to prevent this, steam distillation is employed. Here, the mixture of organic liquids containing the high boiling liquid say, aniline is mixed with water and heated. On doing so, at a temperature close to but less than 100°C (b.p. of water) the vapour pressure of water equals the atmospheric pressure and it boils. Since, in the mixture, aniline is present in conjugation with water it vapourises and moves out of the mixture.

The mixture of water and aniline is separated using a separating funnel. Steam distillation is used extensively in perfumery to separate essential oils.

13. AgNO_3 solution is ionic in nature. It contains Ag^+ ions which when react with Cl^- ions produce a white ppt. of AgCl . In CCl_4 the Cl atoms are covalent in nature. They are not present as ions. Therefore, when AgNO_3 is added it, it does not produce a white ppt. of AgCl .

14. KOH reacts with CO_2 to produce K_2CO_3 which is a solid. The K_2CO_3 formed may be weighed and estimated to know the carbon content of the organic compound.

15. Sulphuric acid cannot be used for acidification of sodium extract because it would oxidize the sulphur to sulphur dioxide which would not give the black ppt. of PbS , which is otherwise obtained upon reaction with lead acetate.

16. Given : % of carbon = 69

% of hydrogen = 4.8

% of oxygen = $100 - (69 + 4.8) = 26.2$

Mass of compound = 0.2 g

100 g of compound contains 69 g of C

0.2 g of compound contains $\frac{69 \times 0.2}{100} = 0.138$ g of C

Also, 12 g of C produces 44 g of CO_2

\therefore 0.138 g of C will give = $\frac{44 \times 0.138}{12} = 0.506$ g of CO_2

100 g of compound contains 4.8 g of H

\therefore 0.2 g of compound contains $\frac{4.8 \times 0.2}{100} = 0.0096$ g of H

Also, 2 g of H produces 18 g of H_2O

\therefore 0.0096 g of H produces $\frac{18 \times 0.0096}{2} \text{g} = 0.0864$ g of H_2O

Thus, mass of CO_2 produced = 0.506 g

and mass of H_2O produced = 0.0864 g

17. Given : Mass of compound taken (M) = 0.50 g

Vol. of H_2SO_4 (V) = 50 mL

Molarity of H_2SO_4 (M) = 0.5 M

Vol. of NaOH required (V_1) = 60 mL

Molarity of NaOH required (M) = 0.5 M

Formula used :

$$\% \text{ of N} = \frac{1.4 \times M \times 2 \left[V - \frac{V_1}{2} \right]}{m}$$

By substituting the values in the formula, we get,

$$\% \text{ of N} = \frac{1.4 \times 0.5 \times 2(50 - 60/2)}{0.5} = 56$$

\therefore % of N in the given compound = 56%

18. Given : Mass of organic compound = 0.3780 g

Mass of silver chloride = 0.5740 g

1 mol of AgCl = 143.5 g

143.5 g of AgCl contains 35.5 g of Cl

\therefore 0.5740 g of AgCl contains $\frac{35.5 \times 0.574}{143.5} = 0.142$ g of Cl

0.142 g of Cl is present in 0.3780 g of the compound

\Rightarrow % of Cl in compound = $\frac{0.142}{0.378} \times 100 = 37.57\%$

19. Given : Mass of organic sulphur compound = 0.468 g

Mass of BaSO_4 = 0.668 g

1 mol of BaSO_4 = 233 g

233 g of BaSO_4 contains 32 g of S

\therefore 0.668 g of BaSO_4 contains $\frac{0.668 \times 32}{233} = 0.09174$ g of S

0.09174 g S is present in 0.468 g of the compound.

\Rightarrow % of S in compound = $\frac{0.09174}{0.468} \times 100 = 19.6\%$

20. (b) : The Prussian blue colour in the Lassaigne's test is due to the formation of $\text{Fe}_4[\text{Fe}(\text{CN})_6]_3$.

