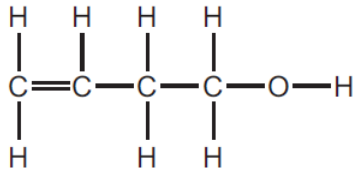
Topic 14 – Organic chemistry (Paper-1)

1.

The diagram shows the structure of a compound.



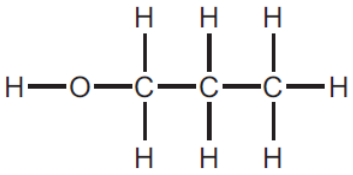
To which classes of compound does this molecule belong?

	alkane	alkene	alcohol
A	no	no	no
B	no	yes	yes
C	yes	no	yes
D	yes	yes	yes

2.

Which structures show compounds that are members of the same homologous series?

1



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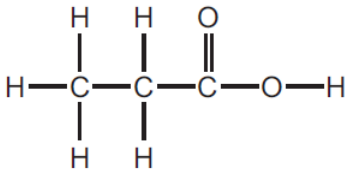

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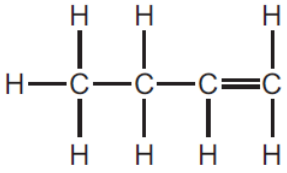

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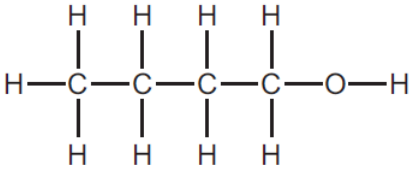


A 1 and 2 **B** 1 and 4 **C** 2 and 3 **D** 3 and 4

3.

Ethene reacts with Y to produce ethanol.

ethene + Y → ethanol

What is Y?

A hydrogen

B oxygen

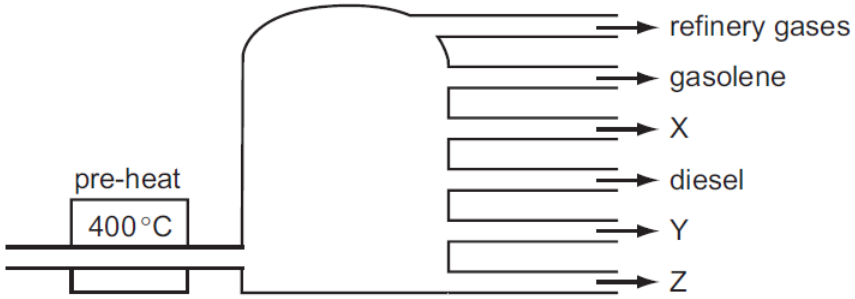
C steam

D yeast

4.

In an oil refinery, crude oil is separated into useful fractions.

The diagram shows some of these fractions.



What are fractions X, Y and Z?

	X	Y	Z
A	fuel oil	bitumen	paraffin (kerosene)
B	fuel oil	paraffin (kerosene)	bitumen
C	paraffin (kerosene)	bitumen	fuel oil
D	paraffin (kerosene)	fuel oil	bitumen

5.

Which statement about methane is **not** correct?

A It is a liquid produced by distilling petroleum.

B It is produced as vegetation decomposes.

C It is produced by animals such as cows.

D It is used as a fuel.

6.

A macromolecule is a very large molecule.

Macromolecules can be made by joining smaller molecules together. This is called polymerisation.

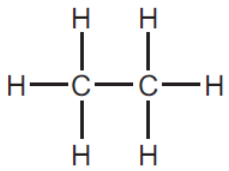
Which row in the table describes the formation of a polymer?

	monomer	polymer
A	ethane	poly(ethane)
B	ethene	poly(ethene)
C	ethane	poly(ethene)
D	ethene	poly(ethane)

7.

Which structure is **incorrect**?

