

**Foundation**

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2	Properties of carbon monoxide that make it hard to detect, calculate mass of methane in given volume of gas – ratio calculation, two renewable sources of methane multiple choice	8	8
2	Cracking and alkene multiple choice, (4.9.3 matching pollutants to effects, pollution multiple choice)	9	10
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## Common content

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2	Calculate percentage by mass of methanol in methylated spirit from information in table, describe how ethanol is produced from sugar solution, name gas produced when sodium added to ethanol, substance that reacts with methanol to produce methanoic acid	11	38
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## Higher

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5	(4.10.1 why wood is more sustainable than natural gas), explain how carbon monoxide is produced in combustion of methane, balance combustion symbol equation, calculate volume of unreacted gas using balanced symbol equation and volumes of reactants and answer in cm <sup>3</sup>	9	45

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0	1
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Crude oil is a mixture of hydrocarbons.

0	1	.	1
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Name the **two** elements in a hydrocarbon.**[2 marks]**

1 \_\_\_\_\_

2 \_\_\_\_\_

0	1	.	2
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What was crude oil formed from?

**[1 mark]**Tick **one** box.

Acids

☐

Enzymes

☐

Metals

☐

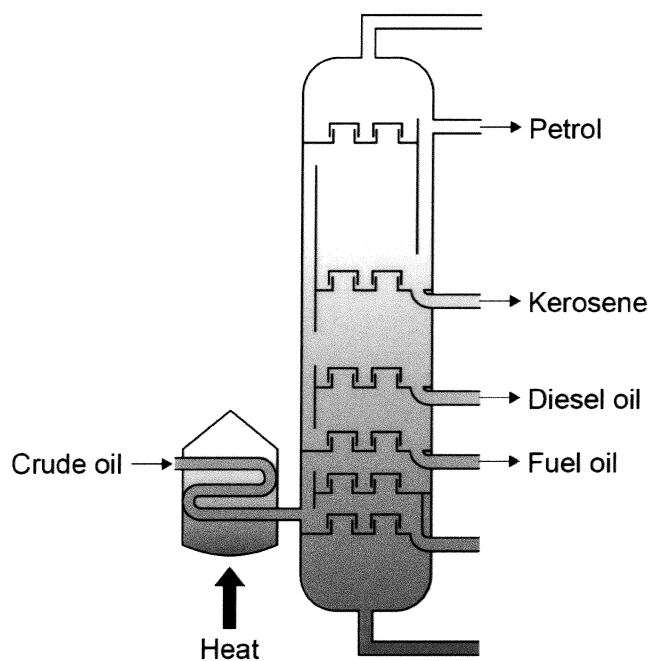
Plankton

☐

**Figure 1** shows how crude oil is separated to produce different fuels.

*Do not write  
outside the  
box*

**Figure 1**



0 1 . 3

What is the name of this process?

**[1 mark]**

Tick **one** box.

Combustion

☐

Fractional distillation

☐

Phytomining

☐

Steam cracking

☐

**Question 1 continues on the next page**

**Turn over ►**



0 1 . 4 Why is the crude oil heated?

[1 mark]

Table 1 shows some properties of the fuels produced by the process.

Table 1

Fuel	Number of carbon atoms in chain	Lowest boiling point in °C	Highest boiling point in °C
Petrol	5–10	20	200
Kerosene	10–16	180	260
Diesel oil	14–20	260	340
Fuel oil	20–70	370	600

0 1 . 5 Which of the fuels has the largest boiling point range?

[1 mark]

Tick **one** box.

Petrol

☐

Kerosene

☐

Diesel oil

☐

Fuel oil

☐

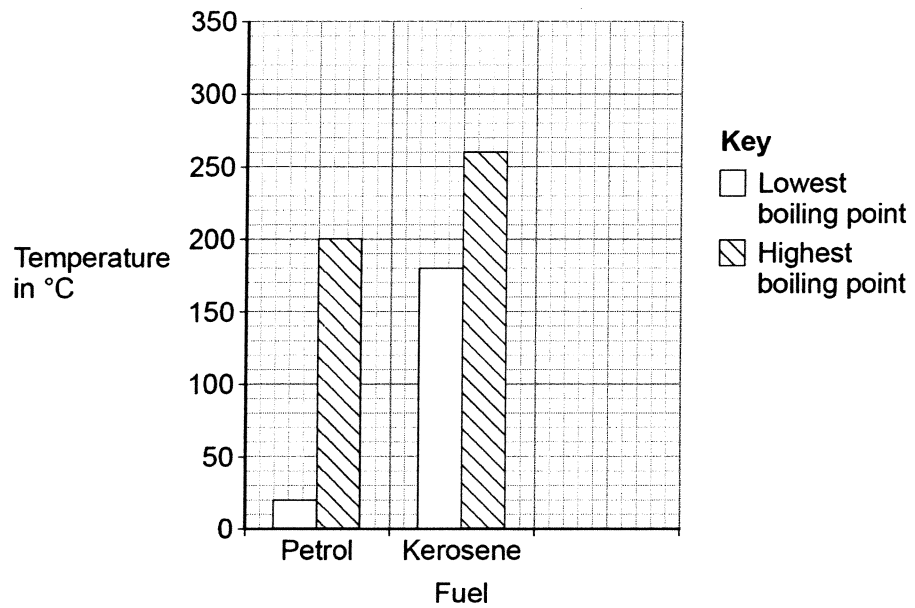
0 1 . 6

Plot the data for diesel oil from Table 1 on Figure 2.

[3 marks]

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outside the  
box

Figure 2



Turn over for the next question

Turn over ►



0 2

Some central heating boilers use methane as a fuel.

Carbon monoxide detectors are placed near central heating boilers.

0 2 . 1

Which **three** properties of carbon monoxide make it necessary to use carbon monoxide detectors?

Choose answers from the box.

[3 marks]

acidic	alkaline	colourless	corrosive
insoluble	odourless	toxic	

1 \_\_\_\_\_

2 \_\_\_\_\_

3 \_\_\_\_\_

0 2 . 2

Complete the sentence.

