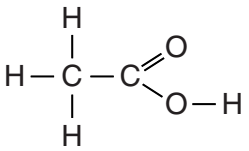
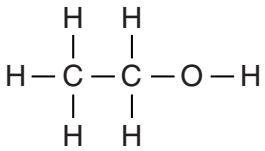
1 This question is about carbon compounds.

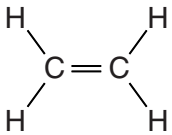
Look at the displayed formulas of some compounds.



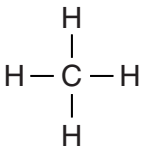
ethanoic acid



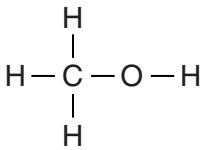
ethanol



ethene



methane



methanol

(a) Methane is an **alkane**.

Explain how you can tell from the displayed formula.

..... **[1]**

(b) Write down the name of a compound that is an **unsaturated** hydrocarbon.

Choose from the compounds shown.

..... **[1]**

(c) Write down the **molecular formula** of ethanoic acid.

..... **[1]**

(d) Ethene reacts with bromine, Br_2, to form dibromoethane, $C_2H_4Br_2$.

Write a **balanced symbol** equation for this reaction.

..... **[1]**

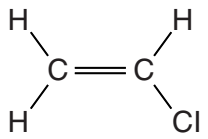
[Total: 4]

2 This question is about polymers.

(a) Poly(chloroethene) is a polymer.

Poly(chloroethene) is made from a monomer called chloroethene.

Look at the displayed formula of chloroethene.



Draw the displayed formula of poly(chloroethene).

[1]

(b) The plastic made from the polymer poly(chloroethene) can be used to make water pipes.

One property of poly(chloroethene) is that it is easy to shape.

Write about **other** properties of poly(chloroethene) that make it suitable for making water pipes.

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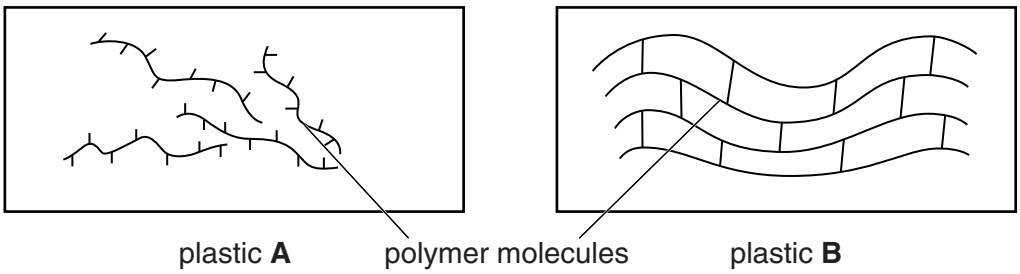
[2]

(c) Look at the diagrams. They show the structures of two plastics.



(i) Plastic **A** can be stretched easily.

Explain why.

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..... **[2]**

(ii) Plastic **B** has a high melting point.

Explain why.

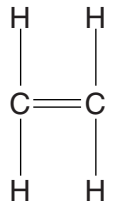
.....

..... **[1]**

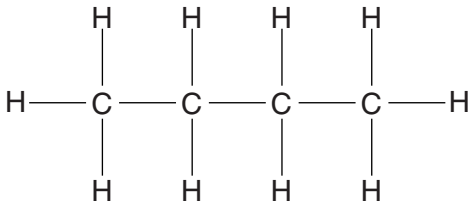
[Total: 6]

3 This question is about carbon compounds.

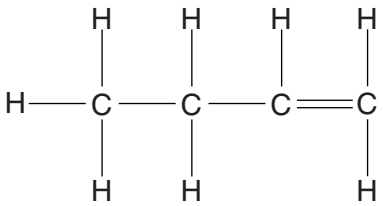
Compounds **A**, **B**, **C** and **D** are hydrocarbons.