A



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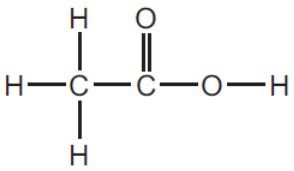

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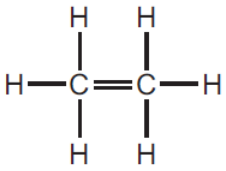

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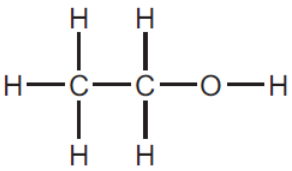
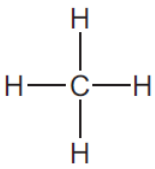


8.

8 Which structure shows a compound that belongs to a **different** homologous series to propane?

A



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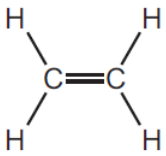

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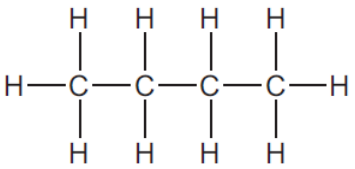
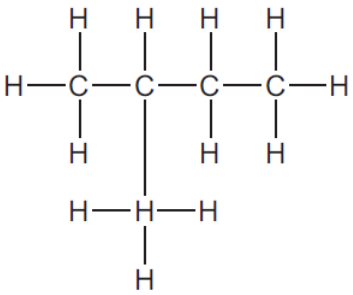
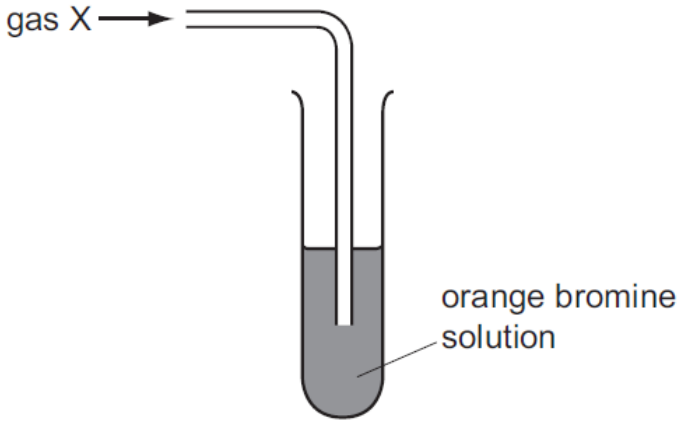


D



9.

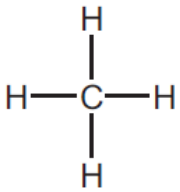
The apparatus shows an experiment used to test gas X.



The bromine solution quickly becomes colourless.

What is the structure of gas X?

A



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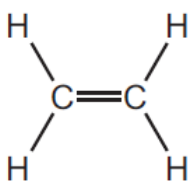

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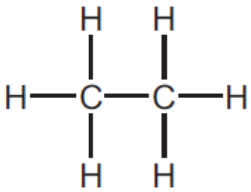

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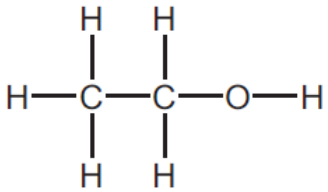


10.
Which statement about petroleum is **not** correct?

A It can be separated into useful substances by fractional distillation.

B It consists mainly of hydrocarbons.

C It is found underground in many parts of the world.

D Its main use is for making lubricants and polishes.

11.
Butene and hexene belong to the same homologous series.

What is the same for butene and hexene?

A boiling point

B functional group

C number of hydrogen atoms per molecule

D relative molecular mass

12.
Diesel, petrol and bitumen are all

A fuels.

B hydrocarbons.

C lubricants.

D waxes.

13.
The table shows the formulae of members of the alkane series.

name of compound	formula
methane	CH_4
ethane	C_2H_6
propane	?
butane	C_4H_{10}
pentane	C_5H_{12}

What is the formula of propane?

