

1 This question is about some of the hydrocarbons found in crude oil.

The table shows some information about four of these hydrocarbons.

Hydrocarbon	Molecular formula	Fraction of crude oil that contains the hydrocarbon	Melting point in °C	Boiling point in °C	Density in g/cm <sup>3</sup>
propane	C <sub>3</sub> H <sub>8</sub>	liquefied petroleum gases	-188	-42	0.002
hexane	C <sub>6</sub> H <sub>14</sub>	petrol	-95	68	0.66
decane	C <sub>10</sub> H <sub>22</sub>	paraffin	-30	174	0.73
hexadecane	C <sub>16</sub> H <sub>34</sub>	diesel	18	287	0.77

(a) Propane is a **hydrocarbon**.

What is meant by a hydrocarbon?

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

(b) Propane is a saturated compound.

What is meant by a **saturated** compound?

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

(c) A mixture of hexane, decane and hexadecane can be separated by fractional distillation.

Explain why. Use ideas about intermolecular forces and information from the table.

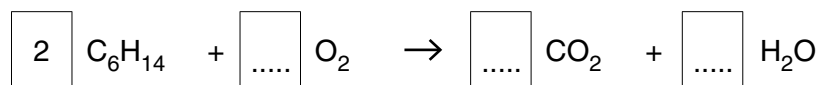
.....  
.....  
.....  
..... [3]

(d) Hexane is one of the hydrocarbons found in petrol.

Hexane completely burns in excess air.

Look at the symbol equation for this reaction.

Balance the equation by putting numbers in the boxes.



[2]

(e) Hexane burns in a limited supply of oxygen.

Incomplete combustion happens.

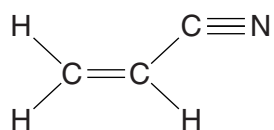
Write a **word equation** for the **incomplete** combustion of hexane.

..... [1]

2 Stowmarket Synthetics is a chemical company that makes polymers.

They make a polymer from a monomer called propenenitrile.

Look at the displayed formula for the monomer propenenitrile.



(a) How many covalent bonds are shown in the displayed formula of propenenitrile?

Tick (✓) the correct box.

three

four

five

eight

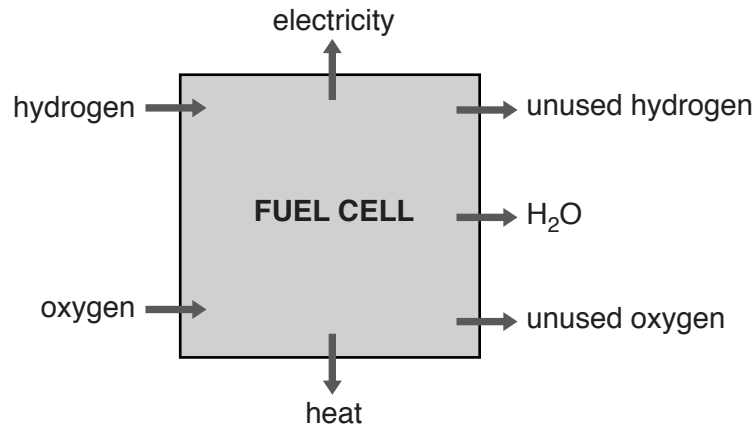
nine

[1]



3 Fuel cells are used to make electricity.

Look at the diagram. It shows what happens in a fuel cell.



(a) In this fuel cell, hydrogen, H<sub>2</sub>, reacts with oxygen, O<sub>2</sub>.

Water, H<sub>2</sub>O, is made.

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

..... [2]

(b) The reaction between hydrogen and oxygen is **exothermic**.

Draw and label an energy level diagram for the reaction between hydrogen and oxygen



[2]

(c) Fuel cells are used to provide electrical energy in spacecraft.

Write down one **other advantage** of using fuel cells in spacecraft.

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

(d) Hydrogen-oxygen fuel cells produce water.

Water is not a pollutant.

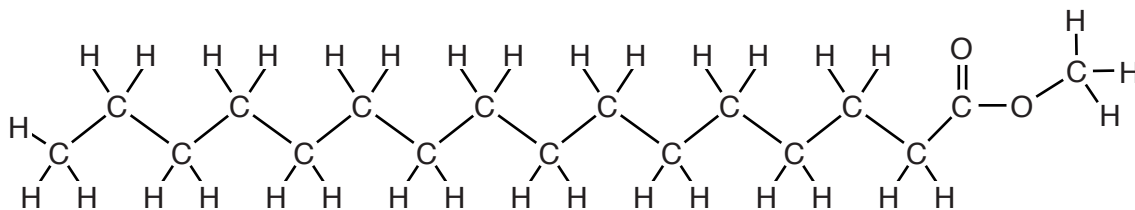
Fuel cells still cause pollution.

