

CHAPTER 8

Organic Chemistry – Some Basic Principles and Techniques

VEDA
ACADEMY

CLASS 11TH

NCERT EXERCISE AND SOLUTIONS - CHEMISTRY

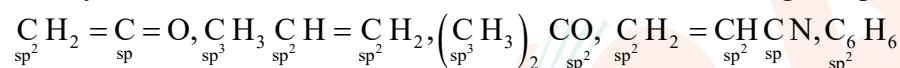


Q. 1. What are hybridisation states of each carbon atom in the following compounds?

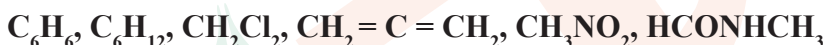


ANSWER:-

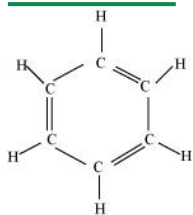
The hybridisation states of each carbon atom in the following compounds are given below.



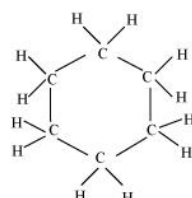
Q. 2. Indicate the σ and π bonds in the following molecules.



ANSWER:-



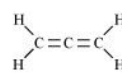
Benzene



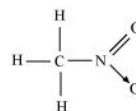
Cyclohexane



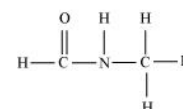
Dichloromethane



Allene



Nitromethane



N-methyl formamide

Benzene contains 6 C–C sigma bonds, 3 C = C pi bonds and 6 C–H sigma bonds respectively.

Cyclohexane contains 6 C – C sigma bonds and 12 C – H sigma bonds.

Dichloromethane contains 2 C–H sigma bonds and 2 C – Cl sigma bonds.

Allene contains 2 C–C sigma bonds, 2 C = C pi bonds and 4 C – H pi bonds.

Nitromethane contains 3 C–H sigma bonds, 1 C – N sigma bond, 2 N–O sigma bonds and 1 N=O pi bond.

N-methyl formamide contains 2 C–N sigma bonds, four C–H sigma bonds, one N–H sigma bond, one C–O sigma bond and one C–O pi bond.

Q. 3. Write the bond line formula for the following compounds:

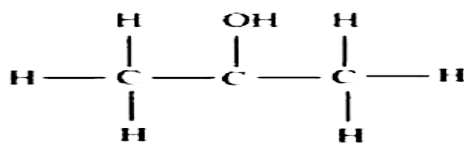
I. Isopropyl alcohol **II.** 2,3-Dimethyl butanal **III.** Heptan-4-one

ANSWER:-

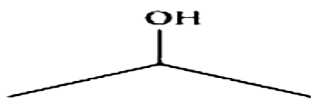
The bond line formulae of the given compounds are:



(a) Isopropyl alcohol



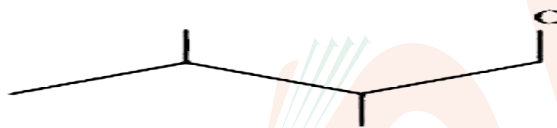
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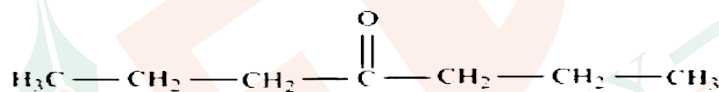
(b) 2, 3-dimethyl butanal



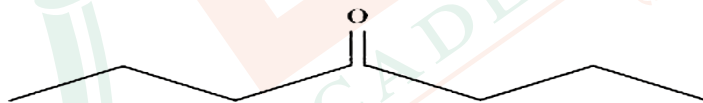
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(c) Heptan-4-one

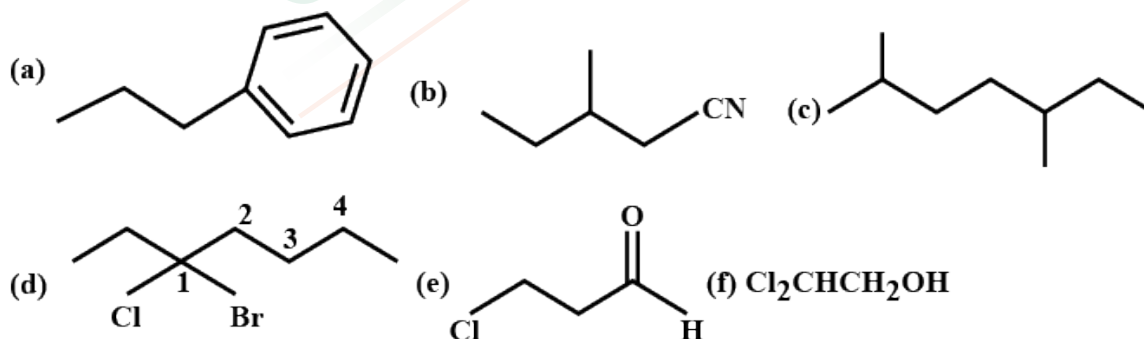


⇒



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Q. 4. Give the IUPAC names of the following compounds:



ANSWER:-

(a) 3-phenyl propane

(b) 2-methyl-1-cyanobutane

(c) 2, 5-dimethyl heptane

(d) 3-bromo-3-chloroheptane

(e) 3-chloropropanal

(f) 2,2-dichloroethanol

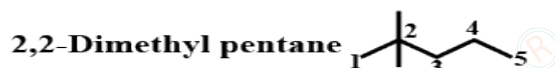


Q. 5. Which of the following represents the correct IUPAC name for the compound concerned?

- A. 2, 2 - Dimethylpentane or 2 - Dimethylpentane
 B. 2, 4, 7 - Trimethyloctane or 2, 5, 7 - Trimethyloctane
 C. 2 - Chloro- 4 - methylpentane or 4 - chloro 2 - methylpentane
 D. But - 3 - yn- 1 - ol- or But - 4 -ol - 1 -yne

ANSWER:-

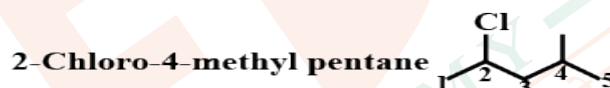
- (a) The prefix di in the IUPAC name indicates that two identical substituent groups are present in the parent chain. Since two methyl groups are present in the C-2 of the parent chain of the given compound, the correct IUPAC name of the given compound is 2, 2-Dimethylpentane.



