

O-level organic chemistry

Organic chemistry is the study of compounds of carbon

Uniqueness of carbon

- Carbon forms very many useful compounds with different physical and chemical properties.

Importance of organic compounds

Organic compounds are used as

- Drugs
- Perfumes
- Clothes
- Shoes
- Dyes
- Detergents for washing
- Packing materials
- Herbicide to dry weeds

Terminologies

Hydrocarbons are compounds that contain carbon and hydrogen only

Functional groups are reactive parts of organic compounds for example

Double bonds ($C=C$) for alkenes

Triple bonds for $C\equiv C$ alkynes

Hydroxyl group ($-OH$) for alcohols

Carboxylic groups ($-COOH$) for carboxylic acids

Homologous series

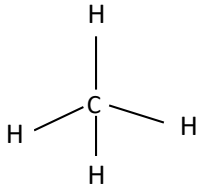
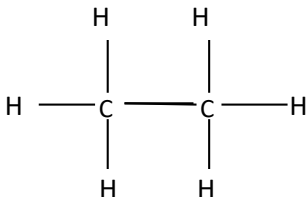
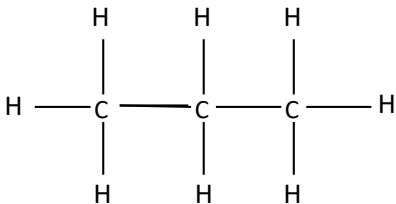
These are group of compounds with members related as follows

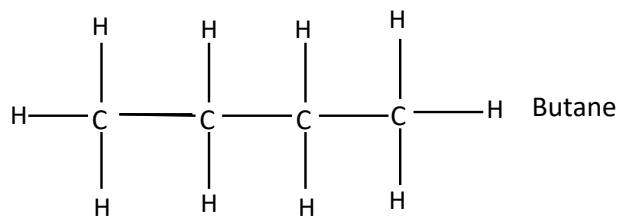
- Members have similar general formula e.g. the general formula of alkanes is C_nH_{2n+2} .
- Have similar functional groups and thus same chemical properties
- Have similar methods of preparation
- Show gradual change in physical properties for instance alkanes range from gases to liquids to solids

Alkanes

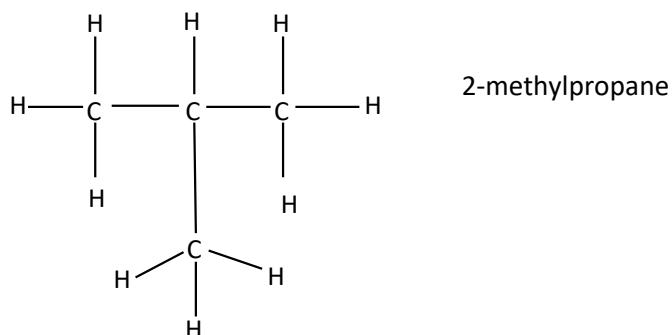
This is the simplest homologous series with saturated hydrocarbons with a general formula C_nH_{2n+2} .

Examples

Molecular formula	Structural formula	name
CH_4		methane
C_2H_6		ethane
C_3H_8		Propane



Or



Compounds with the same molecular formula but different structural formulae like butane and methylpropane are called **isomers**

Physical properties of alkane

- they are insoluble in water
- they are soluble in organic solvents
- they range from gases to liquids to waxy solids

Chemical properties

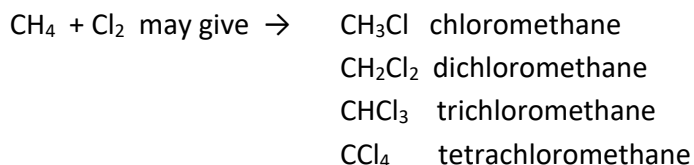
1. They burn in air to produce carbon dioxide, water and heat. Due to production of heat they are used as fuel.

Example



2. Chlorination: they react with chlorine in presence of sunlight or u.v-light to produce chlorinated alkanes.

Example



Preparation of alkanes

1. By distillation of petroleum oil
2. By cracking: cracking is the breakdown of long chain hydrocarbons into useful short chain hydrocarbons by heat (thermos-cracking) or by a catalyst (catalytic cracking)
3. From Biogas: methane is the main component of biogas. Biogas is produced by anaerobic decomposition of organic matter (cow dung, feces, plant remains) in presence of water

