**O-level organic chemistry**

Organic chemistry is the study of compounds of carbon

**Uniqueness of carbon**

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- 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 ≡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 CnH2n+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

CnH2n+2.

**Examples**

Molecular formula Structural formula name

H



CH4 methane

C



H H

H

H H

C2H6

H C C H

ethane

H H



H H H

C3H8

H C C C H

Propane

H H H



H H H H



H C C C C

H Butane

C4H10

H H H H

Or

H H H

H C C C H

2-methylpropane

H H



C

H H

H

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

CH4 + 2O2 → CO2 + 2H2O + heat

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

Example

CH4 + Cl2 may give → CH3Cl chloromethane CH2Cl2 dichloromethane CHCl3 trichloromethane CCl4 tetrachloromethane

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 caontain aa double bond

General formula ia CnH2n n ≥ 2

Examples are

Ethene CH2=CH2

Propene CH3CH=CH2

But-1-ene CH3CH2CH=CH2

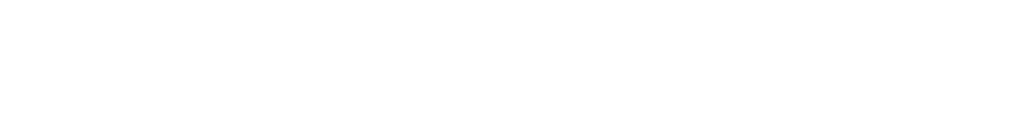
But-2-ene CH3CH=CHCH2

**Preparation of ethene**

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

CH3CH2OH concentrated sulphuric acid CH2=CH2

Ethanol ethene



**Testing or ethene**

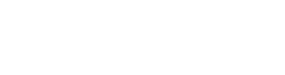
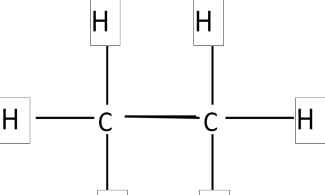
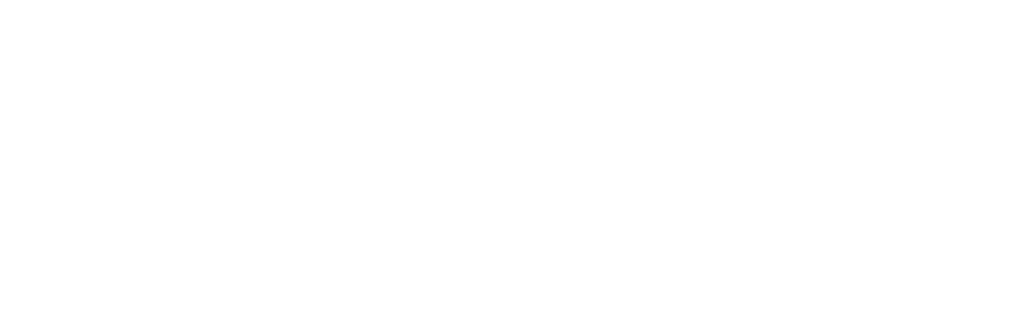
1. Ethene decolorizes bromine water.

H H

C C Br2, H2O

H H

Br OH



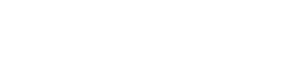
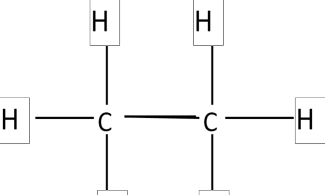
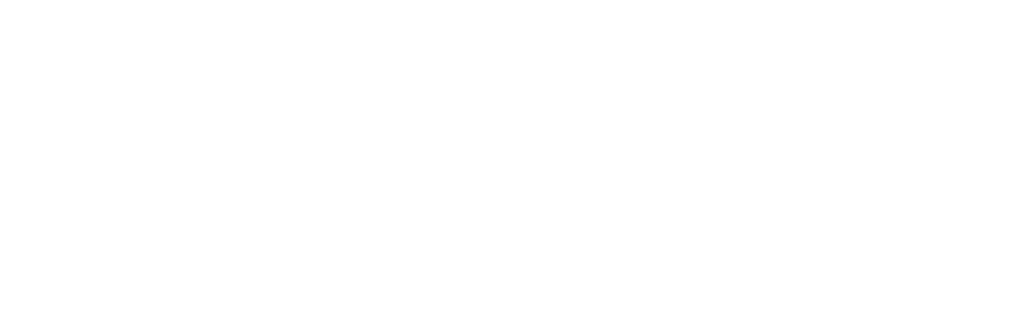
2. Ethene decolorized bromine tetrachloromethane

