

Student Learning Outcomes

After studying this chapter, students will be able to:

- State that the bonding in alkenes includes a double carbon-carbon covalent bond and that alkenes are unsaturated hydrocarbons.
- Describe the manufacture of alkenes by the cracking of large alkane molecules using a high temperature and a catalyst.
- Describe the reasons for the cracking of large alkane molecules.
- Describe the test to distinguish between saturated and unsaturated hydrocarbons by their reaction with aqueous bromine and KMnO_4 .
- Describe the properties of alkenes in terms of addition reactions with:
 - bromine or aqueous bromine
 - hydrogen in the presence of a nickel catalyst
 - steam in the presence of an acid catalyst and draw the structural or displayed formulae of the products
- Describe, using symbol equations, preparation of alkenes by elimination reaction in halogenoalkanes and alcohols.
- Identify alkynes as hydrocarbons containing triple carbon-carbon covalent bond and that alkynes are unsaturated hydrocarbons.
- Describe the use of ethyne as fuel for welding and in artificially ripening fruits.
- Describe separation of petroleum into useful fraction by fractional distillation.
- Describe how the properties of fractions obtained from petroleum change from the bottom to the top of the fractionating column, limited to:
 - decreasing chain length
 - higher volatility
 - lower boiling points
 - lower viscosity
- Name the uses of the fractions as:
 - refinery gas fraction for gas used in heating and cooking
 - gasoline/petrol fraction for fuel used in cars
 - naphtha fraction as a chemical feedstock
 - kerosene/paraffin fraction for jet fuel
 - diesel oil/gas oil fraction for fuel used in diesel engines.
 - fuel oil fraction for fuel used in ships and home heating systems
 - lubricating oil fraction for lubricants, waxes and polishes
 - bitumen fraction for making roads
- Name fossil fuels; coal, natural gas and petroleum

- Name methane as main constituent of natural gas
- State that petroleum is a mixture of hydrocarbons, compounds containing hydrogen and carbon only

Subjective Type Questions

Long Questions prepared in the light of new Examination Techniques
(Knowledge, Understanding, Application, Analytical & Conceptual)

22.1

Alkenes

22.2

Important Reactions of Alkenes

22.3

Alkynes

Q.1: What are alkenes. How are they prepared?

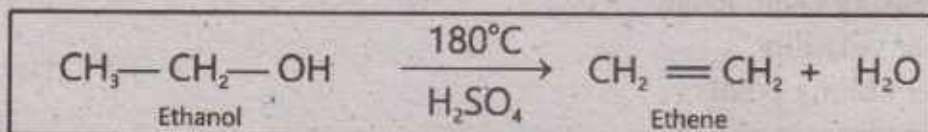
Ans. Alkenes:

Alkenes are unsaturated hydrocarbons containing one or more carbon double bond. They have Alkenes are also called olefins. The have general formula for alkenes is C_nH_{2n} .

Uses of alkenes: Alkenes are widely used in the synthesis of various products, like plastics and fuels.

Preparation of Alkenes: Alkenes may be prepared either by:

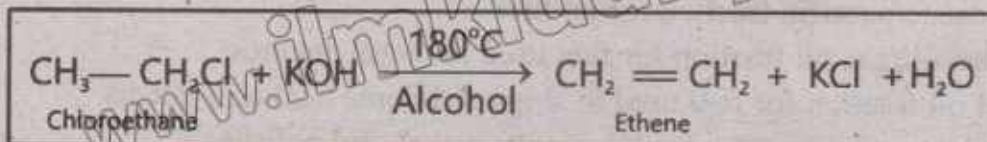
- Dehydration of alcohols
- Dehydrohalogenation of alkyl halides.
- Cracking of alkanes
- **By Dehydration of Alcohols:** Dehydration means removal of water molecule. Dehydration of alcohols is carried out with a dehydrating agent like concentrated sulphuric acid.



- **By Dehydrohalogenation of Alkyl Halides:**

In dehydrohalogenation a molecule of hydrogen halide (HX) is removed from a molecule of alkyl halide.

Dehydrohalogenation of alkyl halides is done with potassium hydroxide dissolved in ethanol.



This is an example of Elimination reactions.

Occurrence of Elimination Reactions: These reactions occur when a molecule is removed from a saturated compound to produce an unsaturated compound.

Q.2: Explain with examples the cracking of alkanes.

Ans. Cracking of alkanes to alkenes:

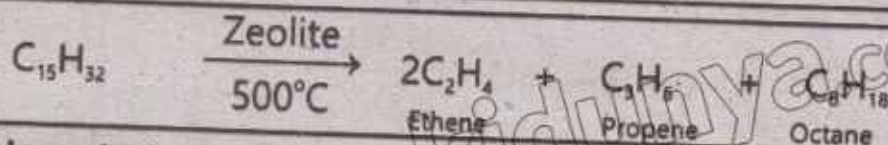
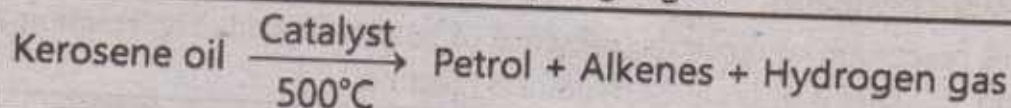
Cracking: Cracking is a process which is carried out to convert high molecular mass alkanes to lower alkanes and alkenes.

Explanation: The process is carried out by heating alkanes at high temperature in the absence of oxygen and in the presence of Zeolites as catalysts.

Importance of cracking: Cracking is important commercially because it produces:

- Smaller Alkanes Which are useful as fuel.
- Alkenes (ethane and propene) which are useful starting materials to produce many commercially important chemicals.

For Example: Kerosene oil and diesel oil which contain higher molecular mass alkanes are often cracked to give petrol, alkenes and hydrogen gas.



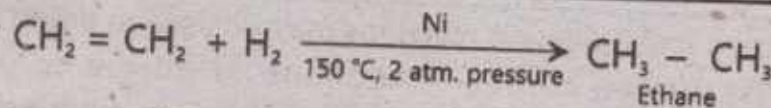
Q.3: Describe important reactions of alkenes.

Ans. **Chemical Reactivity of alkenes:** Alkenes are very reactive compounds. The Chemical reactivity of alkenes is due to the presence of carbon-carbon double bond.