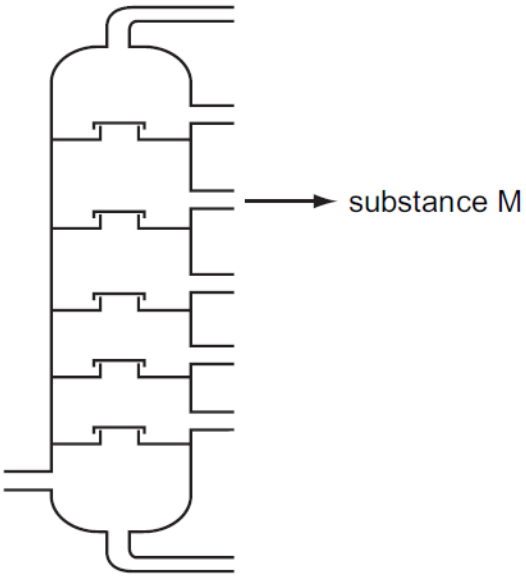
A C_2H_8 **B** C_3H_7 **C** C_3H_8 **D** C_3H_9

14.
Which bond is **not** in a molecule of ethanoic acid?

A C–O **B** C=O **C** C=C **D** O–H

15.

The diagram shows an industrial process. Substance M is one of the substances produced by this process and is used as aircraft fuel.

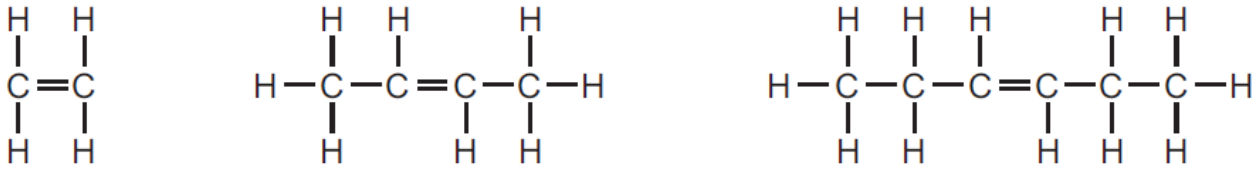


What is this process and what is substance M?

	process	substance M
A	fractional distillation	paraffin
B	fractional distillation	petrol
C	thermal decomposition	paraffin
D	thermal decomposition	petrol

16.

The structures of three compounds are shown.



Why do these substances all belong to the same homologous series?

A They all contain an even number of carbon atoms.

B They all contain the same functional group.

C They are all hydrocarbons.

D They are all saturated.

17.

A compound has the formula $CH_3CH_2CH=CH_2$.

Which row in the table shows the type of compound and the colour change when aqueous bromine is added?

	type of compound	colour change
A	saturated	brown to colourless
B	saturated	colourless to brown
C	unsaturated	brown to colourless
D	unsaturated	colourless to brown

18. ?

Bromine and steam each react with ethene.

Which of these reactions need a catalyst?

	Br_2 / ethene	steam / ethene
A	✓	✓
B	✓	✗
C	✗	✓
D	✗	✗

19. ?

A compound takes part in an addition reaction.

How does its name end?

A .....ane

B .....ene

C .....ol

D .....oic acid

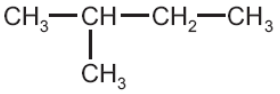
20. ?

Which products are obtained by the cracking of an alkane?

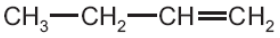
	alkene	hydrogen	water
A	✓	✓	✓
B	✓	✓	✗
C	✓	✗	✓
D	✗	✓	✓

21. ?

The structures of two compounds are shown.



P



Q

Which line in the table is correct?

	polymerises	reacts readily with bromine
A	P	P
B	P	Q
C	Q	P
D	Q	Q

22. ?

Which properties do butane, propene and ethanol **all** have?

	burn	polymerise
A	✓	✓
B	✓	✗
C	✗	✓
D	✗	✗

23. ?

Properties of some organic compounds include:

1 they burn;

2 they dissolve in water;

3 they polymerise.

Which of these properties does ethanol have?

	1	2	3
A	✓	✗	✓
B	✓	✓	✗
C	✗	✓	✓
D	✗	✗	✓

24. ?

Bromine and steam each react with ethene.

Which of these reactions need a catalyst?

	Br_2 / ethene	steam / ethene
A	✓	✓
B	✓	✗
C	✗	✓
D	✗	✗

25. ?

Which fuel is a mixture of hydrocarbons?