H H

C C Br2,

H H

Br Br



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

nCH2=CH2

catalyst

\* CH2CH2 \*

n

Ethene Polyethene

(ii) Propene polymerize to form polypropene

nCH3CH=CH2

catalyst

CH3

\* CH CH2 \*

n

Propene Polypropene

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

Cl

nCH2

CHCl

catalyst

\* CH2CH \*

n

Vinyl chloride

Polyvinyl chloride

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

(i) nCH2=CHCH=CH3

\* CH2CH=CHCH2 \*

But-1,3-diene polybutadiene n

(ii) nCH2=C CH=CH2

CH3

methylbut-1.3-diene

\* CH2C=CHCH2 \*

CH3 n

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 CnH2n-2, n . They contain a triple bond

Examples Ethyne HC≡CH Propyne, CH3C≡ CH

But-1-yne CH3CH2C≡ CH

But-2-yne CH3C≡ CCH3

Like alkenes they decolorize bromine water

Alcohols

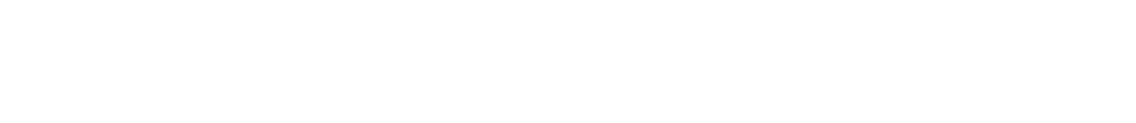
They are compound that contain hydroxyl (-OH) group. Example

Ethanol or CH3CH2OH

Preparation of ethanol

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

C6H12O6 fermentation 2CH3CH2OH + 2CO2



Glucose ethanol

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

C12H22O11 concentrated H2SO4 12C + 11H2O

Exercise

Circle the correct alternative

1. Which of the following process by which the property of rubber is improved by treating it with

Sulphur?

A. Polymerization

B. Hydrogenation C. Vulcanization D. Fermentation

2. Which one of the following is the name given to the reaction between ethanol and hot concentrated sulphuric acid to form ethene?

A. Polymerization B. Decomposition C. Dehydration

D. Reduction

3. Which one of the following hydrocarbon does not belong to the same group?

A. Ethane

B. Ethene

C. Methane

D. propane

4. Which one of the following is the formula of unsaturated hydrocarbon?

A. CH4

B. C2H6

C. C3H6

D. C4H10

5. Which one of the following is the name given to the reaction between ethanol and hot

concentrated sulphuric acid to form ethene? A. Polymerization

B. Decomposition

C. Dehydration

D. Reduction

6. Which of the following hydrocarbons when bubbled through bromine water will change the color of solution from reddish-brown to colorless?

A. C2H4

B. C3H8

C. C2H6

D. CH4

7. Which one of the following substance formed when ethanol is dehydrated by concentrated

sulphuric acid? A. C2H4

B. CH4

C. CO

D. C

8. Which one of the following is the empirical formula of hydrocarbon containing 88.8% carbon?

A. C4H6

B. C2H4

C. CH2

D. CH

9. Which of the following reagent can be used to distinguish between ethene and ethane?

A. Lime water

B. Bromine

C. Potassium iodide

D. Potassium dichromate

10. Which one of the following is the reason why polyethene is regarded as a pollutant?

A. It kills useful bacteria

B. It alters the pH of the soil

C. It is poisonous to plants

D. It takes long to decompose.

11. Which one of the following compounds is an unsaturated hydrocarbon?

A. CH4

B. C2H4

C. C3H8

D. C4H10

12. Which one of the following substance is formed when a mixture of concentrated sulphuric acid

and ethanol is heated? A. Carbon monoxide B. Carbon

C. Ethane

D. Ethene

13. Which one of the following can undergo polymerization reaction?

A. CH4

B. C2H4

C. C3H8

D. C4H10

14. Which one of the following pairs of hydrocarbon can be represented by the same general

formula?

A. Ethane and ethene B. Ethane and propane C. Ethane and methane D. Ethene and butane

15. Which of the following hydrocarbon is saturated?

A. C2H4

B. C2H6

C. C3H6

D. C4H8

16. Which of the following hydrocarbon will produce the least heat energy per mole on complete

combustion?