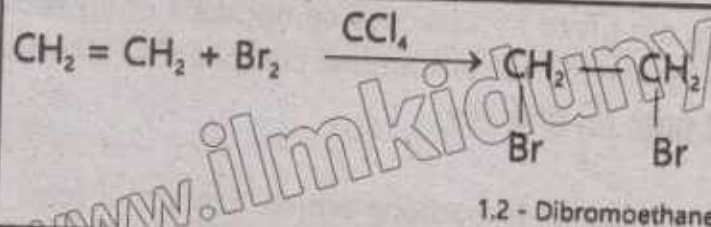
Reactions: Alkenes undergo addition reactions.

Addition Reaction: Addition reactions are those reactions in which reactants combine to form a simple new product.

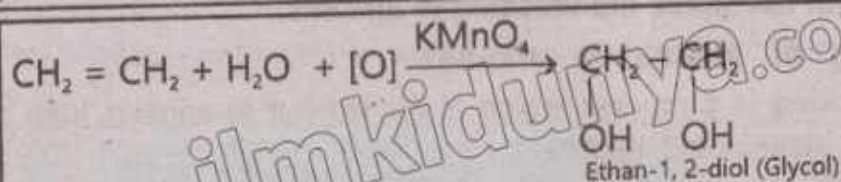
Addition of Hydrogen: Hydrogen is added to alkenes in the presence of nickel metal as a catalyst to give alkanes as the products. This reaction is called catalytic hydrogenation or catalytic reduction.



Addition of Halogens:



Oxidation with KMnO_4 : Alkenes can also react with cold and dilute alkaline potassium permanganate to give an important compound called ethylene glycol or ethane-1,2-diol.



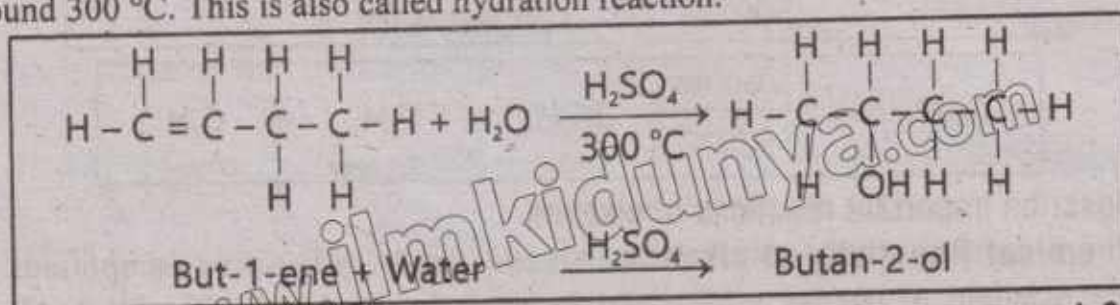
Addition of Hydrogen Halides:

Like halogens, hydrogen halides can also be added to a double bond of an alkene. These reactions are known as hydrohalogenation of alkenes.



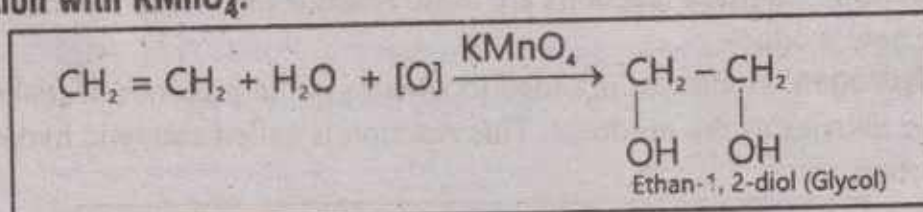
Addition of Water (Steam):

Alkenes react with water in the presence of sulphuric acid. The reaction takes place at around 300 °C. This is also called hydration reaction.



Q.4: How we can distinguish between saturated and unsaturated compounds?

Ans. Oxidation with KMnO_4 :



Both halogenation and oxidation reactions may be used to detect the presence of an alkene. The reddish brown colour of bromine or purple colour of potassium permanganate is rapidly discharged when either two reacts with an alkene. Similarly alkenes also discharge the violet colour of iodine.

These reaction are not given by saturated compounds or alkanes. Thus they are used to distinguish between saturated and unsaturated compounds (alkenes).

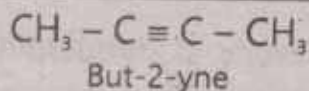
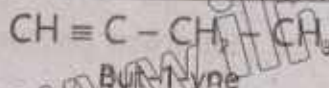
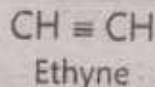
Q.5: Write a detailed note on alkynes.

Ans. Alkynes:

Alkynes are unsaturated hydrocarbons which contain at least one $-\text{C} \equiv \text{C}-$ bond. They are represented by the general formula $\text{C}_n\text{H}_{2n-2}$.

Naming of Alknes:

Just like alkenes are also named by counting the number of carbon atoms present in the longest continuous chain that contains the triple bond.



Ethyne or Acetylene Gas: The simplest unsaturated hydrocarbon containing triple bond is called ethyne or acetylene gas.

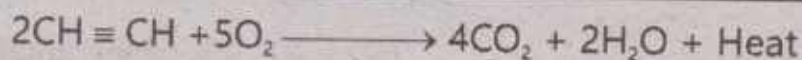
Uses of Acetylene:

For Welding:

It is commonly used for welding and cutting purposes because it produces a large amount of heat when it is ignited in the presence of oxygen or air.



Fig. 22.1: Acetylene torch



In the acetylene torch, acetylene gas burns in oxygen to produce CO_2 and H_2O . The high temperature of the oxy-acetylene flame speeds up the cutting and welding processes.

Ripening of Green fruits:

Acetylene gas is also used for ripening of green fruits. When solid calcium carbide reacts with moisture present in the air it produces acetylene gas which accelerates the ripening of the green fruits and induces a colour change.

22.4 Sources of organic Compounds

22.5 Refining of Petroleum

Q.6: Identify the major sources from which organic compounds can be obtained.

Ans. Organic Compounds: Organic compound are chemical compounds primarily composed of carbon atoms that are covalently bonded to each other or to other elements.