A coal

B methane

C petroleum

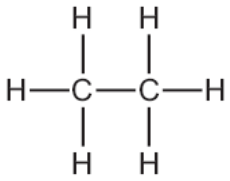
D wood

26. ?

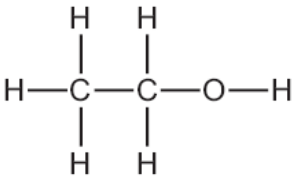
Cholesterol occurs naturally in the body.

Its name indicates that it has the same functional group as

A



B



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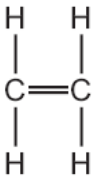
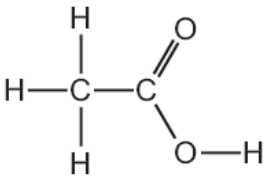


D



27. ?

Which two molecules contain the same number of hydrogen atoms?

A ethane and ethanoic acid

B ethane and ethene

C ethanoic acid and ethanol

D ethanoic acid and ethene

28. ?

What are formed when glucose is fermented?

A ethanol and carbon dioxide

B ethanol and oxygen

C ethene and carbon dioxide

D ethene and oxygen

Topic 14 – Organic chemistry (paper-3)

1. S10

Methanoic acid is the first member of the homologous series of carboxylic acids.

(a) Give **two** general characteristics of a homologous series.

.....

.....

..... [2]

(b) In some areas when water is boiled, the inside of kettles become coated with a layer of calcium carbonate. This can be removed by adding methanoic acid.

(i) Complete the equation.

..... $HCOOH + CaCO_3 \rightarrow Ca(HCOO)_2$ + ... + ...

[2]

(ii) Methanoic acid reacts with most metals above hydrogen in the reactivity series. Complete the word equation.

zinc + methanoic acid → ..... + ...

[2]

(iii) Aluminium is also above hydrogen in the reactivity series.
Why does methanoic acid not react with an aluminium kettle?

.....

..... [1]

(c) Give the name, molecular formula and empirical formula of the fourth acid in this series.

name ..... [1]

molecular formula ..... [1]

empirical formula ..... [1]

[Total: 10]

2. S10

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Why does methanoic acid not react with an aluminium kettle?

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..... [1]

(c) Give the name, molecular formula and empirical formula of the fourth acid in this series.

name ..... [1]

molecular formula ..... [1]

empirical formula ..... [1]

[Total: 10]

3. W10

Monomers polymerise to form polymers or macromolecules.

(a) (i) Explain the term *polymerise*.

.....

..... [1]

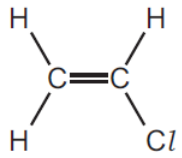
(ii) There are two types of polymerisation - addition and condensation. What is the difference between them?

.....

.....

..... [2]

(b) An important monomer is chloroethene which has the structural formula shown below.



It is made by the following method.

$$C_2H_4 + Cl_2 \rightarrow C_2H_4Cl_2 \quad \text{dichloroethane}$$

This is heated to make chloroethene.

$$C_2H_4Cl_2 \rightarrow C_2H_3Cl + HCl$$

(i) Ethene is made by cracking alkanes. Complete the equation for cracking dodecane.

$$C_{12}H_{26} \rightarrow \text{.....} + 2C_2H_4$$

[1]

Another method of making dichloroethane is from ethane.

$$C_2H_6 + 2Cl_2 \rightarrow C_2H_4Cl_2 + 2HCl$$

(ii) Suggest a reason why the method using ethene is preferred.

.....

..... [1]

(iii) Describe an industrial method of making chlorine.

.....

..... [2]

(iv) Draw the structural formula of poly(chloroethene).

Include three monomer units.

[2]

[Total: 9]

4. M/J/07

A major source of energy is the combustion of fossil fuels.

(a) (i) Name a solid fossil fuel.

..... [1]

(ii) Name a gaseous fossil fuel.

..... [1]

(b) Petroleum is separated into more useful fractions by fractional distillation.

(i) Name **two** liquid fuels obtained from petroleum.

..... and ..... [2]

(ii) Name **two** other useful products obtained from petroleum that are not used as fuels.