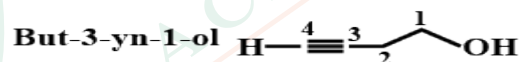
- (b) Locant sum for 2, 4, 7 is lower than 2, 5, 7. Hence, the IUPAC name of the given compound is 2, 4, 7-Trimethyloctane.



- (c) If the substituents are present in the equivalent position of the parent chain, then the lower number is given to the one that comes first in the name according to the alphabetical order. Hence, the correct IUPAC name of the given compound is 2-Chloro-4-methylpentane



- (d) Two functional groups – alcoholic and alkyne – are present in the given compound. The principal functional group is the alcoholic group. Hence, the parent chain will be suffixed with ol. Hence, the correct IUPAC name of the given compound is But-3-yn-1-ol.



Q. 6. Draw the formulae for the first five members of each homologous series beginning with the following compounds:

- a. H-COOH
 b. CH₃-COOH₃
 c. H - CH = CH₂

ANSWER:-

- a. i. HCOOH (Methanoic acid)
 ii. CH₃COOH (Ethanoic acid)
 iii. CH₃CH₂COOH (Propanoic acid)
 iv. CH₃CH₂CH₂COOH (Butanoic acid)
 v. CH₃CH₂CH₂CH₂COOH (Pentanoic acid)



- b.**
- $\text{CH}_3 - \text{CO} - \text{CH}_3$ (Propanone)
 - $\text{CH}_3 - \text{CO} - \text{CH}_2\text{CH}_3$ (Butan - 2 - one)
 - $\text{CH}_3 - \text{CO} - \text{CH}_2\text{CH}_2\text{CH}_3$ (Pentan - 2 - one)
 - $\text{CH}_3\text{COC}_4\text{H}_9$ (Hexan - 2 - one)
 - $\text{CH}_3\text{COC}_5\text{H}_{11}$ (Heptan - 2 - one)
- c.**
- $\text{CH}_2 = \text{CH}_2$ (Ethene)
 - $\text{CH}_3\text{CH} = \text{CH}_2$ (Propene)
 - $\text{CH}_3\text{CH}_2\text{CH} = \text{CH}_2$ (But - 1 - ene)
 - $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH} = \text{CH}_2$ (Pent - 1 - ene)
 - $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{CH} = \text{CH}_2$ (Hex - 1 - ene)

Q. 7. Give condensed and bond line structural formulas and identify the functional group(s) present, if any, for :

- 2, 2, 4-Trimethylpentane
- 2-Hydroxy-1, 2, 3-propanetricarboxylic acid
- Hexanedial

ANSWER:-

- (a)** 2, 2, 4-Trimethylpentane

Condensed formula:



Bond line formula:

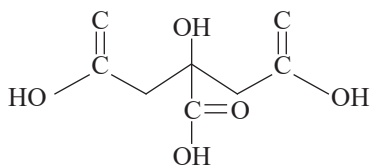


- (b)** 2-Hydroxy-1,2,3-propanetricarboxylic acid

Condensed formula



Bond line formula



The functional groups present in the given compound are carboxylic acid ($-\text{COOH}$) and alcoholic ($-\text{OH}$) groups.

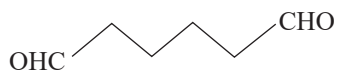


(c) Hexanedial

Condensed formula

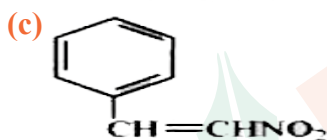
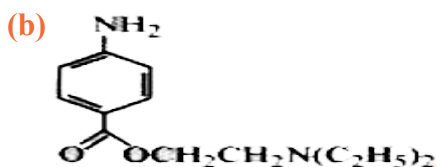
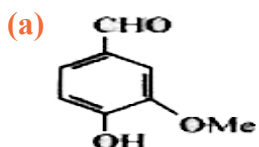


Bond line formula



The functional group present in the given compound is aldehyde (-CHO).

Q. 8. Identify the functional groups in the following compounds.



ANSWER:-

(a) The functional groups present in the given compounds are

Aldehyde (-CHO)

Hydroxyl (-OH)

Methoxy (OMe)

Double bond (-C = C-)

(b) Amino(-NH₂); primary amine

Ester(-O-CO)

Diethylamine (N(C₂H₅)₂)

(c) Nitro(NO₂)

Double bond (-C = C-)

Q. 9. Which of the two: O₂NCH₂CH₂O⁻ or CH₃CH₂O⁻ is expected to be more stable and why?

ANSWER:-

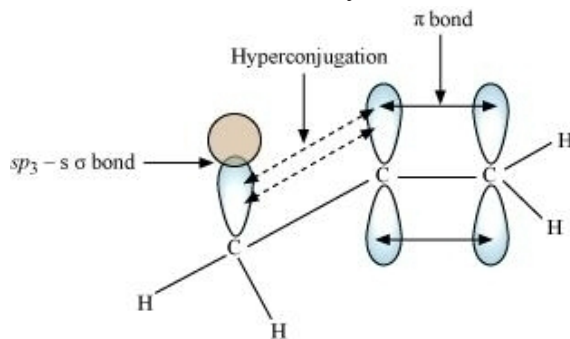
The NO₂ group is an electron-withdrawing group, which exhibits a -I effect. By pulling electrons towards itself, the NO₂ group reduces the negative charge on the compound, thereby stabilizing it. In contrast, the ethyl group is an electron-donating group, showing a +I effect. This increases the negative charge on the compound, making it less stable. As a result, O₂NCH₂CH₂O⁻ is anticipated to be more stable than CH₃CH₂O⁻.