Sources of Organic Compounds: Organic compounds can be obtained from many sources. Three major sources of organic compounds are:

- Coal
- Petroleum
- Natural gas

Sources of aliphatic Hydrocarbons: Chief sources of aliphatic hydrocarbons are:

Source of Aromatic Hydrocarbons: Coal major source of aromatic hydrocarbons.

Natural gas: Natural gas is a mixture of many hydrocarbon gases, with methane (CH_4) being the largest component.

Petroleum: Petroleum and natural gas are mostly found together, held between the layers of non-porous rocks underground.

Extraction: When a well is drilled through the rock, the gas is released carrying with it some of more volatile liquids.

Collection of liquid Petroleum: After the flow of gases ceases, the liquid petroleum is

taken out with the help of pumps.

Liquid Petroleum: Liquid petroleum is a complex mixture of mainly aliphatic hydrocarbons.

Chemical Diversity of Petroleum: It has been estimated that when petroleum is boiled upto 400°C , at least 500 compounds can be obtained.

Principal Products of Petroleum Refining: Although the principal products of petroleum refining are various types of fuels, yet a large number of other important chemicals can also be produced from these fuels.

For Example:

Alkenes: Petroleum products produce alkenes which are starting material to prepare plastics.

Benzene: Benzene, an aromatic hydrocarbons, may be produced from n-hexane.

Uses of Benzene: Benzene may be used to produce thousands of useful aromatic compounds like:

- Perfumes
- Drugs
- Dyes
- Photographic developers

Q.7: Describe the fractional distillation of petroleum.

Ans. Refining of Petroleum:

Petroleum in a crude state is a mixture of many hydrocarbons which do not burn easily. To make it useful, petroleum must be separated into different fractions by a process called refining of petroleum.

Fractional Distillation: Refining process involves the fractional distillation of petroleum at about 400°C whereby it is separated into many useful fractions.

Neutralization: The first step in the refining process is neutralization of the crude oil by washing with acidic or basic solution as required.

Heating: The neutralized oil is then heated in an electric furnace above 400°C and the resulting gases and vapours are allowed to pass into a tall fractionating column.

Fractionating column:

The resulting gases and vapours are allowed to pass into a tall fractionating column.

The column has a number of compartments divided into shelves having holes in them. These holes are covered with babbler caps.

Refinery Gases:

When the oil is heated, the dissolved gases known as the refinery gases first go at the top of the fractionating column and escape there from the outlet.

Fractions with High Boiling Points:

As the temperature, the vapour start going up in the column where the hydrocarbon fractions which have high boiling points are easily condensed to liquids in the lower part of the column.

Fractions with Lower Boiling Points:

The fractions which have lower boiling point ranges rise up near the top of the column as vapours, which are then condensed into liquid state.

Collection of Condensed Liquid Fractions:

These condensed liquid fractions are collected on the various shelves from where they can be drained off into separate storage tanks.

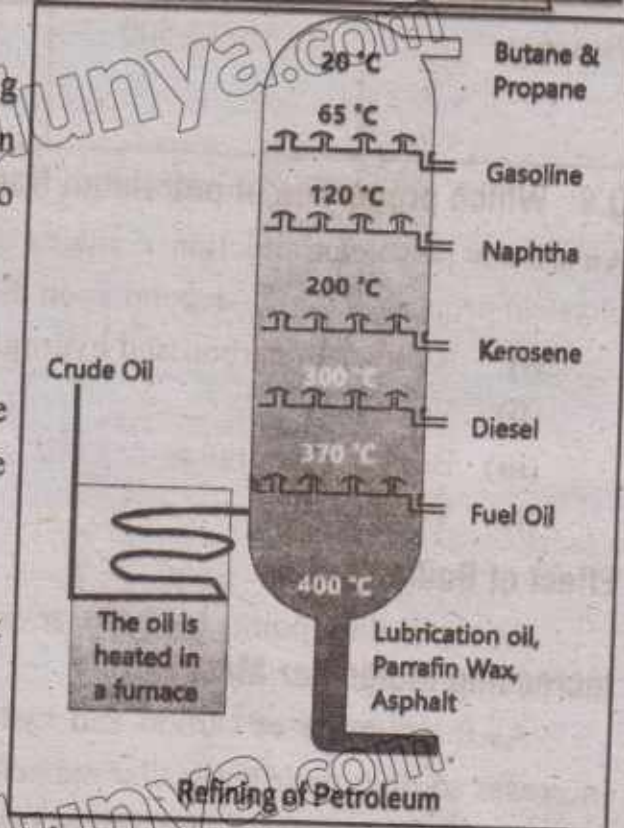
Redistillation of Fractions:

The fractions thus separated are not without impurities from the other fractions.

They are then redistilled to have a better separation of hydrocarbons.

Q.8: Write names, boiling range, composition and use of fractions of petroleum.

Ans. Fractions of petroleum and their uses.



Name of the Fraction	Appropriate boiling range (°C)	Range of carbon atoms in each Fraction	Uses
Refinery gases	Below 0	1-4	Refinery gases are liquified and sold as fuels for stoves
Gasoline (petrol)	0-65	5-6	Used to drive automobiles
Naphtha	65-170	6-10	It is used as source of many useful hydrocarbons
Kerosene oil	170-250	10-14	It is a fuel used in jet engines
Diesel oil	250-340	14-19	Used to run cars, buses and trucks
Lubricating oil	340-500	19-35	Used in cars, buses and truck as lubricant, waxes and polishes
Fuel oil	340-500	Above 20	Used in ships and to run power plants

Bitumen	Above 500	Above 35	Used to construct roads and to water proof roofs and pipes.
---------	-----------	----------	---

Q.9: Which properties of petroleum fractions Change with their boiling points?

Ans. Each petroleum fraction contains a mixture of hydrocarbons. They have similar physical properties which depend upon the following factors.

- (i) Number of carbon and hydrogen atoms present in the molecule of a fraction.
- (ii) Volatility
- (iii) Boiling point range
- (iv) Viscosity

Effect of Boiling points:

As the boiling points increase, several key properties change in a predictable trend:

Increasing Molecular Masses:

As the number of carbon and hydrogen atoms in the molecule of a hydrocarbons increases so does their molecular masses. As the molecular masses increase, this changes the strength of intermolecular forces between the molecules. Higher the molecular mass of a hydrocarbon stronger the intermolecular forces between its molecules. This fact affects the physical properties of hydrocarbons as well. Lower hydrocarbons have high volatility, low boiling points and lower viscosities. As the chain length increases their properties also show upward trends. So the fractions of the petroleum obtained at the top of the column have high volatilities, lower boiling ranges, lower viscosities and they are highly inflammable.