Alkenes

These are hydrocarbons that contain a double bond

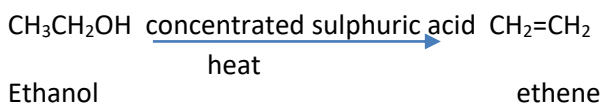
General formula is C_nH_{2n} $n \geq 2$

Examples are

Ethene	$\text{CH}_2=\text{CH}_2$
Propene	$\text{CH}_3\text{CH}=\text{CH}_2$
But-1-ene	$\text{CH}_3\text{CH}_2\text{CH}=\text{CH}_2$
But-2-ene	$\text{CH}_3\text{CH}=\text{CHCH}_3$

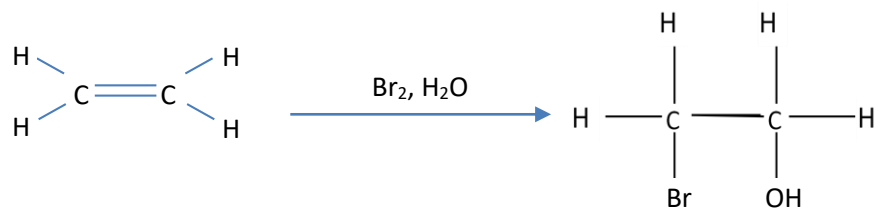
Preparation of ethene

By dehydration (removal of a water molecule from) of ethanol with hot concentrated sulphuric acid

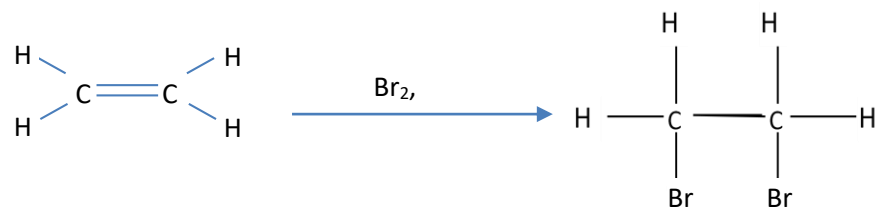


Testing or ethene

1. Ethene decolorizes bromine water.



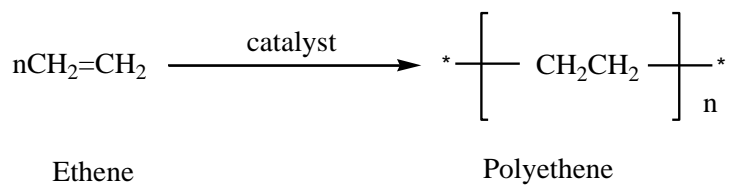
2. Ethene decolorized bromine tetrachloromethane



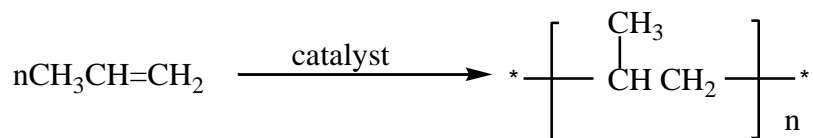
3. Ethene decolorizes acidified potassium permanganate (VII)
4. Alkenes form polymers called polyalkenes

A polymer is a molecule with high molecular mass formed combination of very many small molecules called monomers.

Examples



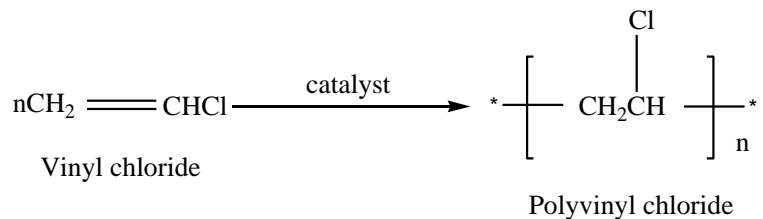
(ii) Propene polymerize to form polypropene



Propene

Polypropene

(i) Vinyl chloride polymerize to form polyvinylchloride (PVC)



Uses of polyethene

- Insulator
- Water pipes
- Packing mate

Polymerization of dienes

Alkenes with conjugated double bond undergo polymerization to form polyalkenes with double bonds

Example



Polymers from conjugated dienes have a double bonds, they are elastic and constitute different forms of rubber.

Vulcanization of rubber

It is heating rubber with Sulphur to make it

- Less elastic,
- More resistant to heat
- More durable
- Easier to dye

Uses of vulcanized rubber

- For rain coats
- Boots
- Shoe soles
- Rubber bands

Natural and artificial polymers

Natural polymers are polymers made plant or animal bodies

Examples are

Polymers	monomers
Starch	glucose
Cellulose	glucose
Protein	Amino acids
Cotton	
Wool	
silk	
sisal	

Artificial polymers are polymers that are man made

Examples

Nylon a

Polyester

Polyethene

Advantage of natural polymers

- Cheap

- biodegradable

disadvantage of natural polymers

- not durable
- have low property value such as low tensile strength

Advantage of synthetic polymers/plastic

- light and potable
- resistant most chemicals
- they are durable
- they are thermos insulators

Disadvantage of synthetic polymers

- they are non biodegradable
- fire hazards

Thermoplastic and thermosetting polymers

Thermoplastic polymers are those that soften and can be remolded into new shape. E.g. polyethene

Thermosetting polymers are those that decompose on heating and cannot be remoulded on heating for example vulcanized rubber, melamine, Bakelite.