Q. 10. Explain why alkyl groups act as electron donors when attached to a π system.

ANSWER:-

Hyperconjugation causes alkyl groups to donate electron density when attached to a π system, leading to the delocalization of π electrons. This delocalization occurs because of the partial overlap between the σ bond orbital of an sp^3 -hybridized carbon atom and the empty p orbital of the adjacent carbon's π bond. This interaction enhances the stability of the molecule.

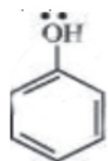


Q. 11. Draw the resonance structures for the following compounds. Show the electron shift using curved-arrow notation.

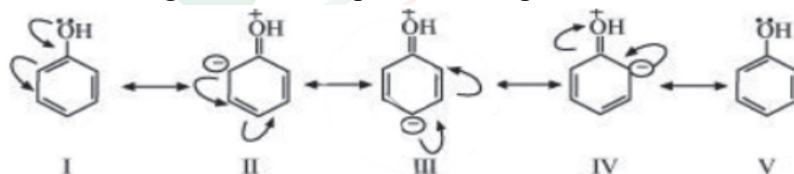
- (a) C_6H_5OH (b) $C_6H_5NO_2$ (c) $CH_3CH = CHCHO$
 (d) $C_6H_5 - CHO$ (e) $C_6H_5 - \overset{+}{C}H_2$ (f) $CH_3CH = \overset{+}{C}HCH_2$

ANSWER:-

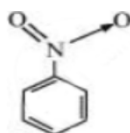
(a) The Structure of C_6H_5OH



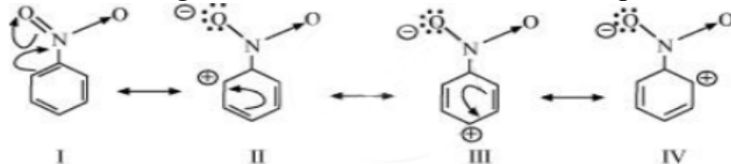
The resonating structures of phenol are represented as:



(b) $C_6H_5NO_2$

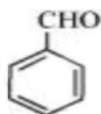
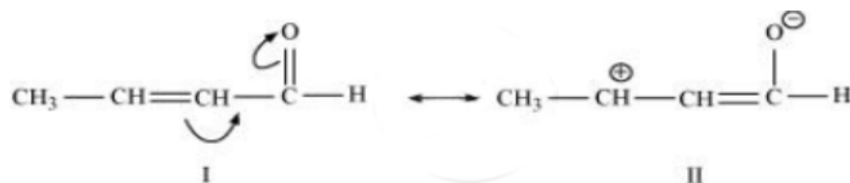


The resonating structures of nitro benzene are represented as:

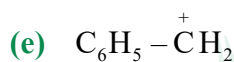
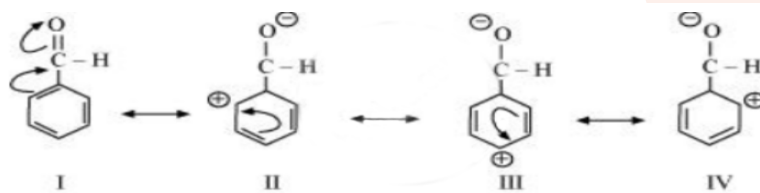




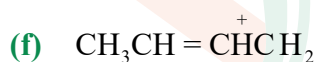
The resonating structure of given compound can be represented as



The resonating structure of benzaldehyde are represented as:



The resonating structure of given compound are:



The resonating structure of the given compound are:



Q. 12. What are electrophiles and nucleophiles? Explain with examples.

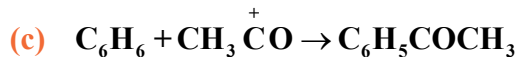
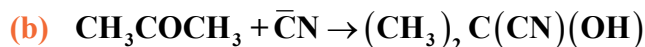
ANSWER:-

Electrophiles are species that are deficient in electrons and can accept an electron pair from electron-rich species. Examples carbocations and carbonyl compounds.

Nucleophiles are electron-rich species that donate electron pairs to electron-deficient species. Examples carbanions, water, ammonia, and the cyanide ion.



Q. 13. Identify the reagents shown in bold in the following equations as nucleophiles or electrophiles:



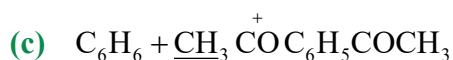
ANSWER:-



Here, HO^- acts as a nucleophile as it is an electron-rich species.

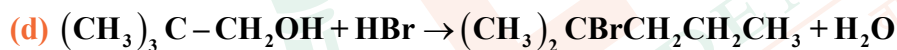
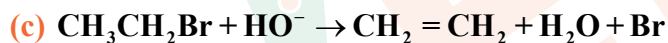


$\bar{\text{C}}\text{N}$ acts as a nucleophile as it is an electron-rich species



Here, $\text{CH}_3\overset{+}{\text{C}}\text{O}$ acts as an electrophile as it is an electron-deficient species,

Q. 14. Classify the following reactions in one of the reaction type studied in this unit.



ANSWER:-

(a) It is an example of substitution reaction as in this reaction the bromine group in bromoethane is substituted by the $-\text{SH}$ group.