DO YOU KNOW?

The use of calcium carbide in our country is prohibited because it is known to cause serious health problems like dizziness, vomiting and skin ulcer.

INTERESTING INFORMATION

Alkenes occur abundantly in nature. Ethylene, for example is a plant hormone that induces ripening in fruit. An alkene β -carotene is an orange pigment responsible for the colour of carrots.



Objective Type Questions

Additional MCQ's

Multiple Choice Questions prepared in the light of new Examination Techniques
(Knowledge, Understanding, Application, Analytical & Conceptual)

22.1 Alkenes

22.2 Important Reactions of Alkenes

22.3 Alkynes

- Which of the following condition is required for the dehydration of ethanol to produce ethane?
(a) Alcoholic KOH at 180°C (b) Dilute H_2SO_4 at 100°C
(c) Concentrated H_2SO_4 at 180°C (d) Nickel catalyst at 150°C
- Which term describes a reaction where a molecule is removed from a saturated compound to produce an unsaturated compound?
(a) Elimination reaction (b) Cracking
(c) Hydrogenation (d) Catalytic reduction
- Which of the following is used as catalyst, in the industrial process of cracking?
(a) Nickel (b) Alcohol (c) Sulphuric acid (d) Zeolite
- What occurs when ethene is treated with hydrogen gas in the presence of a Nickel (Ni) catalyst at 150°C ?
(a) No reaction occurs (b) Ethene is reduced to ethane
(c) Ethene is converted to ethyne (d) None of these
- It is a chemical test used to distinguish between saturated alkanes and unsaturated alkenes.
(a) Addition of bromine water (b) Reaction with concentrated H_2SO_4
(c) Combustion in air (d) Reaction with Nickel catalyst
- When an alkene reacts with cold, dilute alkaline potassium permanganate, what happens to the purple colour?
(a) It remains unchanged (b) It is rapidly discharged
(c) It turns deep blue (d) It turns bright red
- General formula for alkenes is:
(a) CH_4 (b) C_nH_{2n} (c) $\text{C}_n\text{H}_{2n-2}$ (d) $-\text{COOH}$
- Olefins is another name of:
(a) Alkynes (b) Alcohols (c) Alkenes (d) Butane
- Alkene β -carotene is a pigment of:
(a) Green colour (b) Pink colour (c) Yellow colour (d) Orange colour
- What is the general formula for alkynes?
(a) C_nH_{2n} (b) $\text{C}_n\text{H}_{2n-2}$ (c) C_nH_n (d) $\text{C}_n\text{H}_{2n+2}$

11. Hydrohalogenation of ethane with hydrogen bromide (HBr) results in the formation of which compound?
(a) Ethane (b) Ethanol (c) Glycol (d) Bromoethane
12. Which colour of bromine is discharged when it reacts with an alkene?
(a) Reddish brown (b) Purple (c) Blue (d) Green
13. When alkenes react with water in the presence of sulphuric acid, it is called:
(a) Cracking (b) Catalytic reduction
(c) Hydration reaction (d) Dehydrohalogenation
14. A molecule of hydrogen halide (HX) is removed from a molecule of alkyl halide in:
(a) Dehydration (b) Dehydrohalogenation
(c) Hydrohalogenation (d) Hydration
15. Kerosene oil and diesel oil are often cracked to give:
(a) Petrol (b) Alkenes (c) Hydrogen gas (d) All of these
16. Dehydration means:
(a) Removal of water molecule (b) Removal of hydrogen halide
(c) Addition of hydrogen (d) Addition of halogen
17. Hydration means:
(a) Addition of halogen (b) Addition of hydrogen halide
(c) Addition of water (d) Addition of alcohol
18. Which of the following is not an example of alkynes?
(a) Propyne (b) Ethyne (c) Butyne (d) Ethene
19. In the acetylene torch, acetylene gas burns in oxygen to produce:
(a) CO_2 and CO (b) CO_2 and H_2O
(c) H_2O and CO (d) CO_2 , H_2O and CO
20. Calcium carbide is known to cause:
(a) Dizziness (b) Vomiting (c) Skin ulcer (d) All of these

22.4 Sources of Organic compounds

22.5 Refining of Petroleum

22.6 Physical Properties of different Petroleum Fractions

21. The major sources of organic compounds are:
(a) Coal (b) Petroleum (c) Natural gas (d) All of these
22. The chief sources of aliphatic hydrocarbons are:
(a) Coal and petroleum (b) Natural gas and coal
(c) Natural gas and petroleum (d) coke and coal
23. What is the major source of aromatic hydrocarbons?
(a) Natural gas (b) Coal (c) Petroleum (d) None of these
24. The largest component of natural gas is:
(a) CH_4 (b) CO_2 (c) CO (d) O_2