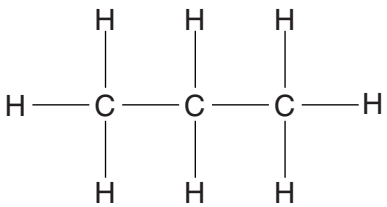
compound **A**



compound **B**



compound **C**



compound **D**

(a) Look at the displayed formulas of these compounds.

Explain why they are all hydrocarbons.

.....

.....

..... **[2]**

(b) Write down the **molecular formula** of compound **B.**

answer ..... **[1]**

(c) Look at the displayed formulas of compounds **A** and **C**.

Compounds **A** and **C** are **unsaturated**.

Explain why.

.....

..... **[1]**

(d) Compound **A** is ethene.

Ethene can be polymerised to make poly(ethene) in a process called addition polymerisation.

In polymerisation, small monomer molecules join together to make large polymer molecules.

Describe the addition polymerisation of ethene.

Your answer should include the displayed formula of poly(ethene).

The quality of written communication will be assessed in your answer to this question.

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..... **[6]**

[Total: 10]

4 This question is about oil and the products from oil.

(a) Crude oil is transported over long distances by sea and through pipelines.

The UK gets some of its crude oil from politically unstable countries.

Suggest one argument for, and one argument against, getting oil from such countries.

.....

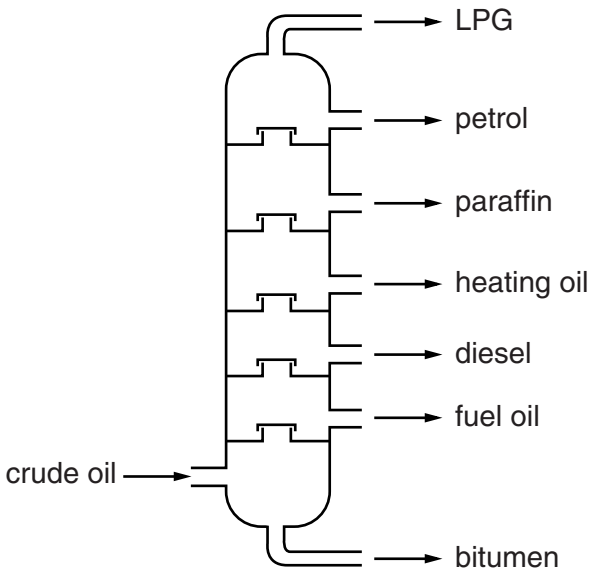
.....

..... **[2]**

(b) Crude oil is separated into many fractions by fractional distillation.

Look at the diagram.

It shows a fractionating column.



LPG has a lower boiling point than petrol.

Explain why.

.....

.....

..... **[2]**

(c) Look at the table.

It shows the percentage of each fraction in crude oil.

It also shows the percentage of each fraction needed for everyday use.

fraction	% in crude oil	% needed
LPG	4	4
petrol	5	22
heating oil	9	5
diesel	19	23
paraffin	13	8
fuel oil and bitumen	50	38

The table shows that fractional distillation cannot supply all the petrol that is needed.

Explain how an oil refinery uses **cracking** to make sure that enough petrol is made.

Use information from the table.

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.....

..... **[2]**

(d) Look at the table.

It gives information about some fuels.

fuel	energy released by one gram of fuel in kJ	products of burning	availability
ethene	44.3	carbon dioxide and water	limited
hydrogen	143.0	water	limited
LPG	55.6	carbon dioxide and water	available
petrol	48.3	carbon dioxide, water and other gases	widely available

Petrol can be used to power a car.

Recommend one of these fuels as an alternative fuel to petrol.

fuel .....

Explain your answer using information from the table.

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..... **[2]**

(e) Ethene, C_2H_4, reacts with oxygen, O_2.

Carbon dioxide and water are made.

Write the **balanced symbol** equation for this reaction.