[1 mark]

Methane produces carbon monoxide when burning in a limited supply of

\_\_\_\_\_.

0 2 . 3

8 g of methane has a volume of  $12 \text{ dm}^3$  at room temperature and pressure.

Calculate the mass of  $36 \text{ dm}^3$  of methane.

[2 marks]

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Mass = \_\_\_\_\_ g





0 2 . 4

Most methane is obtained from natural gas, which is a fossil fuel.

Methane can also be produced renewably.

Which **two** are renewable sources of methane?

**[2 marks]**

Tick (✓) **two** boxes.

Animal waste

☐

Food in landfill

☐

Nitrogen in the air

☐

Non-biodegradable plastics

☐

Scrap iron

☐

---

8

Turn over for the next question

Turn over ►



**0 2**

This question is about fuels.

Octane ( $C_8H_{18}$ ) is a hydrocarbon in petrol.**0 2 . 1**

Cracking breaks down large hydrocarbon molecules into smaller hydrocarbon molecules.

Which hydrocarbon molecule can be cracked to produce octane,  $C_8H_{18}$  ?**[1 mark]**Tick **one** box. $C_4H_8$ ☐ $C_4H_{10}$ ☐ $C_8H_{16}$ ☐ $C_{12}H_{26}$ ☐**0 2 . 2**What type of carbon compound is octane,  $C_8H_{18}$  ?**[1 mark]**Tick **one** box.

Alcohol

☐

Alkane

☐

Carboxylic acid

☐

Ester

☐**Question 2 continues on the next page****Turn over ►**

**0 2 . 3** Oxygen is needed to burn fuels.

Name the source of the oxygen needed to burn fuels.

**[1 mark]**

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**0 2 . 4** Particulates and sulfur dioxide are pollutants produced when some fuels burn.

Draw **one** line from each pollutant to the polluting effect.

**[2 marks]**

**Pollutant**

**Polluting effect**

Particulates

Sulfur dioxide

Acid rain

Global dimming

Global warming

Landfill

Sewage sludge



**0 2 . 5** Which **two** gases are produced when fuels burn in car engines?

**[2 marks]**

Tick **two** boxes.

Ammonia

☐

Carbon dioxide

☐

Carbon monoxide

☐

Nitrogen

☐

Oxygen

☐

Do not write  
outside the  
box

**0 2 . 6** Vehicles produce most of the atmospheric pollution in cities.

How could the atmospheric pollution in cities be reduced?

**[2 marks]**

Tick **two** boxes.

Build more roads in cities

☐

Build new car factories

☐

Develop fuel efficient engines

☐

Make car tax cheaper

☐

Use electric cars

☐

Turn over ►

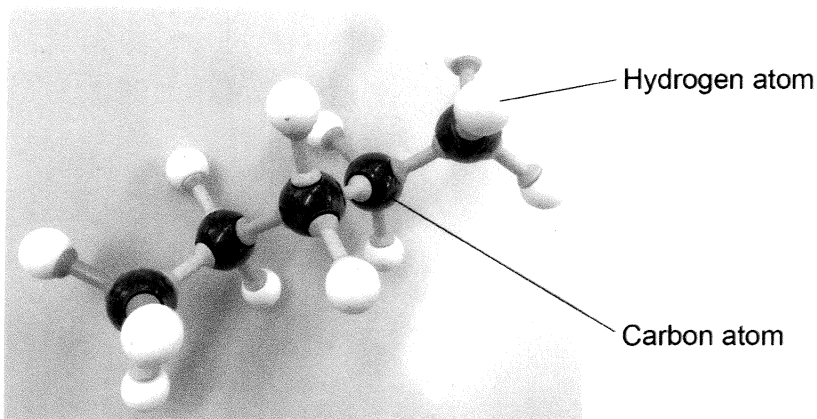


0	4
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This question is about hydrocarbons.

**Figure 6** represents hydrocarbon **A**.

**Figure 6**



0	4	.	1
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Complete the chemical formula of hydrocarbon **A**.

[1 mark]

$C_5$

0	4	.	2
---	---	---	---

What do the links between the atoms in **Figure 6** represent?

[1 mark]

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Question 4 continues on the next page

Turn over ►



**0 4 . 3** Hydrocarbon **A** is a fuel. Hydrocarbon **A** is completely combusted in air.

Which **two** substances are produced?

**[2 marks]**

Tick (✓) **two** boxes.

Carbon dioxide

☐

Ethene

☐

Nitrogen

☐

Oxygen

☐

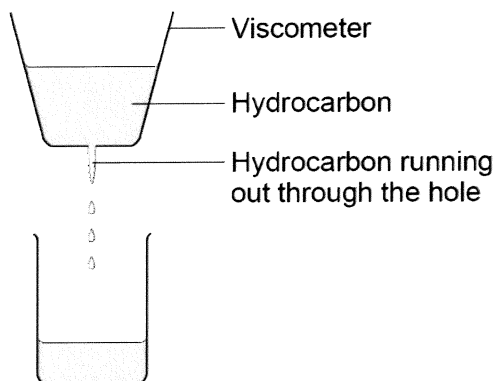
Water

☐

Some students investigated how changing the temperature of a hydrocarbon affects the viscosity of the hydrocarbon.

Figure 7 shows the apparatus used.

Figure 7



The students recorded the time it took for 25 cm<sup>3</sup> of the hydrocarbon to flow through the hole in the viscometer.

0 4 . 4 Table 3 shows a student's results at 60 °C

Table 3

Temperature in °C	Time to flow through the viscometer in s				
	Trial 1	Trial 2	Trial 3	Trial 4	Mean
60	21	20	24	23	X

Calculate the mean value X.

[1 mark]

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Mean value X = \_\_\_\_\_ s

Turn over ►



Another student investigated a different hydrocarbon.

Table 4 shows the results.