25. How many compounds can be obtained when petroleum is boiled upto 400°C ?
(a) 200 (b) 300 (c) 400 (d) 500
26. Where are petroleum and natural gas primarily found?
(a) Between layers of porous rocks (b) Between layers of non-porous rocky
(c) On the ground (d) All of these
27. When a well is first drilled, what is usually the first substance released?
(a) Crude oil (b) Natural gas (c) Water (d) Solid bitumen
28. Chemically, liquid petroleum is a complex mixture consisting mainly of:
(a) Aromatic hydrocarbons (b) Inorganic salts
(c) Aliphatic hydrocarbons (d) Gaseous oxides
29. Which of the hydrocarbons are starting material to prepare plastics?
(a) alkanes (b) Alkynes (c) Cycloalkanes (d) Alkenes
30. Benzene may be used to produce aromatic compounds like perfumes and:
(a) Drugs (b) Dyes
(c) Photographic developers (d) All of these
31. Benzene a petroleum product may be produced from:
(a) n-hexane (b) Methane (c) Propane (d) Ethylene
32. Petroleum in its crude state is a mixture of many:
(a) Elements (b) Hydrocarbons (c) Oxides (d) Metals
33. The process used to separate crude oil into useful fractions is known as:
(a) Evaporation (b) Filtration
(c) Fractional distillation (d) Neutralization
34. Which fraction contains 14–19 carbon atoms per molecule?
(a) Kerosene oil (b) Diesel oil (c) Fuel oil (d) Lubricating oil
35. Which fraction has a boiling range below 0°C ?
(a) Kerosene oil (b) Diesel oil (c) Refinery gases (d) Gasoline
36. Gasoline has range of carbon atoms:
(a) 1–4 (b) 5–10 (c) 6–10 (d) 10–14
37. It is used as source of many useful hydrocarbons.
(a) Lubricating oil (b) Naphtha (c) Bitumen (d) Diesel oil
38. Diesel oil is used to run:
(a) Cars (b) Buses (c) Trucks (d) All of these
39. It is the fracting having boiling point $340\text{--}500^{\circ}\text{C}$.
(a) Fuel oil (b) Diesel oil (c) Bitumen (d) Lubricating oil
40. Which of the following has range of carbon atom above 35?
(a) Naphtha (b) Petrol (c) Fuel oil (d) Bitumen
41. Lubricating oil has a range of carbon atoms:
(a) 6–10 (b) 14–19 (c) 19–35 (d) Above 35
42. $170\text{--}250^{\circ}\text{C}$ is a boiling range of:
(a) Diesel oil (b) Kerosene oil (c) Gasoline (d) Fuel oil
43. Diesel oil has a range of carbon atoms:
(a) 14–19 (b) 5–6 (c) 10–14 (d) Above 20

44. Which of the following fraction has boiling range 65–170 °C?
 (a) Gasoline (b) Naphtha (c) Fuel-oil (d) Lubricating oil
45. As the number of carbon atoms in a hydrocarbon chain increases, the boiling point:
 (a) Increases (b) Decreases
 (c) Remains the same (d) Becomes zero

Answers

- | | | | | | | |
|---------|---------|---------|---------|---------|---------|---------|
| 1. (c) | 2. (a) | 3. (d) | 4. (b) | 5. (a) | 6. (b) | 7. (b) |
| 8. (c) | 9. (d) | 10. (b) | 11. (d) | 12. (a) | 13. (c) | 14. (b) |
| 15. (d) | 16. (a) | 17. (c) | 18. (d) | 19. (b) | 20. (d) | 21. (d) |
| 22. (c) | 23. (b) | 24. (a) | 25. (d) | 26. (b) | 27. (b) | 28. (c) |
| 29. (d) | 30. (d) | 31. (a) | 32. (b) | 33. (c) | 34. (b) | 35. (c) |
| 36. (b) | 37. (b) | 38. (d) | 39. (d) | 40. (d) | 41. (c) | 42. (b) |
| 43. (a) | 44. (b) | 45. (a) | | | | |

Additional Short Question

Short Answer Questions prepared in the light of new Examination Techniques
 (Knowledge, Understanding, Application, Analytical & Conceptual)

22.1

Alkenes

22.2

Important Reactions of Alkenes

22.3

Alkynes

1. What are alkenes?

Ans. Alkenes: Alkenes are unsaturated hydrocarbons containing one or more carbon-carbon double bond.

2. What is another name of alkenes?

Ans. Alkenes are also called olefins.

3. State the general formula for alkenes.

Ans. The general formula for alkenes is C_nH_{2n} .

4. Name three methods used to prepare alkenes.

Ans. Alkenes can be prepared by:

- Dehydration of alcohols
- Dehydrohalogenation of alkyl halides
- Cracking of alkenes.

5. For what purposes are alkenes used?

Ans. Alkenes are widely used in the synthesis of various products, like plastics and fuels.

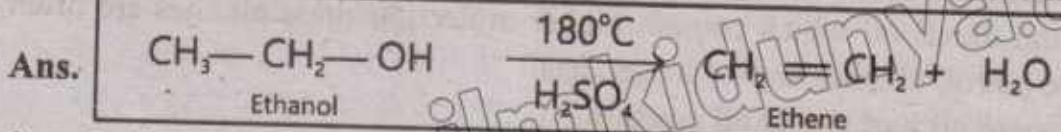
6. What does dehydration mean?

Ans. Dehydration means removal of water molecule.

7. What is meant by the dehydration of alcohols?

Ans. Dehydration of alcohols means the removal of a water molecule from an alcohol. It is carried out with a dehydrating agent like concentrated sulphuric acid.

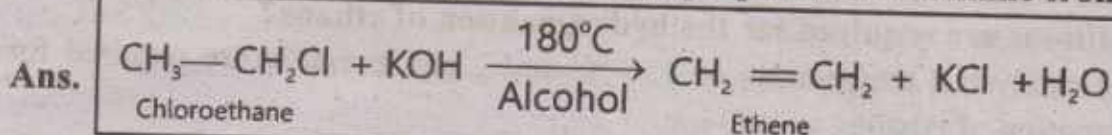
8. Write the chemical equation for the preparation of ethane from ethanol.



9. Define dehydrohalogenation of alkyl halides.

Ans. It is the removal of a molecule of hydrogen halide (HX) from a molecule of alkyl halide. It is done with potassium hydroxide dissolved in ethanol.

10. Write the chemical equation for the preparation of ethane from chloroethene.



11. What is an elimination reaction?

Ans. It is a reaction that occurs when a molecule is removed from a saturated compound to produce an unsaturated compound.

12. What is cracking?

Ans. **Cracking:** Cracking is a process which is carried out to convert high molecular mass alkanes to lower alkanes and alkenes.

13. How is cracking carried out?

Ans. Cracking is carried out by heating alkenes at high temperature in the absence of oxygen and in the presence of zeolites as catalysts.

14. Why is cracking commercially important?

Ans. Cracking is important commercially because it produces smaller alkenes. Smaller alkene which are useful as fuel.

Alkenes (ethene and propene) which are useful starting materials to produce many commercially important chemicals.

For Example: Kerosene oil and diesel oil which contain higher molecular mass alkanes are often cracked to give petrol, alkenes and hydrogen gas.

15. Why are alkenes considered to be very reactive compounds?

Ans. Alkenes are very reactive compounds. Their chemical reactivity is due to the presence of a carbon-carbon double bond.