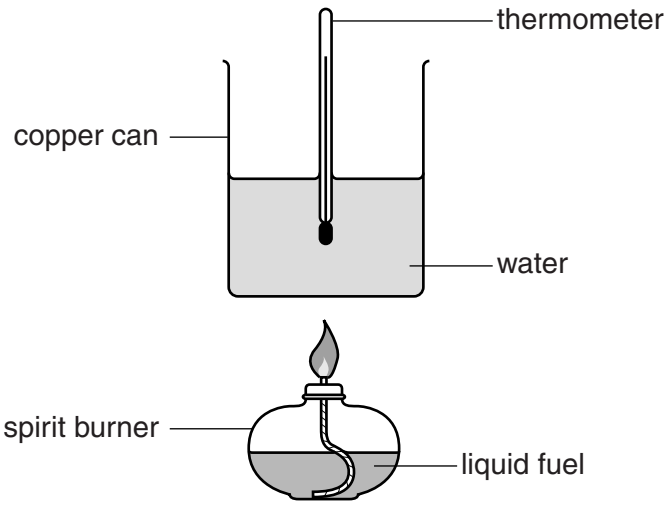
..... **[2]**

[Total: 10]

5 Petrol is a mixture of hydrocarbons.

David investigates the energy released when five of these hydrocarbons are burned.

Look at the apparatus he uses.



Each time, he burns 0.5 g of hydrocarbon and heats 100 g of water.

David measures the temperature of the water before heating.

He measures the temperature again when the hydrocarbon has finished burning.

These are his results.

hydrocarbon	**molecular formula**	**temperature of water in °C**	
		at start	**at end**
hexane	C_6H_{14}	20	40
heptane	C_7H_{16}	19	41
octane	C_8H_{18}	15	39
nonane	C_9H_{20}	18	45
decane	$C_{10}H_{22}$	20	46

(a) Calculate the energy released per gram by **hexane**.

Use the equation

energy = mass × specific heat capacity × temperature change

The specific heat capacity of water is 4.2 J/g °C.

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energy released per gram = ... J/g **[2]**

(b) David knows that the bigger the hydrocarbon molecule, the more carbon atoms it has.

David concludes that the bigger the hydrocarbon molecule, the more energy per gram is released.

Explain whether David's results fully support this conclusion.

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..... **[2]**

[Total: 4]

6 Faye is a scientist. She works for Didcot Detergents.

Faye is researching some new detergents.

Look at the table. It shows if her new detergents remove different stains at low temperatures.

Detergent	Is stain removed?			
	Food	**Paint**	**Grease**	**Blood**
A	✗	✓		✗
B	✗	✓	partly	✗
C	✓	✗		✓
D	✗	✗	✓	✗

(a) One of the detergents contains an **enzyme**.

Suggest which one.

.....

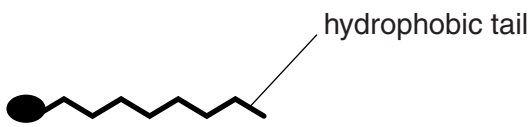
Explain your answer.

.....

.....

..... **[2]**

(b) Look at the diagram of a detergent molecule.



Explain how detergents remove fat and oil stains from clothes.

You may wish to draw a **labelled** diagram.

.....

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.....

.....

..... **[3]**

(c) Some fats are **unsaturated**.

Describe a chemical test to show that a fat is unsaturated.

test .....

result .....

.....

[2]

[Total: 7]

7 Fractional distillation separates crude oil into useful fractions.

The fractions have different boiling temperatures.

Look at the table.

It shows some information about fractions obtained from crude oil.

Fraction	Boiling temperature in °C
bitumen	above 350
LPG	less than 40
fuel oil	300 – 350
heating oil	250 – 300
petrol	40 – 200
paraffin	200 – 250

(a) Use ideas about intermolecular forces to explain how fractional distillation separates crude oil into fractions and list the fractions in the position, from top to bottom, that they 'exit' the fractionating column.

The quality of written communication will be assessed in your answer to this question.

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..... **[6]**

(b) The LPG fraction contains propane gas, C_3H_8.

Write a **balanced symbol** equation for the **incomplete** combustion of propane in oxygen, O_2.

Only carbon monoxide, CO, and water are made.