Alkyne

They are hydrocarbons with a general formula C_nH_{2n-2} , $n \geq 2$. They contain a triple bond

Examples

Ethyne $HC \equiv CH$

Propyne, $CH_3C \equiv CH$

But-1-yne $CH_3CH_2C \equiv CH$

But-2-yne $CH_3C \equiv CCH_3$

Like alkenes they decolorize bromine water

Alcohols

They are compound that contain hydroxyl (-OH) group.

Example

Ethanol or $\text{CH}_3\text{CH}_2\text{OH}$

Preparation of ethanol

By fermentation of glucose or starch containing food (cassava, maize, and bananas)



Uses of ethanol

Social drink

Antiseptic in in soft drinks

Production of ethene

Fuel

Extraction of sugar

- (i) sugar canes are crushed and juice extracted
- (ii) Sulphur dioxide is bubbled through to breach the juice
- (iii) Lime is added to clarify the juice and adjust pH and filtered
- (iv) The juice is boiled to increase its concentration from 15% to 60%.
- (v) Sugar crystals in ethanol are added to crystalize sugar
- (vi) The sugar crystals are washed with water and dried

Reaction of sugar with sulphuric acid

Sugar is dehydrated with concentrated sulphuric acid with evolution of heat to black mass of carbon



Exercise

Circle the correct alternative

- Which of the following process by which the property of rubber is improved by treating it with Sulphur?
 - Polymerization
 - Hydrogenation
 - Vulcanization
 - Fermentation
- Which one of the following is the name given to the reaction between ethanol and hot concentrated sulphuric acid to form ethene?
 - Polymerization
 - Decomposition
 - Dehydration
 - Reduction
- Which one of the following hydrocarbon does not belong to the same group?
 - Ethane
 - Ethene
 - Methane
 - propane
- Which one of the following is the formula of unsaturated hydrocarbon?
 - CH_4
 - C_2H_6
 - C_3H_6
 - C_4H_{10}
- Which one of the following is the name given to the reaction between ethanol and hot concentrated sulphuric acid to form ethene?
 - Polymerization
 - Decomposition
 - Dehydration
 - Reduction
- Which of the following hydrocarbons when bubbled through bromine water will change the color of solution from reddish-brown to colorless?
 - C_2H_4
 - C_3H_8
 - C_2H_6
 - CH_4
- Which one of the following substance formed when ethanol is dehydrated by concentrated sulphuric acid?
 - C_2H_4
 - CH_4
 - CO
 - C
- Which one of the following is the empirical formula of hydrocarbon containing 88.8% carbon?
 - C_4H_6
 - C_2H_4
 - CH_2

- D. CH
9. Which of the following reagent can be used to distinguish between ethene and ethane?
- Lime water
 - Bromine
 - Potassium iodide
 - Potassium dichromate
10. Which one of the following is the reason why polyethene is regarded as a pollutant?
- It kills useful bacteria
 - It alters the pH of the soil
 - It is poisonous to plants
 - It takes long to decompose.
11. Which one of the following compounds is an unsaturated hydrocarbon?
- CH₄
 - C₂H₄
 - C₃H₈
 - C₄H₁₀
12. Which one of the following substance is formed when a mixture of concentrated sulphuric acid and ethanol is heated?
- Carbon monoxide
 - Carbon
 - Ethane
 - Ethene
13. Which one of the following can undergo polymerization reaction?
- CH₄
 - C₂H₄
 - C₃H₈
 - C₄H₁₀
14. Which one of the following pairs of hydrocarbon can be represented by the same general formula?
- Ethane and ethene
 - Ethane and propane
 - Ethane and methane
 - Ethene and butane
15. Which of the following hydrocarbon is saturated?
- C₂H₄
 - C₂H₆
 - C₃H₆
 - C₄H₈
16. Which of the following hydrocarbon will produce the least heat energy per mole on complete combustion?
- CH₃CH₂CH₂CH₃
 - CH₃CH₂CH₃
 - CH₃CH₃
 - CH₄
17. The reaction in which ethene forms a solid whose molecular mass is more than 10,000 is called
- Polymerization
 - Hydrogenation