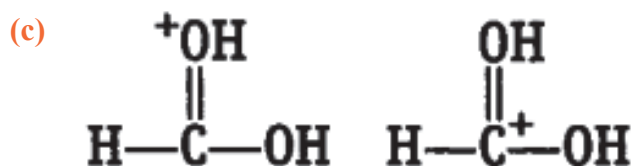
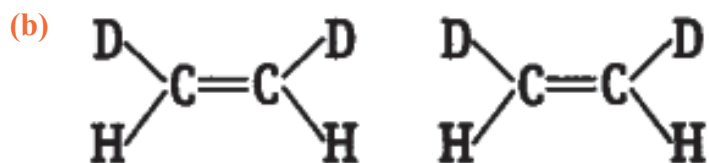
(b) It is an example of addition reaction as in this reaction two reactant molecules combine to form a single product.

(c) It is an example of elimination reaction as in this reaction hydrogen and bromine are removed from bromoethane to give ethene.

(d) In this reaction, substitution takes place, followed by a rearrangement of atoms and groups of atom.

Q. 15. What is the relationship between the members of following pairs of structures? Are they structural or geometrical isomers or resonance contributors?





ANSWER:-

- (a) Compounds having the same molecular formula but with different structures are called structural isomers. The given compounds have the same molecular formula but they differ in the position of the functional group (ketone group).



In structure I, ketone group is at the C-3 of the parent chain (hexane chain) and in structure II, ketone group is at the C-2 of the parent chain (hexane chain). Hence, the given pair represents structural isomers.

- (b) Compounds having the same molecular formula, the same constitution, & the sequence of covalent bonds, but with different relative position of their atoms in space are called geometrical isomers.

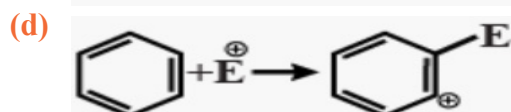
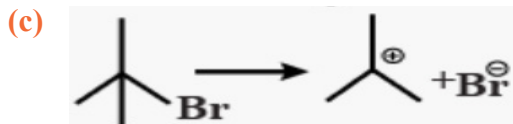
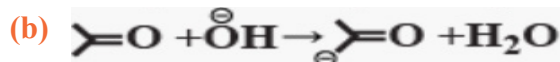
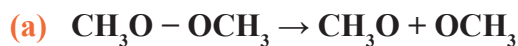


On structures I and II, the relative position of Deuterium (D) and hydrogen (H) in space are different. Hence, the given pairs represent geometrical isomers.

- (c) The given structures are canonical structures or contributing structures. They are hypothetical individually do not represent any real molecule. Hence, the given pair represents resonance structures, called resonance isomers.

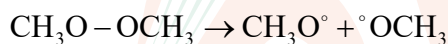


Q. 16. For the following bond cleavages, use curved-arrows to show the electron flow and classify each as homolysis or heterolysis. Identify reactive intermediate produced as free radical, carbocation and carbanion.

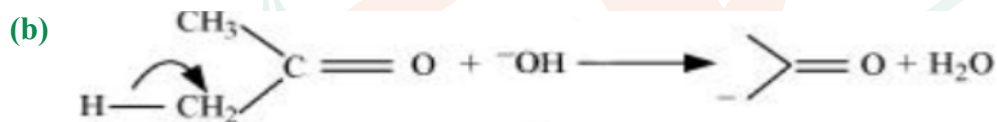


ANSWER:-

(a) The bond cleavage using curved arrows to show the electron flow of the given reaction can be represented as:



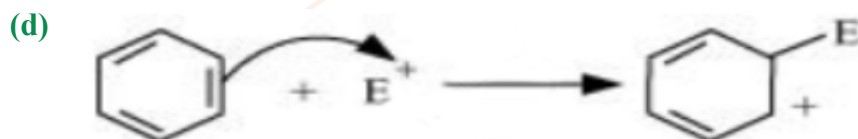
It is an example of homolytic cleavage as one of the shared pair in a covalent bond goes with the bonded atom. The reaction intermediate formed is a free radical.



It is an example of heterolytic cleavage as the bond breaks in such a manner that the shared pair of electrons remains with the carbon of propanone. The reaction intermediate formed is carbanion.



It is an example of heterolytic cleavage as the bond breaks in such a manner that the shared pair of electrons remains with the bromine ion. The reaction intermediate formed is a carbocation



It is a heterolytic cleavage as the bond breaks in such a manner that the shared pair of electrons remains with one of the fragments. The intermediate formed is a carbocation.

Q. 17. Explain the terms Inductive and Electromeric effects. Which electron displacement effect explains the following correct orders of acidity of the carboxylic acids?



ANSWER:-

The inductive effect is a permanent electronic effect that involves the redistribution of sigma electrons within a molecule, caused by the presence of electron-withdrawing or electron-donating groups. This effect operates through sigma bonds and is categorized into two types:

Negative Inductive Effect (-I): This occurs when an electron-withdrawing group, such as $-\text{NO}_2$, $-\text{Cl}$, or $-\text{Br}$, pulls electron density away from the rest of the molecule.

Positive Inductive Effect (+I): This occurs when an electron-donating group, such as $-\text{CH}_3$ or $-\text{C}_2\text{H}_5$, pushes electron density toward the rest of the molecule.

The electromeric effect is the temporary shift of a pair of pi electrons in a double bond to an adjacent atom, usually in the presence of an electrophile (such as H^+). This effect is important in reactions involving double bonds, where the pi electrons move to create a new bond, often leading to the formation of a carbocation.