Table 4

Temperature in °C	Time to flow through the viscometer in s
20	66
25	50
30	40
40	30
50	25

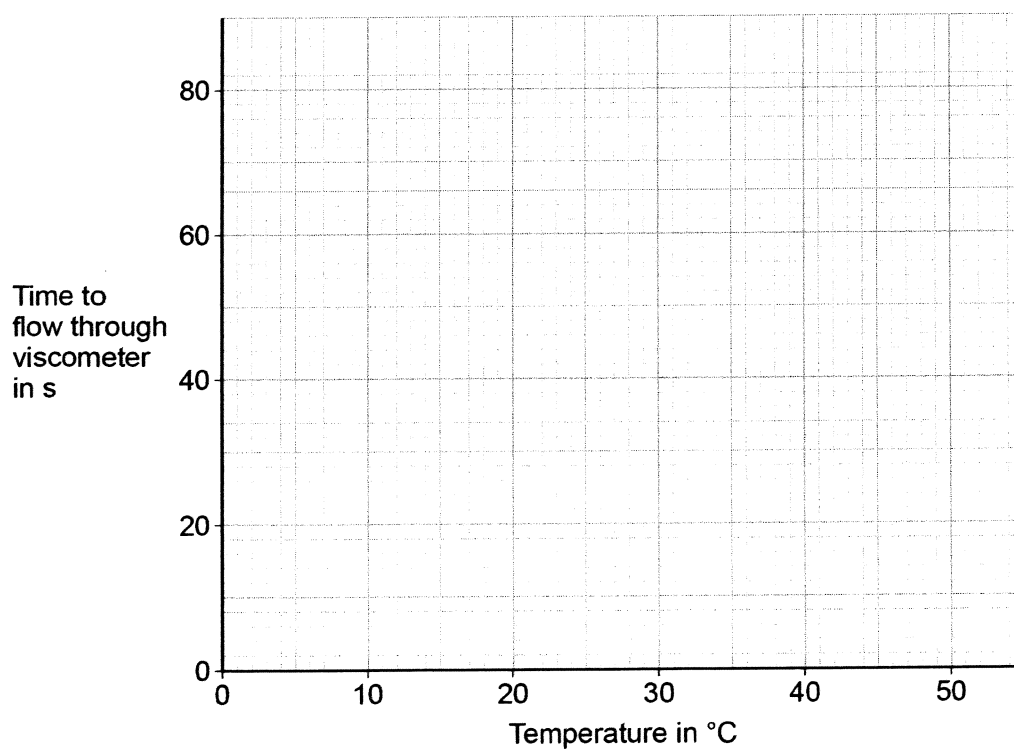
**0 4 . 5** Complete Figure 8.

You should:

- plot the data from Table 4
- draw a line of best fit.

[3 marks]

Figure 8





**0 4 . 6** Describe the pattern shown on **Figure 8**.

[1 mark]

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**0 4 . 7** The viscosity of a substance is linked to how fast the substance flows.

The lower the viscosity, the faster the substance flows.

Complete the sentence.

Choose the answer from the box.

[1 mark]

**decreases      increases      stays the same**

As the temperature increases, the viscosity of

the hydrocarbon \_\_\_\_\_.

10

**Turn over for the next question**

**Turn over ►**



0 4

Large hydrocarbon molecules can be cracked to produce smaller, more useful molecules.

Alkanes and alkenes are produced when hydrocarbons are cracked.

0 4 . 1

Give **two** conditions used for cracking.

[2 marks]

1 \_\_\_\_\_

2 \_\_\_\_\_

0 4 . 2

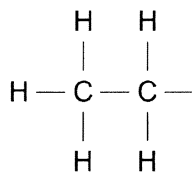
Butane ( $C_4H_{10}$ ) is an alkane.

**Figure 5** shows part of the displayed structural formula of butane.

Complete the displayed structural formula of butane in **Figure 5**.

[1 mark]

**Figure 5**



0 4 . 3

Butane burns in oxygen.

Complete the word equation for the complete combustion of butane.

[2 marks]

butane + oxygen  $\rightarrow$  \_\_\_\_\_ + \_\_\_\_\_

**Question 4 continues on the next page**

**Turn over ►**



0 4 . 4

Ethene is an alkene.

Give a test for alkenes.

Give the result of the test if an alkene is present.

**[2 marks]**

Test \_\_\_\_\_

Result \_\_\_\_\_

0 4 . 5

Each year many tonnes of crude oil are extracted from the Earth.

It took millions of years for the crude oil to be formed.

What do we call development that meets the needs of current generations without compromising the resources for future generations?

**[1 mark]**Tick (✓) **one** box.

Finite development

☐

Global development

☐

Natural development

☐

Sustainable development

☐

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8

0 3

Polymers are used to make fabrics.

**Table 1** shows some properties of two polymers.

**Table 1**

Property	Polymer J	Polymer K
Density in g/cm <sup>3</sup>	0.9	1.4
Melting point in °C	165	260
Flame resistance	Poor	Good
Water absorption	Low	High

0 3

1

Polymer fabrics are used to make firefighter uniforms.

Complete **Table 2** by deciding for each property whether polymer **J** or polymer **K** is **best** for firefighter uniforms.

Use **Table 1**.

Density has been completed for you.

**[2 marks]**

Tick **three** boxes.

**Table 2**

Property	Polymer J	Polymer K
Density in g/cm <sup>3</sup>	✓	
Melting point in °C		
Flame resistance		
Water absorption		



0 3 . 2

A firefighter uniform made from polymer **J** has a mass of 6.0 kg

Calculate the mass of a uniform of the same size made from polymer **K**.

Use **Table 1** and the equation:

$$\text{mass of uniform made from polymer K} = \frac{\text{density of polymer K}}{\text{density of polymer J}} \times 6.0$$

[2 marks]

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Mass of uniform made from polymer **K** = \_\_\_\_\_ kg

0 3 . 3

Polymers **J** and **K** are both thermosoftening polymers.

Polymer **L** is a thermosetting polymer.

Why would polymer **L** be better than polymers **J** and **K** for firefighter uniforms?

[1 mark]

Tick **one** box.

Polymer **L** burns easily

☐

Polymer **L** does not biodegrade

☐

Polymer **L** will not melt

☐

Question 3 continues on the next page

Turn over ►



Polymers **J** and **K** are made from crude oil.

In the past, firefighter uniforms were made from wool.

Wool is obtained from sheep.