..... and ..... [2]

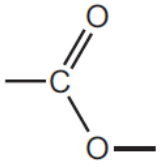
(iii) Give another mixture of liquids that is separated on an industrial scale by fractional distillation.

..... [1]

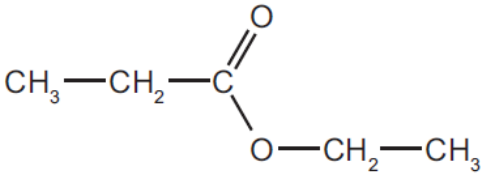
[Total: 7]

5. S10

Hydrolysis is used in chemistry to break down complex molecules into simpler ones.

(a) Compounds containing the group  or —COO— are esters.

(i) Give the names and formulae of the two compounds formed when the ester ethyl propanoate is hydrolysed.

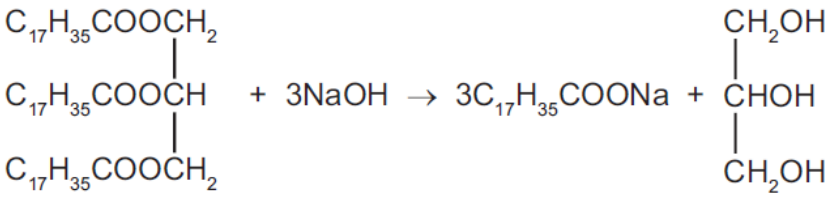


name ..... name .....

formula formula

[4]

(ii) Fats are naturally occurring esters. They can be hydrolysed by boiling with aqueous sodium hydroxide.



fat

What type of compound has the formula $C_{17}H_{35}COONa$ and what is its main use?

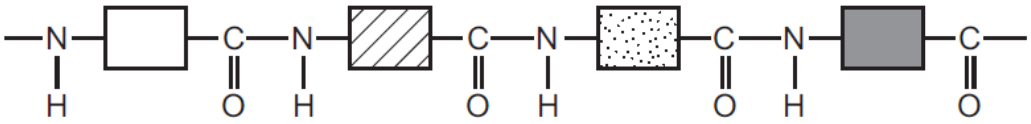
type of compound ..... [1]

use ..... [1]

(iii) Name a synthetic polyester.

..... [1]

(b) The structure of a typical protein is drawn below.



(i) What is the name of the polymer linkage?

..... [1]

(ii) Draw the structural formula of a man-made polymer with the same linkage.

[3]

(iii) A protein can be hydrolysed to a mixture of amino acids which are colourless. Individual amino acids can be identified by chromatography. The R_f value of the amino acid glycine is 0.5. Describe how you could show that glycine was present on a chromatogram.

.....

.....

..... [3]

[Total: 14]

6. N11

The structural formula of a butanol is given below.

$$CH_3—CH_2—CH_2—CH_2—OH$$

(a) Butanol can be made from petroleum and also by fermentation.

(i) Describe the chemistry of making butanol from petroleum by the following route.

petroleum → butene → butanol

.....

.....

..... [3]

(ii) Explain, in general terms, what is meant by *fermentation*.

.....

.....

.....

..... [3]

(b) Butanol can be oxidised to a carboxylic acid by heating with acidified potassium manganate(VII). Give the name and structural formula of the carboxylic acid.

name ..... [1]

structural formula

[1]

(c) Butanol reacts with ethanoic acid to form a liquid, **X**, which has the sweet smell of bananas. Its empirical formula is C_3H_6O and its M_r is 116.

(i) What type of compound is liquid **X**?

..... [1]

(ii) Give the molecular formula of liquid **X**.

..... [1]

(iii) Draw the structural formula of **X**. Show all the individual bonds.

[2]

[Total: 12]

7. W09

Butan-1-ol is used as a solvent for paints and varnishes, to make esters and as a fuel. Butan-1-ol can be manufactured from but-1-ene, which is made from petroleum.

Biobutanol is a fuel of the future. It can be made by the fermentation of almost any form of biomass - grain, straw, leaves etc.

(a) But-1-ene can be obtained from alkanes such as decane, $C_{10}H_{22}$, by cracking.