16. What is catalytic hydrogenation?

Ans. **Catalytic Hydrogenation:** It is the addition of hydrogen to alkenes in the presence of nickel metal as a catalyst to give alkanes as the products.

17. What is another name of catalytic hydrogenation reaction?

Ans. Another name of catalytic hydrogenation reaction is catalytic reduction reaction.

18. How do alkenes react with halogens?

Ans. Halogens are readily added to alkenes in the presence of a non-polar solvent to give alkyl halides.

19. Name the product formed when ethane reacts with bromine.

Ans. When ethane reacts with bromine, 1, 2-Dibromoethane is formed.

20. Name the products obtained after cracking of kerosene oil and diesel oil.
 Ans. Kerosene oil and diesel oil which contain higher molecular mass alkanes are often cracked to give petrol, alkenes and hydrogen gas.
21. What do kerosene oil and diesel oil contain?
 Ans. Kerosene oil and diesel oil contain higher molecular mass alkanes.
22. Why do alkenes undergo addition reactions?
 Ans. Alkenes undergo addition reactions because of the presence of a carbon-carbon double bond. In these reactions reactants combine to form a single new product.
23. What conditions are required for the hydrogenation of ethane?
 Ans. Nickel (Ni) catalyst, a temperature of 150 °C and 2 atm pressure are required for the hydrogenation of ethane.
24. What is hydrohalogenation of alkenes?
 Ans. It is a reaction in which hydrogen halides can be added to a double bond of an alkene.
25. Name the product formed when ethane reacts with hydrogen bromide.
 Ans. Bromoethane is the product formed when ethane reacts with hydrogen bromide.
26. What is a hydration reaction?
 Ans. Hydration Reaction: It is a reaction in which alkenes react with water in the presence of sulphuric acid. This reaction takes place at around 300°C.
27. What are alkynes?
 Ans. Alkynes are unsaturated hydrocarbons which contain at least one $-C \equiv C-$ bond.
28. How are alkynes represented?
 Ans. Alkynes are represented by the general formula $C_n H_{2n-2}$
29. How are alkynes named?
 Ans. Alkynes are named by counting the number of carbon atoms present in the longest continuous chain that contains the triple bond.
- Examples:**
- | | |
|-----------------------------|----------------------------|
| $CH \equiv CH$ | $CH_3 - C \equiv CH$ |
| Ethyne | Propyne |
| $CH \equiv C - CH_2 - CH_3$ | $CH_3 - C \equiv C - CH_3$ |
| But - 1-yne | But - 2-yne |
30. What is ethyne?
 Ans. The simplest unsaturated hydrocarbon containing a triple bond is called ethyne or acetylene gas.
31. What alkyne is used for welding and cutting purposes?
 Ans. Ethyne or acetylene gas is used for welding and cutting purposes.
32. Write the balanced chemical equation for the combustion of ethyne.
 Ans. $2CH \equiv CH + 5O_2 \longrightarrow 4CO_2 + 2H_2O + \text{Heat}$
33. How is acetylene gas used in the food industry?
 Ans. Acetylene gas is used for the artificial ripening of green fruits, where it accelerates the ripening process and induces colour change.

34. Why is the use of calcium carbide prohibited in our country?

Ans. The use of calcium carbide is prohibited in our country because it is known to cause serious health problems like dizziness, vomiting and skin ulcer.

22.4

Sources of Organic Compounds

22.5

Refining of Petroleum

35. What are the three main sources of organic compounds?

Ans. The three main sources of organic compounds are coal, petroleum and natural gas.

36. What are the chief sources of aliphatic hydrocarbons?

Ans. Natural gas and petroleum are chief sources of aliphatic hydrocarbons.

37. What is liquid petroleum?

Ans. Liquid petroleum is a complex mixture of mainly aliphatic hydrocarbons.

38. Name the principal products of petroleum refining.

Ans. Although the principal products of petroleum refining are various types of fuels, yet a large number of other important chemicals can also be produced from these fuels, for example alkenes and benzene.

39. Which are the starting material to prepare plastics?

Ans. Alkenes are the starting material to prepare plastics.

40. What is benzene?

Ans. Benzene is an aromatic hydrocarbon, may be produced from n-hexane.

41. State the uses of benzene.

Ans. Benzene may be used to produce thousands of useful aromatic compounds like:

- Perfumes
- Drugs
- Dyes
- Photographic developers.

42. What is petroleum?

Ans. **Petroleum:** Petroleum in a crude state is a mixture of many hydrocarbons which do not burn easily. To make it useful, petroleum must be separated into different fractions by a process called refining of petroleum.

43. Which scientific method is used for refining of petroleum?

Ans. Fractional distillation is used for refining of petroleum at about 400°C .

44. At what temperature is fractional distillation done?

Ans. Fractional distillation is done at about 400°C .

45. What is the first step in the refining process after obtaining crude oil?

Ans. The first step in the refining process is neutralization of the crude oil by washing it with acidic or basic solution.

46. Where do the heaviest fractions collect in the fractionating column?

Ans. At the bottom of the fractionating column the heaviest fractions are collected.

47. Where do the hydrocarbon fractions having lower boiling points condense into liquid state in the fractionating column?

Ans. The hydrocarbon fractions having lower boiling points condense into liquid state near the top of the fractionating column.

48. What is the boiling range of refinery gases?

Ans. The boiling range of refinery gases is below 0°C .

49. What do you know about boiling range, carbon atoms range and uses of naphtha?

Ans. Boiling range: Boiling range of naphtha is $65-170^{\circ}\text{C}$.

Range of carbon atoms: Range of carbon atoms in naphtha is 6-10.

Uses: Naphtha is used as source of many useful hydrocarbons.

50. Tell boiling range, range of carbon atoms and uses of kerosene oil.

Ans. Boiling point: Boiling point of kerosene oil is $170-250^{\circ}\text{C}$.

Range of carbon atoms: Range of carbon atoms in kerosene oil is 10-14.

Uses: Kerosene oil is used in jet engines.

51. Can you tell the boiling range of diesel oil?

Ans. Boiling range of diesel oil is $250^{\circ}\text{C}-340^{\circ}\text{C}$.

52. What is range of carbon atoms in diesel oil?

Ans. In diesel oil the range of carbon atoms is 14-19.