**0 3 . 4** Why are many fabrics made from polymers instead of wool?

[1 mark]

Tick **one** box.

Polymers are man-made

☐

Polymers are more hard-wearing

☐

Wool is more easily available

☐

Wool is more flame resistant

☐

**0 3 . 5** Why is wool more sustainable than polymers **J** and **K** for making firefighter uniforms?

[2 marks]

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0 5

Figure 3 shows a surfer on a surfboard.

Figure 3



Some surfboards are made from addition polymers.

Addition polymers are made from small alkene molecules.

0 5

. 1

Which type of bonding is present in small alkene molecules?

[1 mark]

Tick (✓) **one** box.

Covalent

☐

Ionic

☐

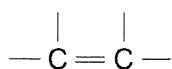
Metallic

☐

**0 5 . 2** What is the functional group in these small alkene molecules?

**[1 mark]**

Tick (✓) **one** box.


☐

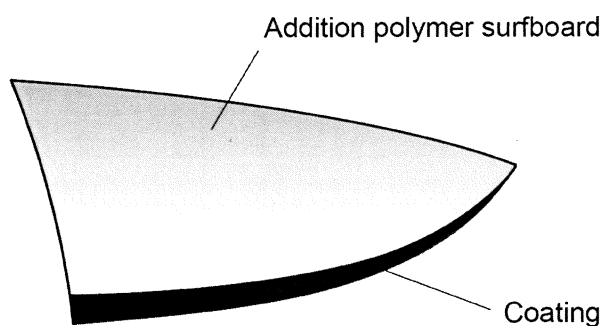
☐

☐

**Figure 4** shows the structure of part of an addition polymer surfboard.

The outer surface of the surfboard is coated.

**Figure 4**



The coating is made from soda-lime glass fibres surrounded by a plastic.

**0 5 . 3** What type of material is the coating of the surfboard?

**[1 mark]**

Tick (✓) **one** box.

Alloy

☐

Ceramic

☐

Composite

☐

Nanotube

☐

Turn over ►





0 5 . 4

Complete the sentence.

Choose answers from the box.

[2 marks]

air	ammonia	copper
limestone	sand	

The materials used to make the soda-lime glass fibres are sodium carbonate,

\_\_\_\_\_ and \_\_\_\_\_.

0 5 . 5

Suggest **two** reasons why surfboards are coated.

[2 marks]

1 \_\_\_\_\_

2 \_\_\_\_\_

Some surfboards are made from wood.

**Table 3** contains information about the materials in an addition polymer surfboard and a wooden surfboard.**Table 3**

	Addition polymer surfboard	Wooden surfboard
Relative strength	14	38
Cost (£ per m <sup>3</sup> )	140	390
Density (kg/m <sup>3</sup> )	50	150
Disposal at end of life	Difficult to recycle	Can be used as fuel



0 5 . 6

Suggest **two** advantages and **two** disadvantages of using addition polymers rather than wood to make surfboards.

Use **Table 3**.

[4 marks]

Advantages of addition polymers \_\_\_\_\_

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Disadvantages of addition polymers \_\_\_\_\_

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0 5 . 7

Calculate the volume of wood in a wooden surfboard of mass 5.25 kg

Use **Table 3** and the equation:

$$\text{Density in kg/m}^3 = \frac{\text{Mass in kg}}{\text{Volume in m}^3}$$

[3 marks]

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Volume = \_\_\_\_\_ m<sup>3</sup>

14

Turn over ►

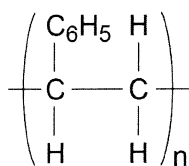


0 6

Disposable cups are made from coated paper or poly(styrene).

**Figure 4** represents the structure of poly(styrene).

**Figure 4**

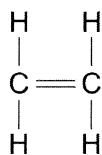
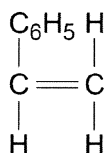
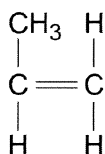
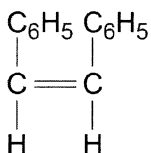


0 6 . 1

Which small molecule is used to produce poly(styrene)?

[1 mark]

Tick **one** box.


☐

☐

☐

☐


**0 6 . 2** Which process is used to make poly(styrene) from small molecules?

**[1 mark]**

Tick **one** box.

Cracking

☐

Distillation

☐

Fermentation

☐

Polymerisation

☐

**0 6 . 3** Complete the sentences.

Choose answers from the box.

**[3 marks]**

ceramics

composites

four

many

monomers

polymers

two

Poly(styrene) is produced from small molecules called \_\_\_\_\_.

When poly(styrene) is made, \_\_\_\_\_ styrene molecules join to form large molecules.

These large molecules are called \_\_\_\_\_.

**Question 6 continues on the next page**

**Turn over ►**



0	6	.	4
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### Table 4

	Coated paper cups	Poly(styrene) cups
Source of raw materials	Wood	Crude oil
Energy to make 1 cup in arbitrary units	550	200
Biodegradable	Yes	No
Recyclable	No	Yes

Compare the advantages and disadvantages of using coated paper and poly(styrene) to make disposable cups.

Use **Table 4** and your knowledge and understanding of life cycle assessments (LCAs). **[4 marks]**

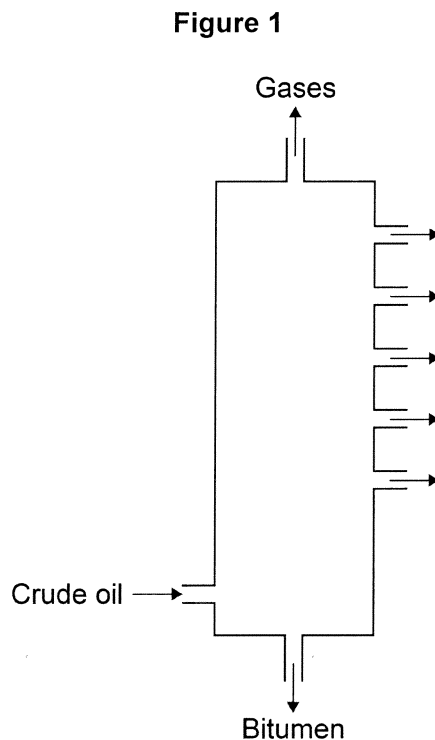
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**0 1**

Crude oil is a mixture of hydrocarbons.