- C. Vulcanization
 - D. Cracking
18. Which one of the following molecular formula is that of alkene?
- A. C_4H_6
 - B. C_3H_6
 - C. C_3H_8
 - D. C_2H_2
19. Which one of the following is not a property of ethene?
- A. It turns potassium permanganate colorless
 - B. It is unsaturated hydrocarbon
 - C. It decolorizes bromine water
 - D. It is a saturated hydrocarbon
20. Which one of the following formulae represent an alkane?
- A. C_2H_4
 - B. C_3H_8
 - C. C_4H_8
 - D. C_4H_{10}
21. The reaction between ethanol and concentrated sulphuric acid to form ethene is called
- A. Hydrogenation
 - B. Catalyst
 - C. Dehydrogenation
 - D. Hydration
22. Which of the following decolorizes bromine water?
- A. Ammonia
 - B. Ethene
 - C. Methane
 - D. Chlorine
23. In which of the following processes does ethene form a polymer
- A. Polymerization
 - B. Precipitation
 - C. Neutralization
 - D. Electrolysis
24. During the manufacture of sugar, which one of the following processes is used to remove the brown color?
- A. Recrystallization
 - B. Filtration
 - C. Evaporation
 - D. Precipitation
25. Which of the following properties is not that of paraffin? It is
- A. Solvent
 - B. A fuel
 - C. Denser than water
 - D. Volatile
26. Which one of the following hydrocarbons has 90% carbon content? (C = 12, H = 1)
- A. C_3H_4
 - B. C_3H_6
 - C. C_2H_6

D. C_3H_8

27. Which one of the following is not used as a fossil fuel?
- A. Hydrogen
 - B. Coal
 - C. Charcoal
 - D. Ethanol
28. An example of a non-biodegradable substance is
- A. Silk
 - B. Wool
 - C. Polyethene
 - D. Paper
29. Which of the following sets contain natural fibres only?
- A. Nylon, wool, cotton
 - B. Cotton, nylon, silk
 - C. Silk, nylon, wool
 - D. Cotton, wool, silk
30. Which one of the following is a synthetic fibre?
- A. Nylon
 - B. Starch
 - C. Rubber
 - D. Wool
31. Which one of the following contains multiple bonds?
- A. CH_4
 - B. C_2H_2
 - C. C_2H_6
 - D. C_3H_8
32. Which one of the following hydrocarbons is saturated?
- A. C_2H_4
 - B. C_2H_6
 - C. C_3H_6
 - D. C_4H_8
33. Which one of the following statements is not true about butane?
- A. It is used as fuel
 - B. It is a hydrocarbon
 - C. It decolorizes bromine water
 - D. It is a saturated compound.
34. Which of the following polymers can be remoulded?
- A. Polyester
 - B. Nylon
 - C. Polyethene
 - D. Rubber
35. Which one of the following formulae represents an alkane?
- A. C_2H_4
 - B. C_3H_4
 - C. C_4H_8
 - D. C_4H_{10}

36. Which of the following polymers is a synthetic?
- Wool
 - Cotton
 - Sisal
 - Nylon
37. Which one of the following is not produced during fermentation of sugar to alcohols?
- Water vapour
 - Carbon dioxide
 - Methane
 - Heat
38. Which gas evolves during fermentation of glucose solution
- Ammonia
 - Nitrogen dioxide
 - Carbon dioxide
 - Methane

Each of the questions 39 to 43 consist of an assertion (statement) on the left hand side and a reason on the right hand side.

Select

- If both assertion and reason are true statements and the reason is a correct explanation of the assertion.
- If both assertion and reason are true statements and the reason is **not** a correct explanation of the assertion
- If the assertion is true but the reason is not correct statement.
- If the assertion is not correct but the reason is a correct statement.

Instruction summarized

Assertion	
A. True	True and a correct explanation
B. True	True but not a correct explanation
C. True	Incorrect
D. Incorrect	Correct

- | | | |
|---|---------|---|
| 39. Ethene undergoes polymerization reaction | because | Ethene is hydrocarbon |
| 40. Ethene changes the color of bromine water from reddish-brown to colorless | Because | Ethene is a hydrocarbon |
| 41. The enthalpy of combustion of butane is higher than that of ethene | Because | Butane contains more carbon atoms than ethene |
| 42. Ethene can form a polymer | Because | It is a hydrocarbon |

43. Sulphuric acid changes sugar from _____ because _____ Sulphuric acid is oxidizing agent
white to black

In each of the questions 44 to 46 one or more of the answers given may be correct. Read each questions carefully and then indicate the correct answer according to the following