..... **[2]**

[Total: 8]

8 Scientists are concerned about the pollution of both the air and water.

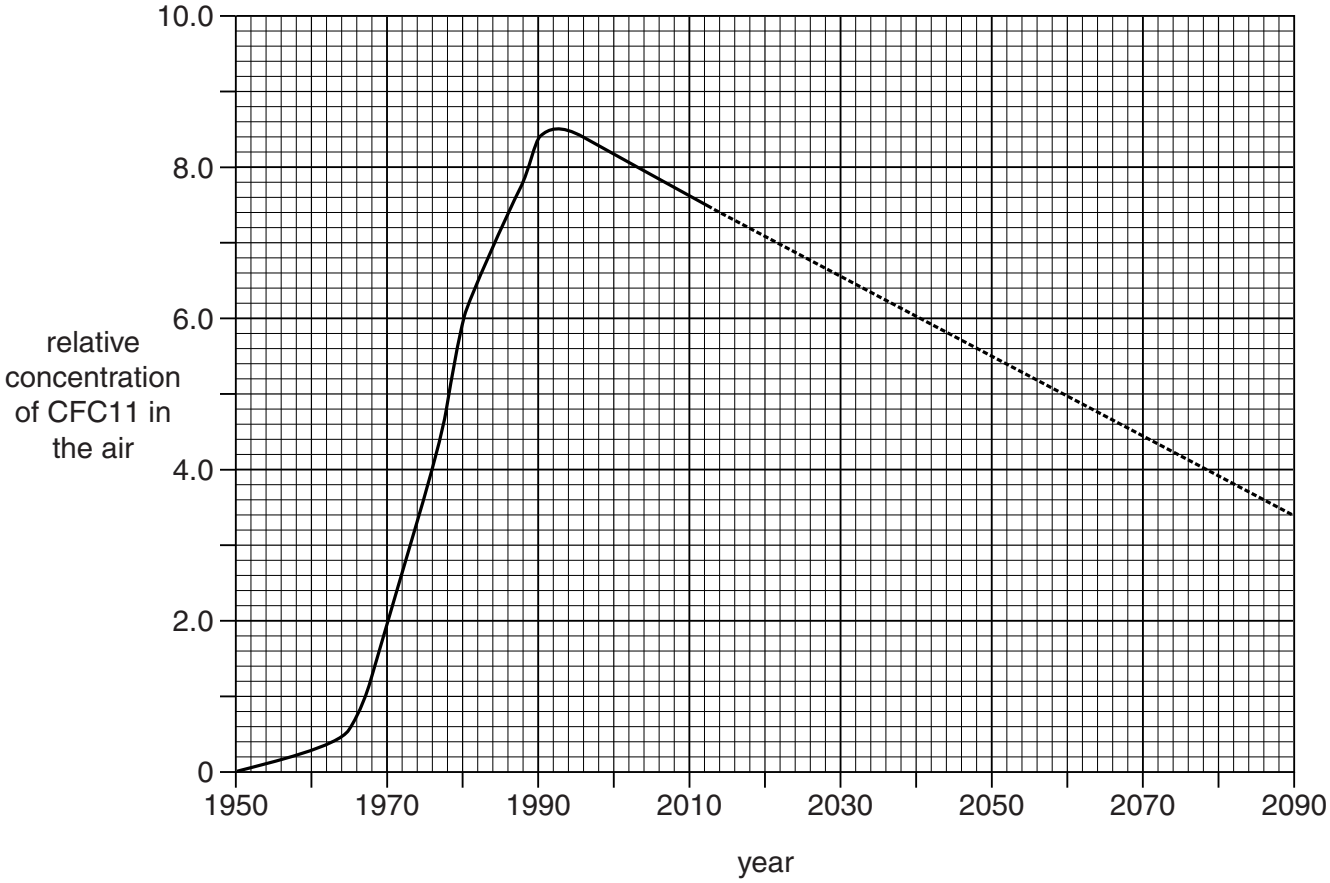
Chlorofluorocarbons, CFCs, are pollutants found in the air.

CFC11 is a chlorofluorocarbon.

Look at the graph.

It shows how the concentration of CFC11 in the air has changed between 1950 and 2013.