**0 1 . 1**

The hydrocarbons in crude oil are separated into fractions by fractional distillation.

**Figure 1** shows a fractional distillation column.

Crude oil vapour passes up the column.

Complete the sentence.

Choose the answer from the box.

**[1 mark]****condenses****dissolves****freezes****melts**

Each fraction \_\_\_\_\_ at a different level.



0 1 . 2 Why do the fractions separate?

[1 mark]

Tick **one** box.

The fractions have different boiling points.

☐

The fractions have different flammability.

☐

The fractions have different melting points.

☐

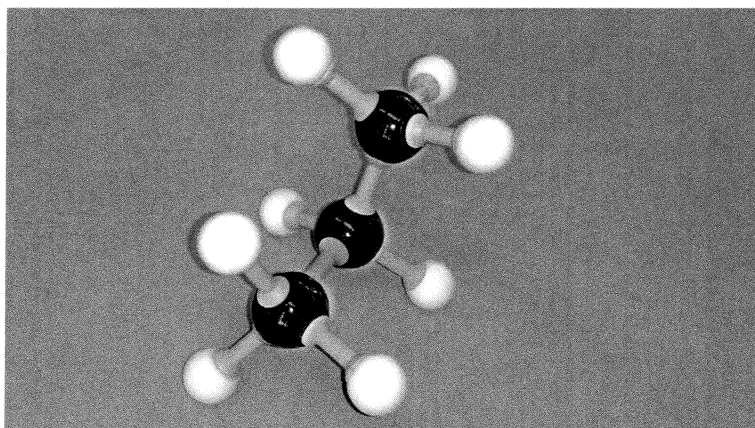
The fractions have different viscosity.

☐

Most of the hydrocarbons in crude oil are alkanes.

0 1 . 3 **Figure 2** represents an alkane molecule.

**Figure 2**



Name the alkane.

[1 mark]

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Question 1 continues on the next page

Turn over ►



0 1 . 4

Methane (CH<sub>4</sub>) is an alkane.

What is the general formula for alkanes?

[1 mark]

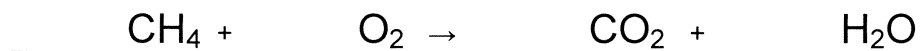
Tick **one** box.C<sub>n</sub>H<sub>n</sub>☐C<sub>n</sub>H<sub>2n</sub>☐C<sub>n</sub>H<sub>2n-2</sub>☐C<sub>n</sub>H<sub>2n+2</sub>☐

0 1 . 5

Alkanes burn in oxygen.

Balance the equation for methane burning.

[1 mark]



0 1 . 6

Ethene is an alkene.

Which reagent is used to test for alkenes?

[1 mark]

Tick **one** box.

Anhydrous copper sulfate

☐

Bromine water

☐

Damp litmus paper

☐

Limewater

☐



**Table 1** shows data from a life cycle assessment (LCA) for the disposal of 10 000 biodegradable plastic bags.

**Table 1**

	Burning and using the energy to generate electricity	Landfill
Mass of carbon dioxide produced in kg	25	15
Mass of solid residue in kg	0.050	0.070
Mass of sulfur dioxide produced in kg	0.20	0.30

**0 1 . 7** Why are life cycle assessments (LCA) done?

**[1 mark]**

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**0 1 . 8** Compare the **two** methods for the disposal of biodegradable plastic bags.

Use information from **Table 1**

**[4 marks]**

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Answer **all** questions in the spaces provided.

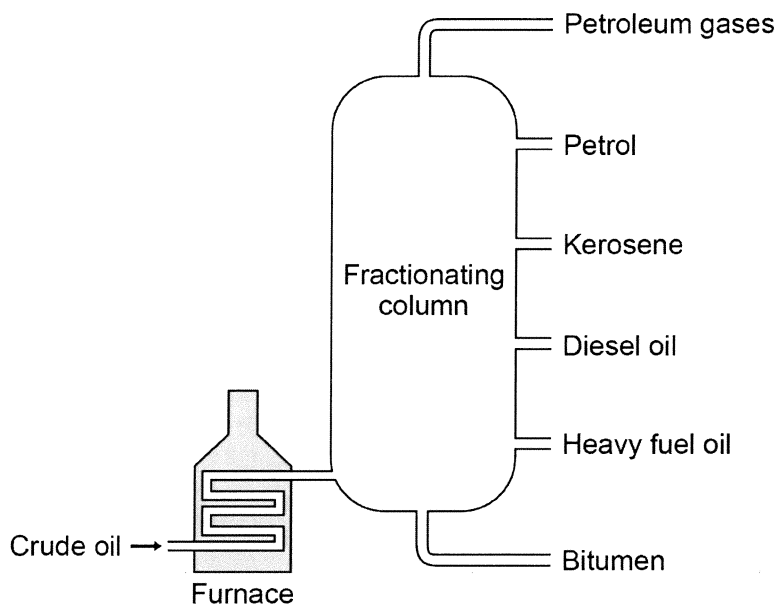
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0 1

This question is about crude oil and hydrocarbons.

**Figure 1** shows a fractionating column used to separate crude oil into fractions.

**Figure 1**



**Table 1** gives information about some of the fractions.

**Table 1**

Fraction	Boiling point range in °C
Petroleum gases	Below 30
Petrol	40–110
Kerosene	180–260
Diesel oil	260–320
Heavy fuel oil	320–400
Bitumen	400–450



0 1 . 1

Suggest a suitable temperature for the furnace in **Figure 1**.

[1 mark]

\_\_\_\_\_ °C

0 1 . 2

Explain why diesel oil collects above heavy fuel oil but below kerosene in the fractionating column.

Use **Table 1**.

[2 marks]

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0 1 . 3

Suggest **two** reasons why bitumen is **not** used as a fuel.