53. Tell uses of diesel oil.

Ans. Diesel oil is used to run cars, buses and trucks.

54. What is boiling range of fuel oil?

Ans. The boiling range of fuel oil is $340^{\circ}\text{C}-500^{\circ}\text{C}$.

55. Tell range of carbon atoms in fuel oil.

Ans. Range of carbon atoms in fuel oil is above 20.

56. Discuss uses of fuel oil.

Ans. Fuel oil is used in ships and to run power plants.

57. What is boiling range, carbon atom range and use of bitumen?

Ans. Boiling range: Boiling range of bitumen is above 500°C .

Range of carbon atoms: Range of carbon atoms of bitumen is above 35.

Uses: Bitumen is used to construct roads and to water proof roofs and pipes.

58. What happens to the temperature as you move from the bottom to the top of the fractionating column?

Ans. The temperature decreases as we move from the bottom to the top of the fractionating column.

59. Which fraction is used to drive automobiles?

Ans. Gasoline (petrol) is used to drive automobiles.

60. Name the fraction that is used in jet engines.

Ans. Kerosene oil is used in jet engines.

61. Which fractions is used to run cars, buses and trucks.

Ans. Diesel oil is used to run cars, buses and trucks.

62. Name the fraction that is used in ships and to run power plants.

Ans. Fuel oil is used in ships and to run power plants.

63. List four factors that determine the physical properties of a petroleum fractions.

Ans. Four following factors determine the physical properties of a petroleum fractions.

(i) Number of carbon and hydrogen atoms present in the molecule of a fraction.

(ii) Volatility. (iii) Boiling point range. (iv) Viscosity.

64. How does the number of carbon atoms affect the boiling point of a fraction?

Ans. As the number of carbon atoms increases, the molecular mass and intermolecular forces increase, leading to a higher boiling point.

65. Why are fractions at the top of the column more inflammable?

Ans. Fractions at the top of the column are more inflammable because they have high volatility and low boiling points, meaning they turn into vapour and ignite more easily than heavier fractions.

66. Which fractions have high viscosity?

Ans. Fractions with more carbon atoms (like bitumen) have high viscosity.

67. What is volatility?

Ans. Volatility: It is the tendency of a substance to evaporate (turn into gas).

68. Which fractions have high volatility?

Ans. Fractions at the top of the fractionating column have high volatility.

Exercise Questions (Solved)

A. Multiple Choice Questions

☆ Choose and tick the correct answer from the given choices.

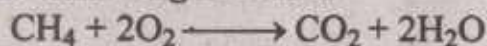
1. Which of the following compounds is expected to give addition reaction?

- (a) $\text{CH}_3 - \text{CH}_3$ (b) $\text{CH}_2 = \text{CH}_2$ (c) CH_4 (d) $\text{CH}_3 - \text{CH}_2 - \text{CH}_3$

2. Which of the followings is not used as a fuel?

- (a) LPG (b) CNG (c) Diesel (d) Asphalt

3. Indicate the type of the following reaction.



- (a) Substitution (b) Oxidation (c) Reduction (d) Addition

4. Which species acts as a reducing agent in the reaction between ethene and KMnO_4 ?

- (a) H_2O (b) $\text{CH}_2 = \text{CH}_2$ (c) KMnO_4 (d) NaOH

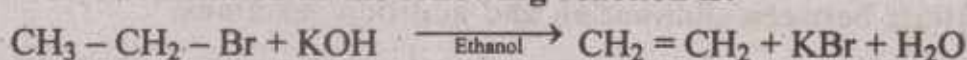
5. The product which will be formed when propene reacts with bromine molecule.

- (a) 1,2-Dibromopropane (b) 1,1-Dibromopropane
(c) 2,3-Dibromopropane (d) 1,3-Dibromopropane

6. Select the name of the petroleum fraction which generates electricity in power plants.

- (a) Bitumen (b) Lubricating oil (c) Kerosene oil (d) Fuel oil

7. The molecule eliminated in the following reaction is:



- (a) Br_2 (b) H_2 (c) HBr (d) H_2O

8. Fractional distillation of petroleum is based on:

- (a) Viscosity
- (c) Flammability

- (b) Boiling point range
- (d) Melting point range

Answers

1 (b) 2 (d) 3 (b) 4 (b) 5 (a) 6 (d) 7 (c) 8 (b)

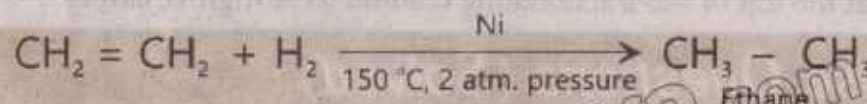
B. Short Answer Questions

22.1 Give two examples of addition reactions.

Ans. Addition Reactions: Addition reactions are those reactions in which reactants combine to form a single new product.

Example of Addition Reactions:

Addition of Hydrogen: Hydrogen is added to alkenes in the presence of nickel metal as a catalyst to give alkanes as the products.



22.2 Give the names of the compounds obtained from coal tar and petroleum.

Ans. Compounds obtained from coal tar: Following compounds are obtained from coal tar:

- Benzene
- Toluene
- Phenol
- Naphthalene

Compounds obtained from petroleum: Following compounds are obtained for petroleum:

- | | |
|------------------|---------------------|
| • Refinery gases | • Gasoline (petrol) |
| • Naphtha | • Kerosene oil |
| • Diesel oil | • Lubricating oil |
| • Fuel oil | • Bitumen |

22.3 How ethene is oxidized by cold aqueous solution of potassium permanganate.

Ans. Oxidation with KMnO_4 : Alkenes can react with cold and dilute alkaline potassium permanganate to give an important compound called ethane-1,2-diol.



22.4 Differentiate between elimination and addition reactions.

Ans. Elimination Reaction: It is a reaction that occurs when a molecule is removed from a saturated compound to produce an unsaturated compound.

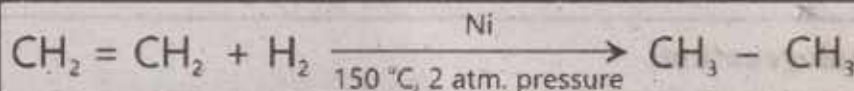
Example:



Addition Reaction:

Addition reaction is the reaction in which reactants combine to form a single new product.