- A. If 1, 2, 3, only are correct
- B. If 1 and 3 only are correct
- C. If 2 and 4 only are correct
- D. If 4 only is correct

44. Which of the following will be dehydrated by concentrated sulphuric acid?

- 1. Lime
- 2. Ethanol
- 3. Soda ash
- 4. Sugar

45. Which of the following is/are natural polymers?

- 1. Cellulose
- 2. Tetrylene
- 3. Protein
- 4. Nylon

46. Which of the following statement is/are true about polythene?

- 1. It is biodegradable
- 2. It is man-made polymer
- 3. It is a natural polymer
- 4. It can be remoulded

Section B

Short answers

47. The molecular formula of an organic compound J is C_3H_8 .

(a) (i) Write the structural formula of J.

(ii) Name J

(iii) Name the group of organic compounds to which J belongs.

(b) (i) It is not wise to burn J in a living room with closed window and doors. Give a reason.

(ii) State one use of J

48. (a) Natural rubber is soft and it is normally made hard before use.

(i) Name one process by which natural rubber is made hard

(ii) State how natural rubber is made hard by the process you have named in (a)(i).

(b) State

(i) two reason why natural rubber is made hard before use.

(ii) two uses of rubber.

49. The molecular formula of ethene is C_2H_4

(a) Write the structural formula of ethene (1marks)

(b) Bromine water is one of the reagents that can be used to test for the presence of ethene

- (i) State what would be observed if ethene is treated with bromine water and write an equation for the reaction
- (ii) Name one other reagent that can be used to test for the presence of ethene (1mark)
- (c) Name one compound from which ethene can be prepared (1mak)

SECTION C

50. (a) Describe how pure sugar can be obtained from sugar cane on large scale (diagram not required)
- (b) Sugar can be converted in the presence of an enzyme to ethanol
- Name
- (i) Process leading to formation of ethanol
 - (ii) Enzyme used in the process.
- (c) Write equation for the reaction that lead to formation of ethanol
- (d) When concentrated sulphuric acid was added to sugar, a black solid was formed. Explain what took place and illustrate your answer with an equation.
- (e) State one use of
- (i) Sugar
 - (ii) Ethanol
51. (a) State the difference between the following terms
- (i) Synthetic and natural polymer
 - (ii) Thermosetting polymers and thermo-softening (or thermoplastic) polymers
- (b) (i) state the condition under which sulphuric acid can react with ethanol to produce ethene.
(ii) Write equation leading to formation of ethene.
- (c) When reacted together, ethene molecules can form a polymer
- (i) Name the polymer
 - (ii) Write an equation leading to the formation of the polymer.
 - (iii) State the use of the polymer.
52. The general formula of compounds Q and R are C_nH_{2n} and C_nH_{2n+2} respectively
- (a) Write the molecular formula and the name of Q and R for $n=2$
- (i) Q: Formula
Name
 - (ii) R: Formula
Name
- (b) State the structural difference between Q and R.
- (c) (i) Name a reagent which can be used to distinguish Q and R.
(ii) state what would be observed if the reagent you have named in (c)(i) was treated separately with Q and R.
(iii) Write equation for any reaction that would take place to illustrate your observation in (c)(ii).
53. A compound Q of formula mass 60, contains carbon, 40%, hydrogen 6.7% and the rest being oxygen.

- (a) (i) calculate the empirical formula of Q (H = 1; C = 12, O=16)
 (ii) Determine the molecular formula of Q
 (b) Q Dissolve in aqueous sodium hydrogen carbonate with effervescence
 (i) Suggest the chemical formula of Q
 (ii) Write an ionic equation for reaction between Q and aqueous hydrogen carbonate
54. (a) Write the structural formula of
 (i) Ethene
 (ii) Ethane
 (b) Name one reagent which can be used to distinguish between ethene and ethane.
 (c) state what would be observed if ethene was treated with the reagent you have named in (b)
 (d) Write equation for the polymerization of ethene

55. Using a suitable yeast, glucose can be converted to ethanol and carbon dioxide according to the following equation



- (a) Name the
 (i) Enzyme in yeast that converts glucose to ethanol
 (ii) Process in which glucose is converted to ethanol in the presence of yeast.
 (b) Glucose also produces carbon dioxide when burnt in air. The reaction takes place according to the following equation.



Calculate the mass of glucose that when burnt, would produce 1.2dm³ of carbon dioxide at room temperature.