[2 marks]

1 \_\_\_\_\_

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2 \_\_\_\_\_

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Question 1 continues on the next page

Turn over ►



0 1 . 4 Petrol contains mainly alkanes.

Which of the following compounds is an alkane?

[1 mark]

Tick (✓) **one** box.

☐☐☐☐

Large hydrocarbon molecules in the diesel oil fraction are cracked to produce smaller hydrocarbon molecules.

0 1 . 5 Describe the conditions needed to crack hydrocarbon molecules from the diesel oil fraction.

[2 marks]

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0 1 . 6

Explain why large hydrocarbon molecules in the diesel oil fraction are cracked to produce smaller hydrocarbon molecules.

**[2 marks]**

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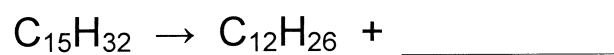
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0 1 . 7

Complete the equation for the cracking of  $C_{15}H_{32}$

**[1 mark]**

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11

Turn over for the next question

**Turn over ►**

0 2

Methylated spirit is a useful product made from a mixture of substances.

**Table 1** shows the mass of the substances in a sample of methylated spirit.

**Table 1**

Substance	Mass in grams
Ethanol	265.5
Methanol	23.3
Pyridine	3.0
Methyl violet	1.5

0 2 . 1

What name is given to a useful product such as methylated spirit?

[1 mark]

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0 2 . 2

Calculate the percentage by mass of methanol in methylated spirit.

Use **Table 1**.

[2 marks]

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Percentage = \_\_\_\_\_ %

**Question 2 continues on the next page**

**Turn over ►**



Methylated spirit contains ethanol and is available cheaply.

Methylated spirit also contains:

- pyridine which has a very unpleasant smell
- methyl violet which makes the mixture purple.

0 2 . 3

Suggest why pyridine and methyl violet are added to ethanol to make methylated spirit.

[1 mark]

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0 2 . 4

Suggest **one** use of methylated spirit.

[1 mark]

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0 2 . 5

Describe how ethanol is produced from sugar solution.

Give the name of this process.

[3 marks]

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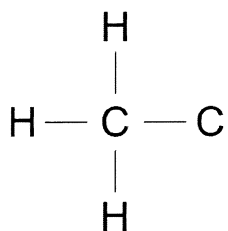


0 2 . 6 Figure 2 shows part of the displayed formula for ethanol.

Complete Figure 2.

[1 mark]

Figure 2



0 2 . 7 Name the gas produced when sodium is added to ethanol.

[1 mark]

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0 2 . 8 Methanol is used to produce methanoic acid.

What type of substance reacts with methanol to produce methanoic acid?

[1 mark]

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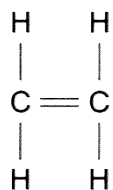
0 2

Supermarket carrier bags can be made from poly(ethene).

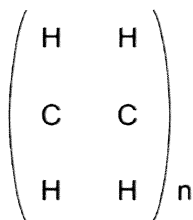
0 2 . 1

Poly(ethene) is produced from ethene.

The structure of ethene is:



Complete the structure of poly(ethene).

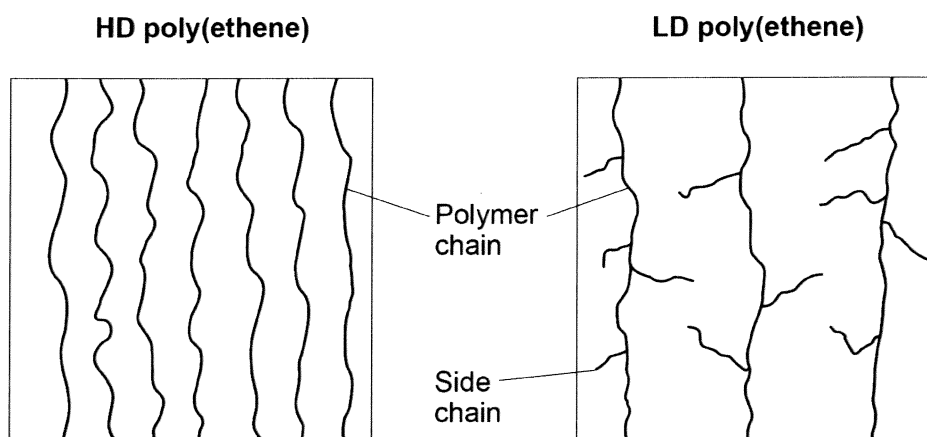
**[2 marks]**

There are two types of poly(ethene): HD poly(ethene) and LD poly(ethene).

0 2 . 2

**Figure 2** shows the polymer chains in HD poly(ethene) and LD poly(ethene).

**Figure 2**



Describe the differences in the structure and arrangement of the polymer chains in the two types of poly(ethene).

**[2 marks]**

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**Question 2 continues on the next page**

**Turn over ►**



A student investigated how poly(ethene) extends when a force is applied.

0 2 . 3

Describe a method to investigate how the extension of poly(ethene) changes with the force applied.

[4 marks]