- (a) The presence of chlorine atoms, which have a strong -I effect, enhances the acidity of carboxylic acids. The greater the number of chlorine atoms, the stronger the -I effect, which helps stabilize the negative charge on the carboxylate ion formed after deprotonation. As a result, the acidity increases with the number of chlorine substituents.

The order of acidity is:



- (b) In this case, the alkyl groups exhibit a +I effect, which increases the electron density on the carboxylate ion. However, as the number of alkyl groups increases, the +I effect becomes more pronounced, thereby destabilizing the carboxylate ion. Consequently, the acidity decreases as the number of alkyl groups increases.

The order of acidity is



Q. 18. Give a brief description of the principles of the following techniques taking an example in each case.

(a) Crystallisation

(b) Distillation

(c) Chromatography

ANSWER:-

Crystallization

Crystallization is a widely used technique for purifying solid organic compounds.

Principle: This method relies on the difference in solubilities of the target compound and its impurities in a given solvent. The impure compound dissolves in a solvent in which it is sparingly soluble at room temperature but more soluble at elevated temperatures. The solution is then concentrated to form a nearly saturated solution. Upon cooling, the pure compound crystallizes, while the impurities remain in the solution and are separated by filtration.

Example: Pure aspirin can be obtained by recrystallizing crude aspirin. Around 2–4 g of crude aspirin is dissolved in approximately 20 mL of ethyl alcohol. The solution is heated (if necessary) to ensure complete dissolution. Afterward, the solution is allowed to cool slowly until crystals begin to form. These crystals are then filtered and dried.



Distillation

Distillation is a method used to separate volatile liquids from non-volatile impurities or separate liquids with a sufficient difference in their boiling points.

Principle: This technique is based on the fact that liquids with different boiling points vaporize at different temperatures. The vaporized components are then condensed and collected separately as liquids.

Example: A mixture of chloroform (b.p. = 334 K) and aniline (b.p. = 457 K) can be separated using distillation. The mixture is heated in a round-bottom flask fitted with a condenser. Since chloroform is more volatile, it vaporizes first and enters the condenser. The vapor then condenses in the condenser, and chloroform is collected. Aniline, with a higher boiling point, remains in the round-bottom flask.

Chromatography

Chromatography is a highly effective method for the separation and purification of organic compounds.

Principle: This technique is based on the differing rates at which components of a mixture move through a stationary phase when influenced by a mobile phase.

Example: A mixture of red and blue ink can be separated by chromatography. A drop of the mixture is applied to a chromatographic surface (such as paper or a column). The component of the ink that is less adsorbed on the stationary phase moves more readily with the mobile phase, while the more strongly adsorbed component stays behind, effectively separating the two.

Q. 19. Describe the method, which can be used to separate two compounds with different solubilities in a solvent S.

ANSWER:-

Fractional crystallization is a technique used to separate two compounds with different solubilities in a solvent S. The process involves multiple recrystallization steps. The mixture of the two compounds is dissolved in solvent S and heated to create a saturated solution. Upon cooling, the less soluble compound crystallizes first, while the more soluble compound remains dissolved in the solution. The crystals of the first compound are then separated from the mother liquor. The remaining mother liquor is further concentrated and cooled to allow the second compound to crystallize.

Q. 20. What is the difference between distillation, distillation under reduced pressure and steam distillation?

ANSWER:-

Distillation	Steam Distillation	Distillation under reduced pressure
1. Distillation is a process used to separate a liquid from impurities or to separate different liquids that have different boiling points.	1. This method is used to purify an organic compound that can mix with steam but not with water. When steam is passed, the compound heats up, and the steam condenses into water. As the mixture boils, it passes through a condenser. The water and compound are then separated using a separating funnel.	1. This method is used to purify liquids that may break down when heated. By reducing the pressure, the liquid boils at a lower temperature than its normal boiling point, which prevents it from decomposing.



2. Mixture of petrol & kerosene is separated by this method.	2. A mixture of water and aniline is separated by steam distillation.	2. Glycerol is purified by this method. It boils with decomposition at a temperature of 593 K. At a reduced pressure, it boils at 453 K without decomposition
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Q. 21. Discuss the chemistry of Lassaigne's test.

ANSWER:-

In organic compounds, nitrogen, sulfur, and halogens are covalently bonded, but their detection in Lassaigne's test is possible only if they exist in their ionic forms. This can be achieved by fusing the organic compound with sodium metal.

Test for Nitrogen:

The sodium fusion extract is boiled with ferrous sulfate and acidified with sulfuric acid. Sodium cyanide reacts with ferrous sulfate to form sodium hexacyanoferrate(II). Upon heating with sulfuric acid, some of the ferrous ion is oxidized to ferric hexacyanoferrate(III), which is Prussian blue in color ($\text{Fe}_4[\text{Fe}(\text{CN})_6]_3$).

Test for Sulfur:

Acetic acid is added to the sodium fusion extract, leading to the complete precipitation of sulfur as lead(II) sulfate, which is black in color. Additionally, the sodium fusion extract is treated with sodium nitroprusside, resulting in a violet color. If both nitrogen and sulfur are present, sodium thiocyanate (NaSCN) is formed instead of sodium cyanide (NaCN), and this reacts with Fe^{3+} ions to give a blood-red color.

Test for Halogens:

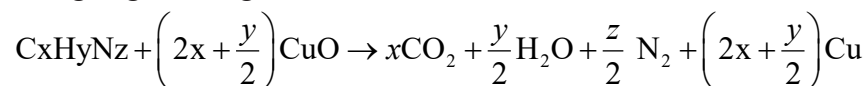
The sodium fusion extract is acidified with nitric acid and then treated with silver nitrate. If both nitrogen and sulfur are present, the Lassaigne's extract is boiled to expel nitrogen and sulfur, as their presence would interfere with the test for halogens.