A. CH3CH2CH2CH3

B. CH3CH2CH3

C. CH3CH3

D. CH4

17. The reaction in which ethene forms a solid whose molecular mass is more than 10,000 is called

A. Polymerization

B. Hydrogenation

C. Vulcanization

D. Cracking

18. Which one of the following molecular formula is that of alkene?

A. C4H6

B. C3H6

C. C3H8

D. C2H2

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. C2H4

B. C3H8

C. C4H8

D. C4H10

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. C3H4

B. C3H6

C. C2H6

D. C3H8

27. Which one of the following is not used a fossil fuel?

A. Hydrogen

B. Coal

C. Charcoal

D. Ethanol

28. An example of 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. CH4

B. C2H2

C. C2H6

D. C3H8

32. Which one of the following hydrocarbons is saturated?

A. C2H4

B. C2H6

C. C3H6

D. C4H8

33. Which one of the following statement is not true about butane?

A. It is used as fuel

B. It is 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. C2H4

B. C3H4

C. C4H8

D. C4H10

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36. Which of the following polymers is a synthetic?

A. Wool B. Cotton C. Sisal

D. Nylon

37. Which one of the following is not produced during fermentation of sugar to alcohols?

A. Water vapour B. Carbon dioxide C. Methane

D. Heat

38. Which gas evolves during fermentation of glucose solution

A. Ammonia

B. Nitrogen dioxide C. Carbon dioxide D. 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

A. If both assertion and reason are true statements and the reason is a correct explanation of the assertion.

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

C. If the assertion is true but the reason is not correct statement.

D. If the assertion is not correct but the reason is a correct statement.

Instruction summarized

**Assertion**

**A. True B. True C. True**

**D. Incorrect**

**True and a correct explanation True but not a correct explanation Incorrect**

**Correct**

39. Ethene undergoes polymerization reaction

40. Ethene changes the color of bromine water from reddish-brown to colorless

41. The enthalpy of combustion of butane

is higher than that of ethene

because Ethene is hydrocarbon

Because Ethene is a hydrocarbon

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

white to black

because Sulphuric acid is oxidizing agent

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 C3H8. (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 C2H4

(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 CnH2n and CnH2n+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

C6H12O6 yeast 2CH3CH2OH + 2CO2

(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.

C6H12O6 (s) + 6O2 (g) 6CO2(g) + 6H2O (g)

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

room temperature.

56. (a) Alkanes and alkenes are hydrogen: (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 (0C)** | -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

C2H4 (g) + 3O2 (g) 2CO2(g) + 2H2O(g) ∆H = -1410kJmol-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

CH2-CH2 n



(a) (i) What is the change from eth

ene to call



CH2-CH2 n

ed?

(ii) what name is given to compou

nd ?



CH2-CH2 n

(iii) Write an equation for the reaction leading to the formation of

CH2-CH2 n



(iv) State one possible use of

CH2-CH2 n



(b) Name one other compound of the cat

egory



CH2-CH2 n

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 a part 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) Sate 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)

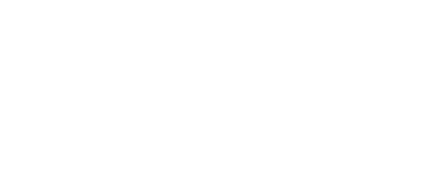
(iv) T was reacted with bromine water. State what was observed and write an equation for the reaction. (02mark)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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)

H H H

H C C C H H H H



(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

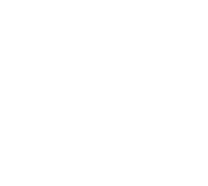
- increases resistance to heat

- reduces elasticity

(ii) rain coat Shoe soles Gum boots

49. (a)

H H C = C



H H

(b) (i) bromine water

C2H4 + Br2 C2H4Br2

(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

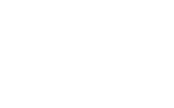
- lime is mixed with the juice to normalize pH

- The juice is concentrated by evaporation

- Sugar crystal in ethanol are added to promote crystallization. (b) (i) fermentation