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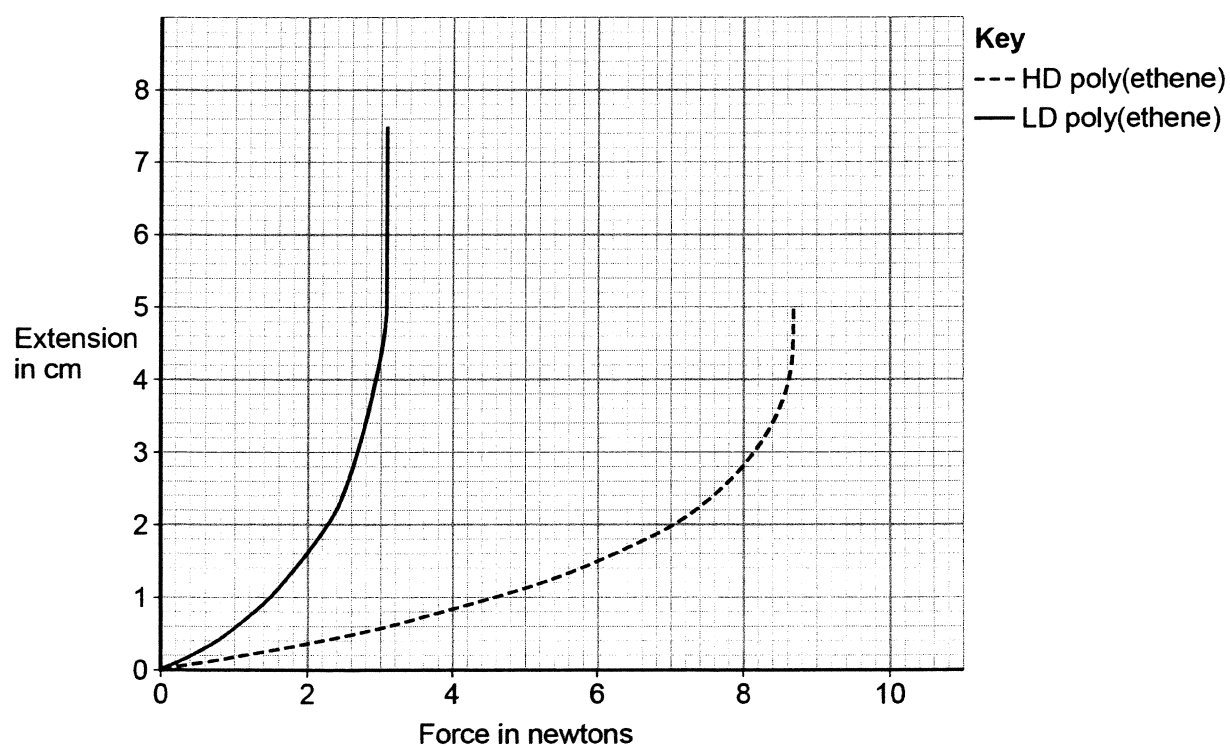
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Figure 3 shows the results for HD poly(ethene) and LD poly(ethene).

Figure 3



0 2 . 4

Give **two** comparisons between the results for HD poly(ethene) and for LD poly(ethene).

Use **Figure 3**.

[2 marks]

1 \_\_\_\_\_

\_\_\_\_\_

2 \_\_\_\_\_

\_\_\_\_\_

0 2 . 5

Carrier bags in supermarkets used to be provided free. Supermarkets now make customers pay for carrier bags.

When they were free, 8.0 billion new carrier bags were used each year.

After supermarkets started making customers pay for carrier bags, the use of new bags dropped by 85%

Calculate how many carrier bags are now used each year.

[2 marks]

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Number of bags = \_\_\_\_\_

Question 2 continues on the next page

8

Turn over ►



**0 5**

This question is about combustion of fuels.

**0 5****1**

Some central heating boilers use wood as a fuel.

Suggest **two** reasons why wood is more sustainable than natural gas as a fuel for central heating boilers.

**[2 marks]**

1 \_\_\_\_\_

\_\_\_\_\_

2 \_\_\_\_\_

\_\_\_\_\_

Natural gas is mainly methane.

When methane burns it can produce both carbon monoxide and carbon dioxide.

**0 5****2**

Explain the process by which carbon monoxide can be produced when methane is burned.

**[2 marks]**

\_\_\_\_\_

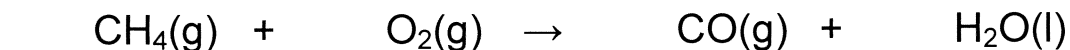
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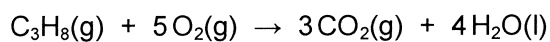
**0 5****3**

Balance the equation for the combustion of methane to produce carbon monoxide.

**[1 mark]**

**0 5 . 4** Propane burns to form carbon dioxide and water.

The equation for the reaction is:



3.60 dm<sup>3</sup> carbon dioxide is produced when a sample of propane is burned in 7.25 dm<sup>3</sup> oxygen.

Calculate the volume of unreacted oxygen.

Give your answer in cm<sup>3</sup>

**[4 marks]**

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Volume of unreacted oxygen = \_\_\_\_\_ cm<sup>3</sup>

9

**Turn over for the next question**

**Turn over ►**



07

This question is about hydrocarbons and crude oil.

07.1

Hydrocarbon fuels are produced from crude oil.

Describe how crude oil is separated into fractions.

[4 marks]

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Butane is a hydrocarbon.

07.2

Two equations for the combustion of butane are:

- $2\text{C}_4\text{H}_{10} + 13\text{O}_2 \rightarrow 8\text{CO}_2 + 10\text{H}_2\text{O}$
- $2\text{C}_4\text{H}_{10} + 5\text{O}_2 \rightarrow 8\text{C} + 10\text{H}_2\text{O}$

Why are different products formed?

[1 mark]

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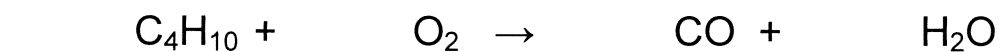
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07.3

One other product of the combustion of butane is carbon monoxide.

Balance the equation.

[1 mark]



**0 8**

Crude oil is a mixture of hydrocarbons.

Hydrocarbons can be used as fuels.

**0 8 . 1**

One alkane hydrocarbon contains 34 hydrogen atoms.

What is the formula of the hydrocarbon?