56. (a) Alkanes and alkenes are hydrocarbon:
 (i) Define the term hydrocarbon
 (ii) State the structural difference between alkanes and alkenes
 (b) The boiling points of straight chain alkanes having two to seven carbon atoms are shown in the table below

Number of carbon atoms	2	3	5	6	7
Boiling point (°C)	-79	-42	37	69	98

- (i) Plot a graph of boiling points against the number of carbon atom (01mark)
 (ii) From the graph, determine the boiling point of the alkanes with four carbon atoms.
 (c) (i) What is the shape of the graph?
 (ii) State the relationship between boiling point of an alkane and the number of carbon atoms in the alkane
 (d) (i) name one reagent other than bromine that can be used to distinguish between ethane and ethene.
 (ii) State what would be observed if the reagent you have named in (d) was Separately treated with ethane and ethene.
 (e) Ethene burns in air according to the following equation

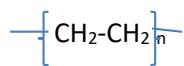
$$\text{C}_2\text{H}_4 (\text{g}) + 3\text{O}_2 (\text{g}) \longrightarrow 2\text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{g}) \quad \Delta H = -1410\text{kJmol}^{-1}$$

 Calculate the amount of heat evolved when 12.5g of ethene is completely burnt.

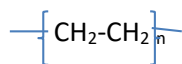
57. The molecular formula of ethene is C₂H₄.

- (a) Write the structural formula of ethene
- (b) Bromine water is one of the reagents that can be used to test for the presence of ethene
 - (i) State what would be observed if ethene is treated with bromine water and write an equation for the reaction
observation
equation
 - (ii) Name one other reagent that can be used to test for the presence of ethene
- (c) Name **one** compound from which ethene can be prepared.

58. Under suitable laboratory conditions, ethene can be converted to a compound with the general formula



- (a) (i) What is the change from ethene to $\text{---} \left[\text{CH}_2\text{-CH}_2 \right]_n \text{---}$ called?
- (ii) what name is given to compound $\text{---} \left[\text{CH}_2\text{-CH}_2 \right]_n \text{---}$?
- (iii) Write an equation for the reaction leading to the formation of



- (iv) State one possible use of $\text{---} \left[\text{CH}_2\text{-CH}_2 \right]_n \text{---}$

- (b) Name one other compound of the category $\text{---} \left[\text{CH}_2\text{-CH}_2 \right]_n \text{---}$ which is not manmade?

59. (a) (i) Describe how would obtain a sample of sugar crystals from sugar cane.

- (ii) State two uses of sugar in the world of the sick

(b) Concentrated sulphuric acid was added to sugar

- (i) What was observed

- (ii) What name is given to this process.

(iii) How would you convert sugar to alcohol (ethanol)?

(iv) Why is ethanol important to the society?

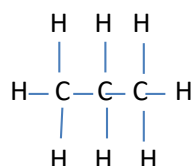
- (c) A mass of 3.10g of an organic compound that contains carbon, hydrogen and oxygen only, produced 4.40g of carbon dioxide and 2.79g of water on complete combustion.
Calculate the empirical formula of organic compound (C = 12, O = 16, H = 1)

60. (a) Name the raw material used in your locality to make alcoholic drink.
(b) Briefly describe how ethanol can be obtained from the material you have named in (a).
(c) State how ethanol prepared in (b) can be concentrated and suggest a way of determining whether the ethanol is pure or not.
(d) Ethene can be formed from ethanol. Write equation and state conditions for the reaction leading to formation of ethene.
(e) Name two uses of ethanol apart from preparation of ethene
61. (a) (i) What is a polymer?
(ii) Distinguish between a natural and artificial polymer
(b) Describe the process of vulcanization of rubber. In your description include
(i) Importance of vulcanization
(ii) Two useful items of vulcanized rubber
62. (a) (i) state the conditions under which sulphuric acid reacts with ethanol to ethene (2 ½ marks)
(ii) Write an equation for the formation of ethene from ethanol and sulphuric acid (01 mark)
(b) State the property of sulphuric acid shown in the reaction in (a)(ii). (01mark)
(c) Name one reagent apart from bromine that can be used to distinguish between ethene and ethane, and each case state what would be observed if the reagent is separately treated with ethane and ethene.
(d) A hydrocarbon, T, molecular mass 42, contains 85.7% carbon
(i) Calculate the empirical formula of T. (3 ½ marks)
(ii) Determine the molecular formula of T (01mark)
(iii) Write the structure of T (01mark)
(iv) T was reacted with bromine water. State what was observed and write an equation for the reaction. (02mark)

Answers

1	C	11	B	21	C	31	B	41	A
2	C	12	D	22	B	32	B	42	B
3	B	13	B	23	A	33	C	43	B
4	C	14	C	24	A	34	C	44	C
5	C	15	B	25	C	35	D	45	B
6	A	16	D	26	A	36	D	46	C
7	A	17	A	27	D	37	C		
8	A	18	D	28	C	38	C		
9	B	19	D	29	D	39	B		
10	D	20	A	30	A	40	B		