(i) Give the reaction conditions.

.....

..... [2]

(ii) Complete an equation for the cracking of decane, $C_{10}H_{22}$, to give but-1-ene.

$C_{10}H_{22} \rightarrow$ ..... [2]

(iii) Name the reagent that reacts with but-1-ene to form butan-1-ol.

..... [1]

(b) (i) Balance the equation for the complete combustion of butan-1-ol.

..... C_4H_9OH + ... $O_2 \rightarrow$ ..... CO_2 + ... H_2O [2]

(ii) Write a word equation for the preparation of the ester butyl methanoate.

..... [2]

(c) The fermentation of biomass by bacteria produces a mixture of products which include biobutanol, propanol, hydrogen and propanoic acid.

(i) Draw the structural formula of propanol and of propanoic acid. Show all the bonds.

propanol

propanoic acid

[2]

(ii) Why is it important to develop these fuels, such as biobutanol, as alternatives to petroleum?

..... [1]

(d) How could you show that butanol made from petroleum and biobutanol are the same chemical?

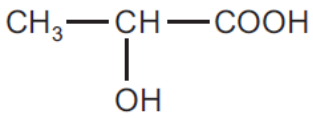
.....

..... [1]

[Total: 13]

8. S09

Lactic acid can be made from corn starch.



lactic acid

It polymerises to form the polymer, polylactic acid (PLA) which is biodegradable.

(a) Suggest **two** advantages that PLA has compared with a polymer made from petroleum.

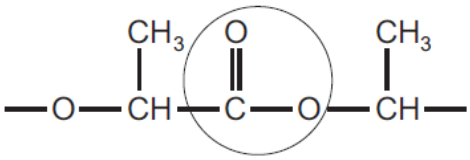
.....

.....

.....

..... [2]

(b) The structure of PLA is given below.



(i) What type of compound contains the group that is circled?

..... [1]

(ii) Complete the following sentence.

Lactic acid molecules can form this group because they contain both an

..... group and an .....group. [2]

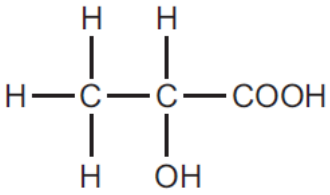
(iii) Is the formation of PLA, an addition or condensation polymerisation? Give a reason for your choice.

.....

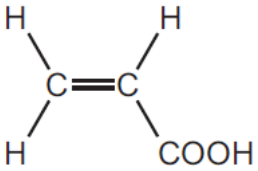
.....

..... [2]

(c) When lactic acid is heated, acrylic acid is formed.



lactic acid



acrylic acid

(i) Complete the word equation for the action of heat on lactic acid.

lactic acid → ..... + ... [1]

(ii) Describe a test that would distinguish between lactic acid and acrylic acid.

test .....

result for lactic acid .....

result for acrylic acid ..... [3]

(iii) Describe a test, other than using an indicator, which would show that both chemicals contain an acid group.

test .....

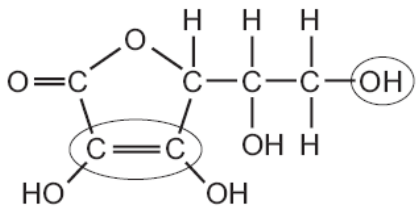
result .....

..... [2]

[Total: 13]

9. W08

The structural formula of Vitamin C is drawn below.



(i) What is its molecular formula?

..... [1]

(ii) Name the two functional groups which are circled.

..... [2]

10. W08

The alkanes are generally unreactive. Their reactions include combustion, substitution and cracking.

(a) The complete combustion of an alkane gives carbon dioxide and water.

(i) 10 cm^3 of butane is mixed with 100 cm^3 of oxygen, which is an excess. The mixture is ignited. What is the volume of unreacted oxygen left and what is the volume of carbon dioxide formed?

$$C_4H_{10}(g) + 6\tfrac{1}{2}O_2(g) \longrightarrow 4CO_2(g) + 5H_2O(l)$$

Volume of oxygen left = ... cm^3

Volume of carbon dioxide formed = ... cm^3 [2]

(ii) Why is the incomplete combustion of any alkane dangerous, particularly in an enclosed space?