(ii) zymaze

Zymaze



(c) C6H12O6 2CH3CH2OH + 2CO2

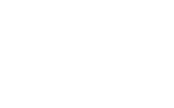
fermentation

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

Conc. H2SO4

C6H12O6 6C

-6H2O



(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

(ii) nC2H4

Catalyst CH -CH

2 2 n



(iii) Packing materials

52. (a) Q is C2H4 is ethene

R is C2H6 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

(iii) C2H4 + Br2 C2H4Br2

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 CH2O

(ii) molecular formula

(CH2O)n = 60 n(12 +2 +16) = 60 n = 2

molecular formula = C2H4O2

(b) (i) carboxylic acid; CH3COOH

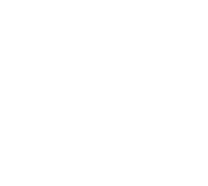
- +

(ii) HCO3 (aq) + H (aq) H2O(l) + CO2(g)

54. Ethene

H H C = C

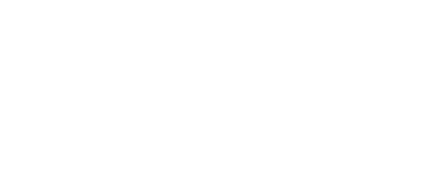
H H



Ethane

H H

H C C H H H



(b) bromine water

(c) ethene decolorizes bromine water, thane does not

(d)

nC2H4

Catalyst

CH2-CH2 n



55. (a) (i) zymaze

(ii) fermentation

(b) Rfm of C6H12O6 = ( 6 x 12 + 1 x 12 + 6 x 16) = 180

 6 x 24000cm3 of carbon dioxide require 180g

 1.2 dm3 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.

Boiling point against number of carbon atoms in a compound

Temperatur

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 120 |  | | | | | | | |
| 100 |
| 80 |
| 60 |
| 40 |
| 20 |
| 0 |
| -20 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 8 |
| -40 |  |  |  |  |  |  |  |  |
| -60 |  |  |  |  |  |  |  |  |
| -80 |  |  |  |  |  |  |  |  |

(b)

-100

Nomber of carbon atoms

(b)(ii) the boiling point of butane is 00C. (c)(i) linear

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

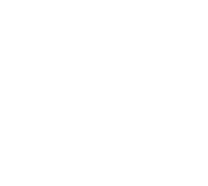
57. (a)

(d) (i) Acidified potassium permanganate (VII)

(ii) Alkenes decolorize acidified potassium permanganate (VII) solution. (e) Rfm C2H4 = 2 x 12 + 1 x 4 = 28

 28g of ethene produce 1410 kJ

 12.5g of ethene produce 629 kJ H H



C = C

H H

(b)(i) ethene decolorize bromine water

(ii) C2H4 + Br2 C2H4Br2

(iii) Acidified potassium permanganate (VII) (c) ethanol

58 (a) (i) polymerization

(ii) polyethene

(iii)

nC2H4



Catalyst CH -CH

(iv) packaging material, water pipes

2 2 n

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

(iv) mass of carbon =

mass of hydrogen =

mass of oxygen = 3.1 – (1.2 + 0.3) = 1.6

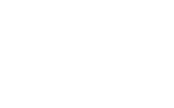
**Elements C H O**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **mass** | 1.2 |  | 0.3 |  | 1.6 |
| **RAM** | 12 |  | 1 |  | 16 |
| **moles** | 0.1 |  | 0.3 |  | 0.1 |
| **Mole ratio** | 1 |  | 3 |  | 1 |
| **Formula** | CH3O |  |  |  |  |

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

(c) C H OH Conc. H2SO4 CH = CH



2 5 2 2

heat

(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

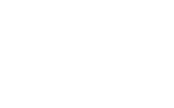
(b) (i) Vulcanization is heating rubber with sulphur

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

(ii) C2H5OH

Conc. H2SO4



heat

CH2 = CH2

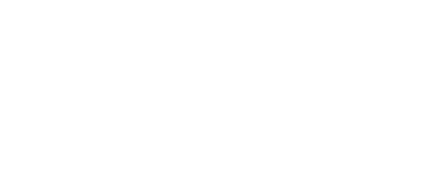
(b) dehydration

(c) ethene decolorizes acidified potassium permanganate (VII) whereas ethane does not. (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** | CH2 | |

(e) (CH2)n = 42 n = 3

Molecular formula = C3H6



|  |  |  |
| --- | --- | --- |
|  | H | H H |
| H | C | C C |
|  | H | H |

(iii) bromine was decolorized

(iv) C3H6 + Br2 C3H6Br2