47. (a) (i)



(ii) Propane

(iii) Alkane

(b) (i) may produce poisonous carbon monoxide

(ii) fuel

48. (a)(i) vulcanization

(ii) by heating rubber with sulphur

(b) - increases durability

- increases resistance to heat

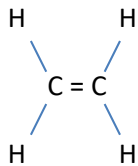
- reduces elasticity

(ii) rain coat

Shoe soles

Gum boots

49. (a)



(b) (i) bromine water



(ii) Acidified potassium permanganate (VII)

(c) Ethanol

50. (a) – mature sugar canes are washed cut into pieces

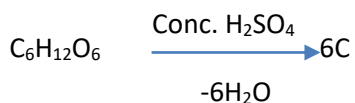
- juice is extracted by pressure
- Sulphur dioxide is bubbled through the juice to clarify it
- lime is mixed with the juice to normalize pH
- The juice is concentrated by evaporation
- Sugar crystal in ethanol are added to promote crystallization.

(b) (i) fermentation

(ii) zymaze



(d) Sugar is dehydrated to carbon by concentrated sulphuric acid.



(e) (i) sugar is a sweetener and provide energy

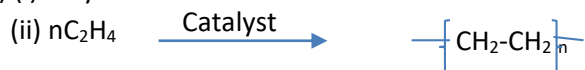
- (ii) ethanol
- antiseptic
 - social drink
 - fuel
 - for synthesis of ethene

51. (a)(i) Synthetic polymer are manmade polymers while natural polymers are made by plants or animal bodies such as proteins, starch, cellulose, silk, cotton, wool.

(ii) thermosetting polymers are polymers that decompose and cannot be remoulded on heating whereas thermosoftening polymers are those that soften and can be remoulded on heating

(b)(i) acid is concentrated and a mixture heated

(c) (i) Polyethene



(iii) Packing materials

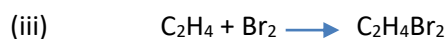
52. (a) Q is C_2H_4 is ethene

R is C_2H_6 is ethane

(b) Q (alkene) contains a double bond whereas R does not.

(c) (i) Bromine water

(ii) Q decolorizes bromine water whereas R does not



53. (a) (i) percentage of oxygen = $100 - (40 + 6.7) = 53.3$

Elements	C	H	O
Percentage	40	6.7	53.3
RAM	12	1	16
moles	3.33	6.7	3.33
Mole ratio	1	2	1
Empirical formula CH_2O			

(ii) molecular formula

$$(\text{CH}_2\text{O})_n = 60$$

$$n(12 + 2 + 16) = 60$$

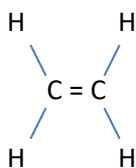
$$n = 2$$

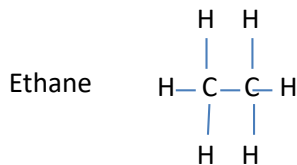
$$\therefore \text{molecular formula} = \text{C}_2\text{H}_4\text{O}_2$$

(b) (i) carboxylic acid; CH_3COOH



54. Ethene





(b) bromine water

(c) ethene decolorizes bromine water, thane does not



55. (a) (i) zymaze

(ii) fermentation

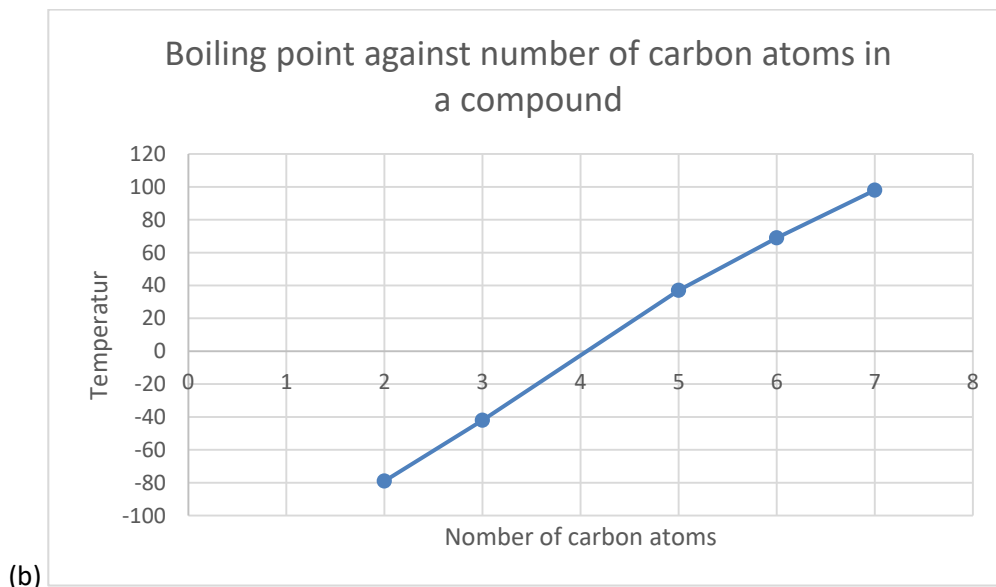
(b) Rfm of $\text{C}_6\text{H}_{12}\text{O}_6 = (6 \times 12 + 12 \times 1 + 6 \times 16) = 180$