Q. 22. Differentiate between the principle of estimation of nitrogen in an organic compound by (i) Dumas method and (ii) Kjeldahl's method.

ANSWER:-

(i) Dumas method

In the Dumas method, a known amount of nitrogen-containing organic compound is heated strongly with excess copper oxide in a carbon dioxide atmosphere. This reaction produces nitrogen gas, along with carbon dioxide and water. The chemical equation for the process is:



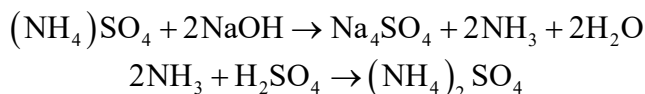
Some nitrogen oxides may form during the reaction. These can be converted into nitrogen gas by passing the gas mixture over heated copper. The nitrogen gas is then collected in a



solution of potassium hydroxide. Finally, the volume of nitrogen produced is measured at room temperature and atmospheric pressure.

(ii) Kjeldahl's method

In Kjeldahl method, a known quantity of nitrogen containing organic compounds is heated with concentrated sulphuric acid. The nitrogen present in the compound is quantitatively converted into ammonium sulphate. It is then distilled with excess of sodium hydroxide. The ammonia evolved during this process is passed into a known volume of H_2SO_4 . The chemical equations involved in the process are organic compound.



The acid is left unused is estimated by volumetric analysis (titrating against a standard alkali) & the amount of ammonia produced can be determined. Thus, the % of nitrogen in the compound can be estimated. This method cannot be applied to the compounds, in which nitrogen is present in a ring structure, & also not applicable to compounds nitro & azo groups.

Q. 23. Discuss the principle of estimation of halogens, sulphur and phosphorus present in an organic compound.

ANSWER:-

Estimation of halogens

Halogens are estimated by the Carius method. In this method, a known quantity of organic compound is heated with fuming nitric acid in the presence of silver nitrate, contained in a hard glass tube called the Carius tube, taken in a furnace. Carbon and hydrogen that are present in the compound are oxidized to form CO_2 and H_2O respectively and the halogen present in the compound is converted to the form of AgX . This AgX is then filtered, washed, dried, and weighed.

Let the mass of organic compound be m g.

Mass of AgX formed = m_1 g

1 mol of AgX contains 1 mol of X.

Therefore,

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

$$\text{Thus, \% of halogen will be} = \frac{\text{Atomic mass of X} \times m_1 \times 100}{\text{Molecular mass of AgX} \times m}$$

Estimation of Sulphur

In this method, a known quantity of organic compound is heated with either fuming nitric acid or sodium peroxide in a hard glass tube called the Carius tube. Sulphur, present in the compound, is oxidized to form sulphuric acid. On addition of excess of barium chloride to it, the precipitation of barium sulphate takes place. This precipitate is then filtered, washed, dried, and weighed.

Let the mass of organic compound be m g.

Mass of BaSO_4 formed = m_1 g

1 mol of BaSO_4 = 233 g BaSO_4 = 32 g of Sulphur



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

Thus, percentage of sulphur $\frac{32 \times m_1 \times 100}{233 \times m}$

Estimation of phosphorus

In this method, a known quantity of organic compound is heated with fuming nitric acid. Phosphorus, present in the compound, is oxidized to form phosphoric acid. By adding ammonia and ammonium molybdate to the solution, phosphorus can be precipitated as ammonium phosphomolybdate.

Phosphorus can also be estimated by precipitating it 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 be m g.

Mass of ammonium phosphomolybdate formed = m_1 g

Molar mass of ammonium phosphomolybdate = 1877 g

Thus, percentage of phosphorus = $\frac{31 \times m_1 \times 100}{1877 \times m}$

If P is estimated as $\text{Mg}_2\text{P}_2\text{O}_7$,

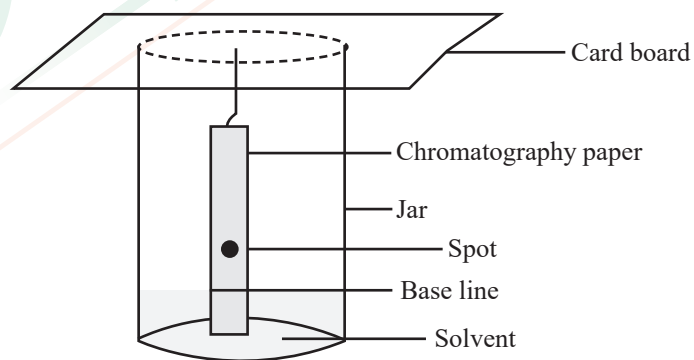
Thus, percentage of phosphorus = $\frac{62 \times m_1 \times 100}{222 \times m}\%$

Q. 24. Explain the principle of paper chromatography.

ANSWER:-

In paper chromatography, chromatography paper is used which contains water trapped in it which is the stationary phase. On the base of the paper, a solution (containing the mixture to be separated) is spotted. The paper strip is suspended in suitable solvent which is mobile phase. The solvent rises to the top of the paper by capillary action. During this, it flows

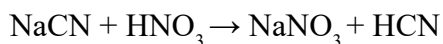
over the spot. The components are selectively retained on the paper. The spots of different components travel with the mobile phase to different heights. The developed paper is called chromatogram.

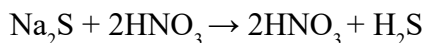


Q. 25. Why is nitric acid added to sodium extract before adding silver nitrate for testing halogens?

ANSWER:-

The added nitric acid decomposes NaCN to HCN and Na_2S to H_2S .