Example:



22.5 Name the starting materials used to generate oxyacetylene flame:

Ans. Oxygen and acetylene gas (C_2H_2) are the starting materials used to generate oxyacetylene flame.

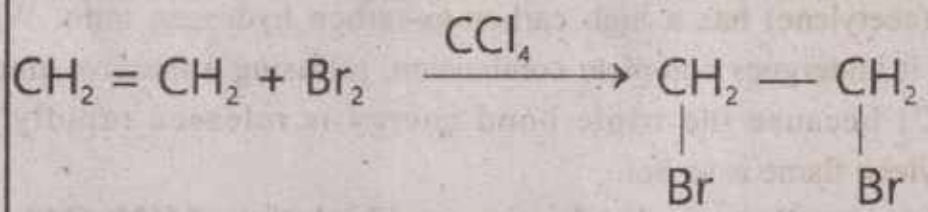
22.6 How can an alkene be identified?

Ans. Alkenes can be identified by following reactions:

- Halogenation reaction
- Oxidation reaction
- Iodine Test

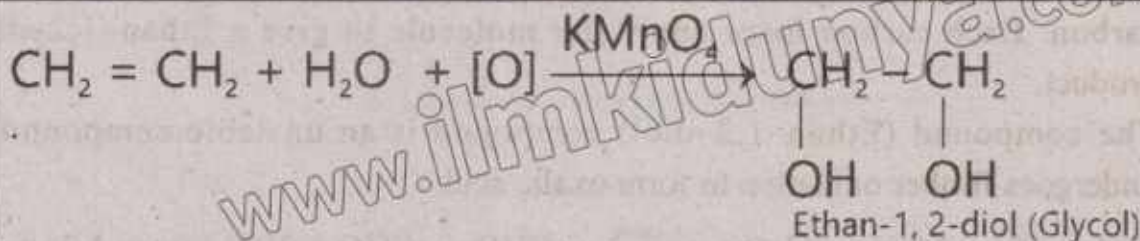
Halogenation Reaction:

When bromine is added to an alkene, the reddish brown colour of bromine is rapidly discharged.



Oxidation Reaction:

When an alkene reacts with cold and dilute alkaline potassium permanganate, the purple colour of potassium permanganate is rapidly discharged.



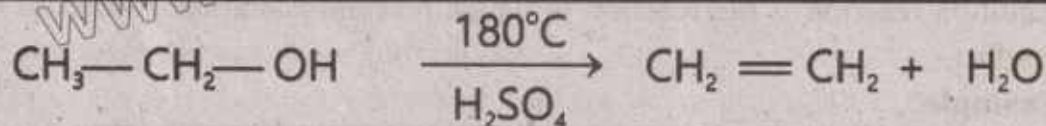
Iodine Test:

Similarly alkenes also discharge the violet colour of iodine.

C. Constructed Response Questions

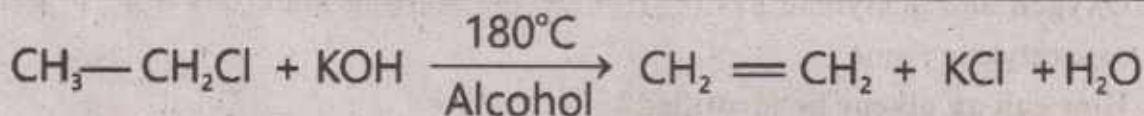
22.1 What is the difference between the terms dehydration and dehydrohalogenation?

Ans. Dehydration means removal of water molecule from an alcohol using a dehydrating agent like concentrated sulphuric acid.



Dehydrohalogenation:

Dehydrohalogenation means removal of a molecule of hydrogen halide (HX) from a molecule of alkyl halide using alcoholic KOH.



22.2 You have got two test tubes A and B containing a saturated and unsaturated compound (Alkene). How will you identify the two?

Ans. Identification of saturated and unsaturated compounds:

Add bromine water to both the test tubes. The test tube where the reddish brown colour disappears contains the alkene (unsaturated compound).

The test tube where the colour remains same contains the saturated compound.

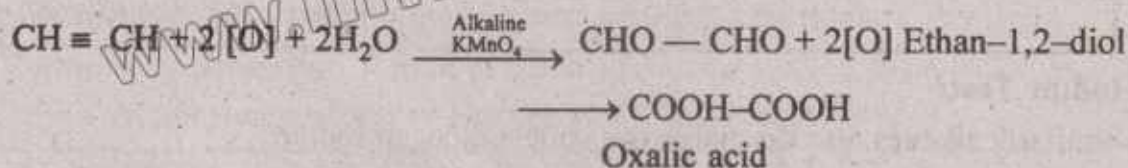
22.3 Why is oxyacetylene flame so hot?

Ans. Ethyne (acetylene) has a high carbon-to-carbon hydrogen ratio. When burned in oxygen, it undergoes complete combustion, releasing a massive amount of energy (3000°C) because the triple bond energy is released rapidly. This is why oxyacetylene flame is so hot.

22.4 Do you expect ethyne to decolourize a cold solution of KMnO₄?

Ans. Yes, Ethyne is unsaturated (contains a triple bond). Like alkenes, when ethyne is allowed to react with cold basic KMnO₄ solution then the triple bond present in the ethyne is oxidized by KMnO₄. It means, the two groups of (—OH) add on each carbon. Each carbon loses one water molecule to give a Ethan-1,2-diol as a product.

The compound (Ethan-1,2-diol) compound is an unstable compound. So, it undergoes further oxidation to form oxalic acid.



22.5 How do chlorine and hydrogen chloride add to ethene?

Ans. Reaction of Chlorine with Ethene:

Chlorine reacts with ethene to form 1,2-dichloroethene.



Reaction of Hydrogen Chloride with Ethene:

Hydrogen Chloride reacts with ethene to form chloroethane.



D. Descriptive Questions

22.1 Describe two methods of preparation for ethene.

Ans. For answer see Q1

22.2 Describe the fractional distillation of petroleum.

Ans. For answer see Q7

22.3 Which properties of petroleum fractions change with their boiling points?

Ans. For answer see Q9

22.4 Explain with examples the cracking of alkanes.

Ans. For answer see Q2

22.5 Give uses of acetylene.

Ans. For answer see Q5 (uses of Acetylene)