The dotted line shows how it may change up to 2090.



(a) In 1989, some countries banned the use of CFCs.

(i) Look at the graph.

Estimate the year when the concentration of CFC11 will drop to 50% of the 2003 value.

.....

..... **[2]**

(ii) Nick estimates that CFC11 molecules remain in the atmosphere for 45 years.

Is this value consistent with the data shown on the graph?

Explain your answer.

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..... **[1]**

(iii) It is difficult to predict how the concentration of CFC11 in the air will change in the future.

Suggest **two** reasons why.

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..... **[2]**

(b) CFC11 dissolves in rainwater.

Some rainwater collects underground.

Once underground, the concentration of CFC11 in the water does not change.

In 2013, a scientist analyses some underground rainwater.

She finds that the CFC11 concentration in the air, when the rain fell, was 2.0 units.

Use the graph to decide how many years this rainwater has been underground.

.....

..... **[2]**

(c) CFC12 is another chlorofluorocarbon.

Look at the table. It shows how the concentration of **CFC12** has changed between 1950 and 2010.

Year	Relative concentration of CFC12 in the air
1950	0
1960	0.1
1970	1.5
1980	4.0
1990	4.4
2000	4.5
2010	4.4

(i) What is the percentage decrease in CFC12 concentration in the air from the year 2000 to 2010?

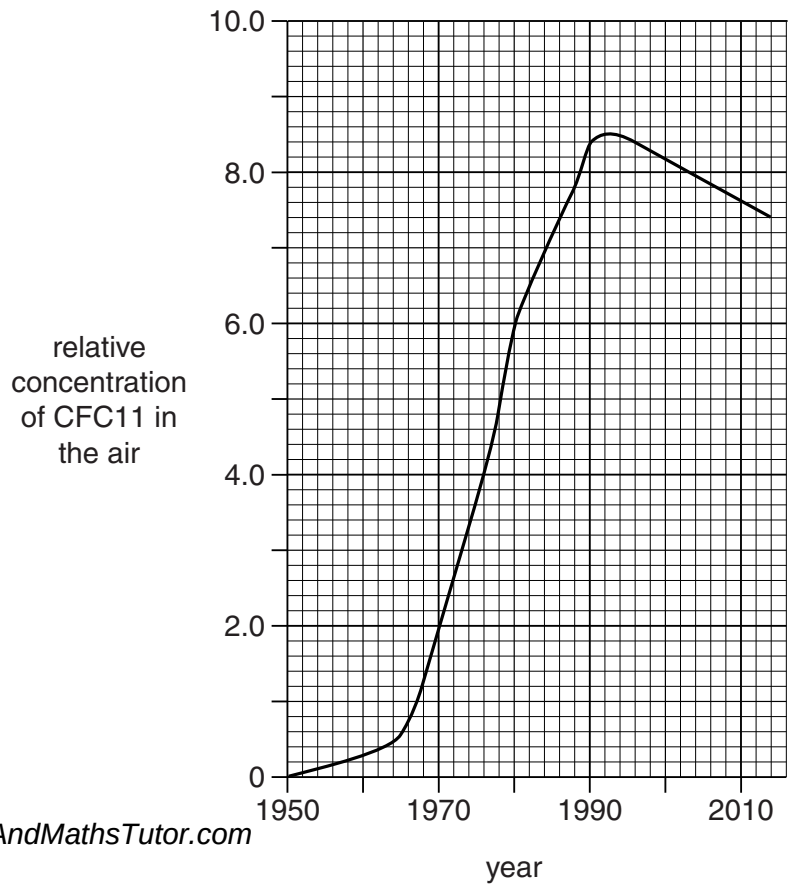
.....

..... **[1]**

(ii) Many countries signed an international agreement to ban the use of CFCs in 1989.

Look at this graph.

It shows how the concentration of **CFC11** in the air has changed between 1950 and 2010.



Did the ban on the use of CFCs have the same effect on the concentration in the air of CFC11 as on CFC12?

Explain your answer.

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..... **[2]**

[Total: 10]