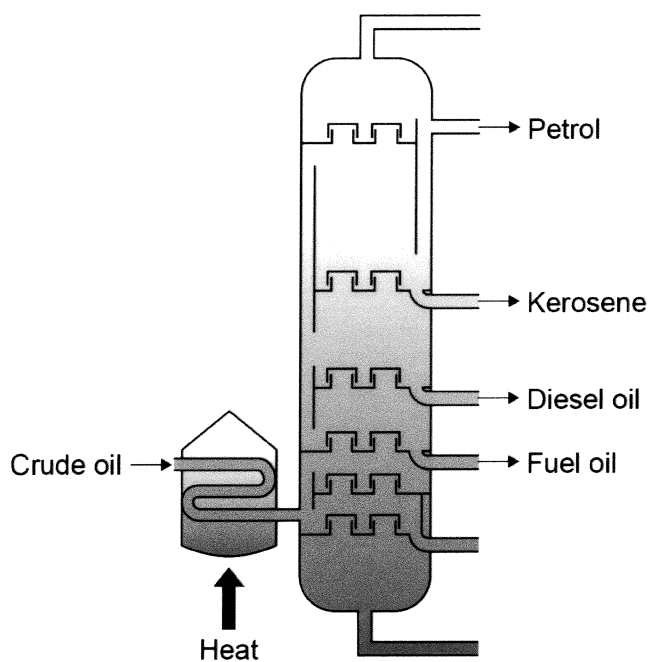
**[1 mark]**Tick **one** box. $C_{15}H_{34}$ ☐ $C_{16}H_{34}$ ☐ $C_{17}H_{34}$ ☐ $C_{18}H_{34}$ ☐**Question 8 continues on the next page****Turn over ►**



0 8 . 2

Figure 10 represents a fractionating column used to separate crude oil.

Figure 10



Describe how crude oil is separated using fractional distillation.

[4 marks]

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0 8 . 3

Propane is a hydrocarbon fuel obtained from crude oil.

Figure 11 shows the displayed equation for the complete combustion of propane.

Figure 11

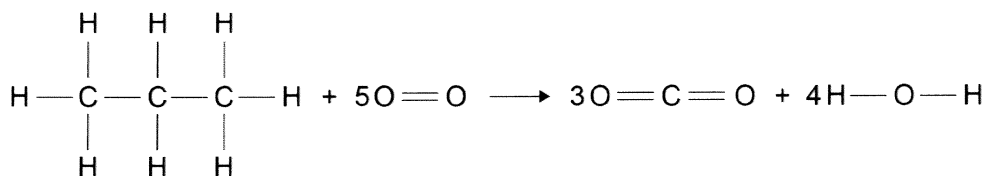


Table 5 shows bond energies.

Table 5

Bond	Bond energy in kJ/mol
C–C	347
C–H	413
O=O	495
C=O	799
O–H	467

Calculate the overall energy change in kJ/mol for the reaction.

Use Figure 11 and Table 5.

[3 marks]

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Overall energy change = \_\_\_\_\_ kJ/mol

Turn over ►



0	8	.	4
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Some fuels are obtained from plants.

Evaluate the environmental impact of fuels obtained from plants and from crude oil.

**[4 marks]**

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0 8 . 5

Butane is another hydrocarbon fuel obtained from crude oil.

The equation for the complete combustion of butane is:



14.5 g of butane was burned in 72.0 g of oxygen.

Determine the limiting reactant.

You must include calculations in your answer.

Relative atomic masses ( $A_r$ ): C = 12 H = 1 O = 16

[4 marks]

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16

END OF QUESTIONS



0 6

Figure 5 shows a surfer on a surfboard.

Figure 5



Surfboards are made from polymers.

Surfboards have a poly(styrene) core and an outer skin.

0 6 . 1

Figure 6 shows the displayed structural formula of poly(styrene).

Figure 6

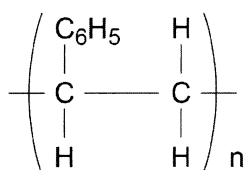
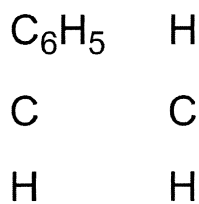


Figure 7 shows an incomplete displayed structural formula of the monomer styrene.

Complete Figure 7.

[2 marks]

Figure 7



The outer skin of surfboards contains a polyester.

Two monomers, **A** and **B**, are needed to make the polyester.

**Figure 8** shows how these two monomers are represented.

**Figure 8**



Monomer **A**



Monomer **B**

**0 6 . 2** Name the functional group in monomer **B**.

[1 mark]

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**0 6 . 3** Monomers **A** and **B** join together to produce a polyester and a small molecule.

Name the small molecule.

[1 mark]

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**0 6 . 4** Why does this type of polyester melt when it is heated?

[2 marks]

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Turn over ►



The outer skin of surfboards is a composite material.

The composite material contains glass fibres surrounded by a polyester.

0 6 . 5

Draw **one** line from each material to the description of that material.

[2 marks]

Material	Description of the material
	Hydrocarbon
Glass fibres	Matrix
	Monomer
Polyester	Polypeptide
	Reinforcement

0 6 . 6

The outer skin makes the surfboard more expensive.

Suggest **two** reasons why an outer skin is added to the poly(styrene) core.

[2 marks]

- 1 \_\_\_\_\_
- \_\_\_\_\_
- 2 \_\_\_\_\_
- \_\_\_\_\_



0 6

This question is about polymers.

0 6 . 1

Polyesters are produced when monomers join together and lose a small molecule.

Name the small molecule lost.

[1 mark]

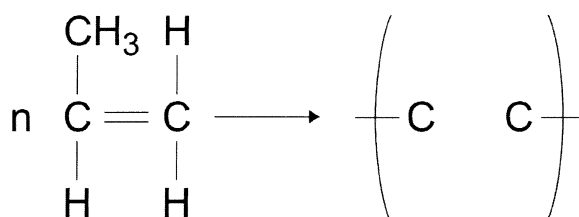
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0 6 . 2

Poly(propene) is produced from propene.

Complete the structure of poly(propene) in the equation.

[3 marks]



0 6 . 3

Carpets are made from:

- poly(propene)
- wool
- a mixture of poly(propene) and wool.

Poly(propene) wears out more slowly than wool.

A mixture of poly(propene) and wool to make carpets is more sustainable than using just poly(propene) or just wool.

Suggest why.

[2 marks]

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Polymer fibres are used to make firefighter uniforms.

**Table 3** shows some properties of two polymer fibres.

**Table 3**

Property	Polymer fibres	
	Poly(propene)	Polyester
Density in g/cm <sup>3</sup>	0.90	1.38
Melting point in °C	165	260
Flame resistance	Poor	Good
Water absorption	Low	High

Do not write  
outside the  
box

**0 6 . 4** Evaluate the suitability of poly(propene) and polyester for firefighter uniforms.

**[4 marks]**

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Turn over ►