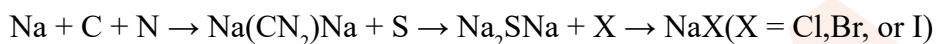


This removes all the nitrogen and sulphur present. Hence, only halogen is available for testing.

Q. 26. Explain the reason for the fusion of an organic compound with metallic sodium for testing nitrogen, sulphur and halogens.

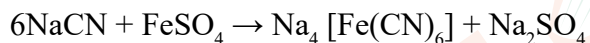
ANSWER:-

Elements like halogens, nitrogen, and sulfur are covalently bonded in organic compounds. To detect these elements, they need to be converted into their ionic forms. According to the principle, when fused with sodium, all the elements in an organic compound are transformed into ionic forms. The resulting ionic salts are then extracted by boiling the mixture with distilled water, a process known as sodium fusion extraction.



For testing nitrogen,

The extract is converted to sodium ferrocyanide by heating with ferrous sulphate and acidified with concentrated H_2SO_4 . The presence Prussian blue precipitate of ferric ferrocyanide indicates the presence of nitrogen. The reactions occur,



Here, the formula for Sodium ferrocyanide is $\text{Na}_4[\text{Fe}(\text{CN})_6]$

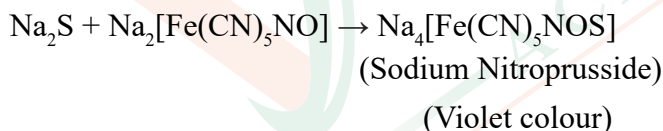


Here, the formula for Ferric ferrocyanide is $\text{Fe}_4[\text{Fe}(\text{CN})_6]_3$

For testing Sulphur,

Sulphide ions are tested using sodium nitroprusside. The appearance of violet colour indicates presence of sulphur.

Below is the reaction that occurs



For testing halogens,

For the case of testing extract for the presence of halogens such as Cl, Br, I we will add silver nitrate solution after acidifying with dil. HNO_3 to it. A yellowish white precipitate sparingly soluble in ammonium hydroxide (NH_4OH) indicates presence of Bromine(Br), yellowish precipitate insoluble in ammonium hydroxide (NH_4OH) indicates presence of Iodine(I), White precipitate soluble in (NH_4OH) indicates presence of Chlorine.

Q. 27. Name a suitable technique of separation of the components from a mixture of calcium sulphate and camphor.

ANSWER:-

Sublimation can be employed to separate the components of a mixture of calcium sulfate and camphor. Upon heating, camphor sublimes, transitioning directly from solid to vapor, while calcium sulfate remains as a residue.



Sublimation is a process in which a solid substance directly converts into its vapor phase without passing through the liquid state.

Q. 28. Explain, why an organic liquid vaporises at a temperature below its boiling point in its steam distillation?

ANSWER:-

During steam distillation, the organic liquid starts to boil when the sum of vapour pressure due to the organic liquid (p_1) and the vapour pressure due to water (p_2) is equal to atmospheric pressure (p).

$$p = p_1 + p_2$$

As $p_1 < p_2$, the liquid vaporises at temperature lower than its boiling point.

Q. 29. Will CCl_4 give white precipitate of AgCl on heating it with silver nitrate? Give reason for your answer.

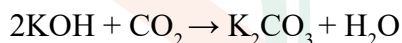
ANSWER:-

CCl_4 will not produce a white precipitate of AgCl when heated with silver nitrate because the chlorine atoms are covalently bonded to carbon in CCl_4 . For the precipitate to form, the chlorine must be in its ionic form. Therefore, it is necessary to prepare the Lassaigne's extract of CCl_4 to convert the chlorine into its ionic state.

Q. 30. Why is a solution of potassium hydroxide used to absorb carbon dioxide evolved during the estimation of carbon present in an organic compound?

ANSWER:-

Acidic carbon dioxide reacts with basic potassium hydroxide to form potassium carbonate and water.

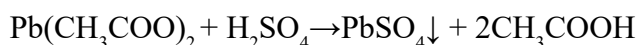


The increase in the mass of U tube corresponds to the mass of carbon dioxide produced from which, the percentage of carbon in the organic compound is estimated.

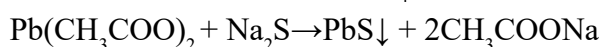
Q. 31. Why is it necessary to use acetic acid and not sulphuric acid for acidification of sodium extract for testing sulphur by lead acetate test?

ANSWER:-

For testing of sulphur present in the organic compound lassaigne's extract is acidified with acetic acid (CH_3COOH) and not sulphuric acid because lead acetate is soluble and does not interfere with the test. If sulphuric acid (H_2SO_4) is used, lead acetate will react with H_2SO_4 itself to form white precipitate of PbSO_4 as follows



The white precipitate of PbSO_4 so formed will interfere with this test of sulphur.



- Q. 32.** An organic compound contains 69% carbon and 4.8% hydrogen, the remainder being oxygen. Calculate the masses of carbon dioxide and water produced when 0.20 g of this substance is subjected to complete combustion.

ANSWER:-

100 g of organic compound contains 69 g of C, 4.8 g of hydrogen and 26.2 g of oxygen. 0.2 g of organic compound will contain $\frac{69 \times 0.2}{100} = 0.138$ g of C.

12 g of C is present in 44 g of CO_2 .

0.138 g of carbon will be present in $\frac{44 \times 0.138}{12} = 0.506$ g of CO_2 .

0.2 g of organic compound will contain $\frac{4.8 \times 0.2}{100} = 0.0096$ g of hydrogen.

18 g of water contains 2 g of hydrogen.

Hence, 0.0096 g of hydrogen will be present in $\frac{18 \times 0.0096}{2} = 0.864$ g of water.