$\Rightarrow 6 \times 24000\text{cm}^3$ of carbon dioxide require 180g

$\Rightarrow 1.2 \text{ dm}^3$ of carbon dioxide will require 0.765g

56. (a) (i) Hydrocarbons is a compound that contains carbon and hydrogen only.

(ii) alkenes have double bonds whereas alkanes do not.



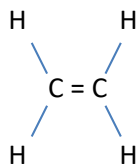
(b)(ii) the boiling point of butane is 0°C .

(c)(i) linear

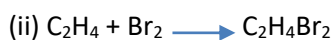
(ii) boiling point of straight chain alkanes increase directly with increase in number carbon atoms in the chain

- (d) (i) Acidified potassium permanganate (VII)
 (ii) Alkenes decolorize acidified potassium permanganate (VII) solution.
- (e) Rfm $C_2H_4 = 2 \times 12 + 1 \times 4 = 28$
 \Rightarrow 28g of ethene produce 1410 kJ
 \Rightarrow 12.5g of ethene produce 629 kJ

57. (a)



(b)(i) ethene decolorize bromine water



(iii) Acidified potassium permanganate (VII)

(c) ethanol

58 (a) (i) polymerization

(ii) polyethene



(iv) packaging material, water pipes

59. (a)(i) – mature sugar canes are washed cut into pieces

- juice is extracted by pressure
- Sulphur dioxide is bubbled through the juice to clarify it
- lime is mixed with the juice to normalize pH
- The juice is concentrated by evaporation
- Sugar crystal in ethanol are added to promote crystallization.

(ii) sugar provides energy and is used in pharmaceuticals as a sweetener.

(b)(i) turns black

(ii) dehydration

(iii) fermentation

$$\text{(iv) mass of carbon} = \frac{12 \times 4.4}{44} = 1.2g$$

$$\text{mass of hydrogen} = \frac{2 \times 2.7}{18} = 0.3g$$

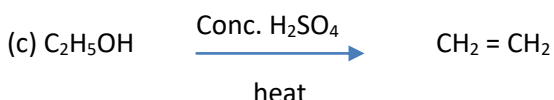
$$\text{mass of oxygen} = 3.1 - (1.2 + 0.3) = 1.6$$

Elements	C	H	O
mass	1.2	0.3	1.6
RAM	12	1	16
moles	0.1	0.3	0.1
Mole ratio	1	3	1
Formula	CH ₃ O		

60 (a) (i) Bananas and sorghum

(ii) ripe bananas are crushed and mixed with water and left for a few days to ferment.

(b) by distillation



(d) ethanol is antiseptic and a social drink

61. (a) (i) A polymer is a molecule of high molecular mass that is formed by combination of very many identical molecules called monomers.

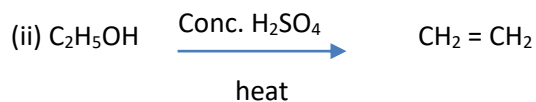
(ii) Natural polymers are polymers made by plants or animal bodies while artificial polymers are manmade

(b) (i) Vulcanization is heating rubber with sulphur

Vulcanization make rubber durable, resistant to heat and less elastic.

(ii) Vulcanized rubber is used to make rain coats, shoe soles, tyres.

62. (a) (i) heat and acid should be concentrated



(b) dehydration

(c) ethene decolorizes acidified potassium permanganate (VII) whereas ethane does not.

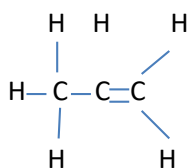
$$\text{(d) percentage of hydrogen} = 100 - 85.7 = 14.3$$

Elements	C	H
Percentage	85.7	14.3
RAM	12	1
moles	7.14	14.3
Mole ratio	1	2
Formula	CH ₂	

(e) $(\text{CH}_2)_n = 42$

$n = 3$

Molecular formula = C₃H₆



(iii) bromine was decolorized