.....

..... [2]

(b) The equation for a substitution reaction of butane is given below.

$$CH_3{-}CH_2{-}CH_2{-}CH_3 + Cl_2 \longrightarrow CH_3{-}CH_2{-}CH_2{-}CH_2{-}Cl + HCl$$

(i) Name the organic product.

..... [1]

(ii) This reaction does not need increased temperature or pressure.
What is the essential reaction condition?

..... [1]

(iii) Write a different equation for a substitution reaction between butane and chlorine.

..... [1]

(c) Alkenes are more reactive and industrially more useful than alkanes. They are made by cracking alkanes.

$$\underset{\text{heptane}}{C_7H_{16}} \longrightarrow \underset{\text{propene}}{CH_3{-}CH{=}CH_2} + \underset{\text{but-1-ene}}{CH_3{-}CH_2{-}CH{=}CH_2} + H_2$$

(i) Draw the structural formula of the polymer poly(propene).

[2]

(ii) Give the structural formula and name of the alcohol formed when but-1-ene reacts with steam.

name ..... [1]

structural formula

[1]

(iii) Deduce the structural formula of the product formed when propene reacts with hydrogen chloride.

[1]

[Total: 12]

11. S08

Large areas of the Amazon rain forest are cleared each year to grow soya beans. The trees are cut down and burnt.

(a) Why do these activities increase the percentage of carbon dioxide in the atmosphere?

.....

..... [2]

(b) Soya beans contain all three main food groups. Two of which are protein and carbohydrate.

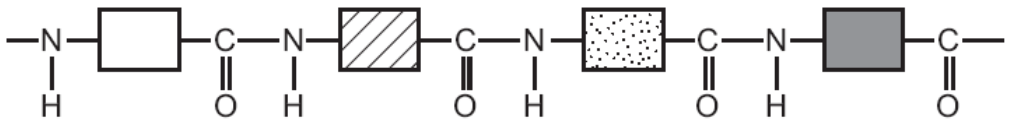
(i) What is the third group?

..... [1]

(ii) Draw the structural formula of a complex carbohydrate such as starch.

[3]

(iii) Compare the structure of a protein with that of a synthetic polyamide. The structure of a typical protein is given below.



How are they similar?

.....

How are they different?

.....

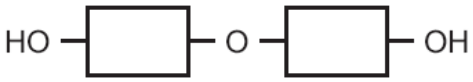
..... [3]

[Total: 9]

12. N/06

The three types of food are carbohydrates, proteins and fats.

(a) Aqueous starch is hydrolysed to maltose by the enzyme amylase.
The formula of maltose is:



Starch is hydrolysed by dilute sulphuric acid to glucose.

(i) What is an enzyme?

.....

[1]

(ii) Draw the structure of starch.

[1]

(iii) Name the technique that would show that the products of these two hydrolyses are different.

.....

[1]

(b) Proteins have the same linkage as nylon but there is more than one monomer in the macromolecule.

(i) Draw the structure of a protein.

[2]

(ii) What class of compound is formed by the hydrolysis of proteins?

.....

[1]

(c) Fats are esters. Some fats are saturated, others are unsaturated.

(i) Write the word equation for the preparation of the ester, propyl ethanoate.

..... [2]

(ii) Deduce the structural formula of this ester showing each individual bond.

[2]

(iii) How could you distinguish between these two fats?
Fat 1 has the formula

$CH_2 - CO_2 - C_{17}H_{33}$
|
$CH - CO_2 - C_{17}H_{33}$
|
$CH_2 - CO_2 - C_{17}H_{33}$

Fat 2 has the formula

$CH_2 - CO_2 - C_{17}H_{35}$
|
$CH - CO_2 - C_{17}H_{35}$
|
$CH_2 - CO_2 - C_{17}H_{35}$

test .....

result with fat 1 .....

result with fat 2 ..... [3]

(iv) Both of these fats are hydrolysed by boiling with aqueous sodium hydroxide. What type of compounds are formed?

.....and ..... [2]