Thus, complete combustion of 0.20 g of organic compound will produce 0.506 g of carbon dioxide and 0.864 g of water.

- Q. 33.** A sample of 0.50 g of an organic compound was treated according to Kjeldahl's method. The ammonia evolved was absorbed in 50 ml of 0.5 M H_2SO_4 . The residual acid required 60 mL of 0.5 M solution of NaOH for neutralisation. Find the percentage composition of nitrogen in the compound.

ANSWER:-

Total miliequivalent (mEq.) of H_2SO_4 taken

= Volume \times Molarity \times n-factor

= $50 \times 0.5 \times 2$

= 50mEq.

Excess H_2SO_4 = mEq. of NaOH

= $60 \times 0.5 \times 1 = 30\text{mEq.}$

mEq. of H_2SO_4 used to neutralise $\text{NH}_3 = (50 - 30) = 20$ mEq.

Percentage of N = $\frac{1.4 \times \text{mEq. of } \text{H}_2\text{SO}_4 \text{ used to neutralise } \text{NH}_3}{\text{Mass of substance}}$

= $1.4 \times 20/0.5 = 56\%$

Hence, percentage composition of nitrogen in the compound is 56.

- Q. 34.** 0.3780 g of an organic chloro compound gave 0.5740 g of silver chloride in Carius estimation. Calculate the percentage of chlorine present in the compound.

ANSWER:-

0.3780 g of organic compound gives 0.5740 g of AgCl.

143.32g of AgCl contains 35.5 g of Cl.



0.5740 g of AgCl contains $\frac{35.5 \times 0.5740}{143.32} = 0.1421$ g of chlorine.

The percentage of chlorine in the organic chloro compound is $\frac{0.1421 \times 100}{0.3780} = 37.6\%$.

- Q. 35.** In the estimation of sulphur by Carius method, 0.468 g of an organic sulphur compound afforded 0.668 g of barium sulphate. Find out the percentage of sulphur in the given compound.

ANSWER:-

The molar mass of BaSO₄ is 233 g/mol.

Thus, 233 g of BaSO₄ corresponds to 32 g of sulphur.

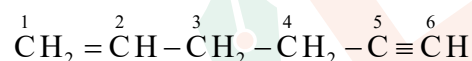
0.668 g of BaSO₄ will contain $\frac{32 \times 0.668}{233} = 0.0917$ g of sulphur.

The percentage of sulphur in the given compound is $\frac{0.0917 \times 100}{0.468} = 19.6\%$.

- Q. 36.** In the organic compound CH₂ = CH – CH₂ – CH₂ – C ≡ CH, the pair of hybridised orbitals involved in the formation of: C₂ – C₃ bond is:

- (a) sp – sp² (b) sp – sp³ (c) sp² – sp³ (d) sp³ – sp³

ANSWER:-



we know that when both double and triple bonds are present at equivalent positions, then we have to give preference to the double bond. Hence, the numbering of the Carbon chain starts near the double bond. here, it is clear which is the C₂ – C₃ bond. hence, C₂ – C₃ bond is formed by overlap of sp² and sp³ orbitals

Option (c) sp² & sp³

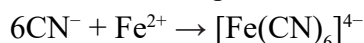
- Q. 37.** In the Lassaigne's test for nitrogen in an organic compound, the Prussian blue colour is obtained due to the formation of:

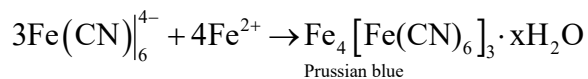
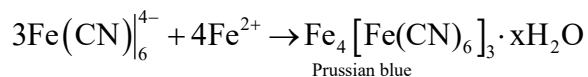
- (a) Na₄[Fe(CN)₆] (b) Fe₄[Fe(CN)₆]₃
 (c) Fe₂[Fe(CN)] (d) Fe₃[Fe(CN)₆]₄

ANSWER:-

Option (b) correct.

In the Lassaigne's test for nitrogen in an organic compound, the sodium fusion extract is boiled with iron (II) sulphate and then acidified with sulphuric acid. In the process, sodium cyanide first reacts with iron (II) sulphate and forms sodium hexacyanoferrate (II). Then, on heating with sulphuric acid, some iron (II) gets oxidised to form iron (III) hexacyanoferrate (II), which is Prussian blue in colour. The chemical equations involved in the reaction can be represented as





Q. 38. Which of the following carbocation is most stable ?

- (a) $(\text{CH}_3)_3\text{C}-\text{CH}_2^+$ (b) $(\text{CH}_3)_3\text{C}^+$ (c) $\text{CH}_3\text{CH}_2\text{CH}_2^+$ (d) $\text{CH}_3\text{CH}^+\text{CH}_2\text{CH}_3$

ANSWER:-

Option (b) correct

$(\text{CH}_3)_3\text{C}^+$ is a tertiary carbocation. A tertiary carbocation is the most stable carbocation due to the electron releasing effect of three methyl groups. An increased + I effect by three methyl groups stabilizes the positive charge on the carbocation.

Q. 39. The best and latest technique for isolation, purification and separation of organic compounds is:

- (a) Crystallisation (b) Distillation (c) Sublimation (d) Chromatography

ANSWER:-

Option (d) correct

Chromatography is the most useful & latest technique for isolation, purification and separation of organic compounds.

Q. 40. The reaction:



- (a) electrophilic substitution (b) nucleophilic substitution
(c) elimination (d) addition

ANSWER:-

Option (b) correct

It is an example of nucleophilic substitution reaction. The hydroxyl group of $\text{KOH}(\text{OH}^-)$ with a lone pair of itself acts as a nucleophile and substitutes iodide ion in $\text{CH}_3\text{CH}_2\text{I}$ to form ethanol.