Write down two ways that fuel cells can cause pollution.

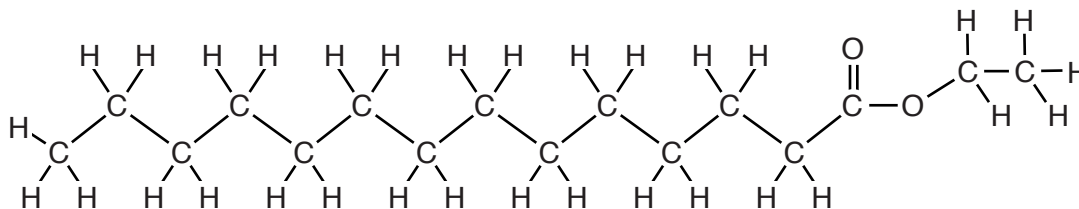
1 .....  
.....  
2 .....  
..... [2]

4 Look at the diagrams. They show the displayed formulas of some fats and oils.

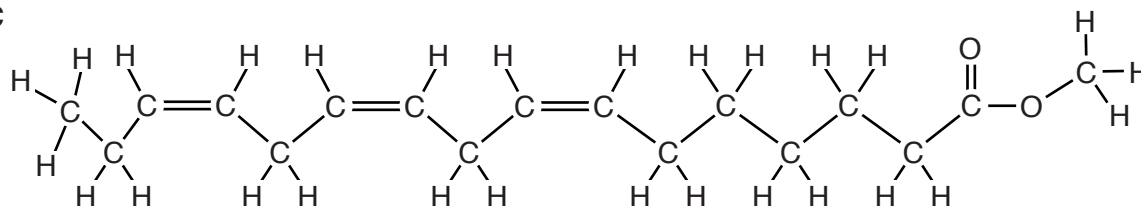
Formula A



Formula B



Formula C



(a) Which formula is **unsaturated**?

Explain your answer.

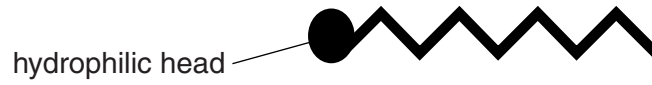
.....  
..... [2]

(b) Fats and oils can be split up by **saponification**.

Explain what happens during saponification.

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

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



Explain, using its structure, how a detergent molecule removes fat and oil stains from clothes.

.....

.....

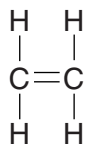
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..... [2]

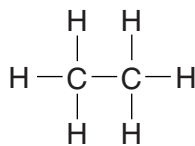


This question is about compounds containing carbon. Look

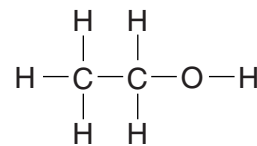
5 at the displayed formulas of some compounds.



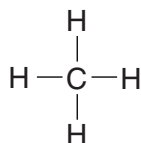
compound A



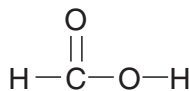
compound B



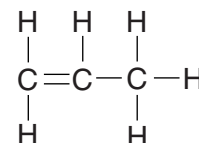
compound C



compound D



compound E



compound F

(a) What is the **molecular formula** for compound B?

.....

[1]

(b) Explain why compound B is a hydrocarbon but compound C is not a hydrocarbon.

.....  
.....  
.....

[3]

(c) Two compounds are **unsaturated**.

Which two?

..... and .....

[1]

[Total: 5]

6 A power station burns methane, CH<sub>4</sub>.

(a) Construct a **balanced symbol** equation for the complete combustion of methane.

..... [2]

(b) The power station produces nitrogen dioxide gas.

The owners need to stop the nitrogen dioxide going into the atmosphere.

They can choose two methods:

- use limestone
- use sea water.

Look at the table. It shows some information about each method.

	<b>Limestone</b>	<b>Sea water</b>
Percentage of nitrogen dioxide removed	90%	99%
Waste made	carbon dioxide and a solid waste product	none – sea water is pumped back into the sea
Cost	expensive	cheap
Availability	mined from under the ground	must be pumped in from the coast
Mass needed to remove 1 g of nitrogen dioxide	1.2 g	3000 g

The power station is 100 kilometres from the coast.

The power station makes 9000 g of nitrogen dioxide.

Which method would be more suitable for removing nitrogen dioxide from the waste gases?

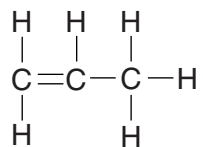
Explain your answer.

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

[Total: 4]

7 Poly(propene) is a polymer made from propene.

Look at the displayed formula for propene.



(a) Draw the displayed formula for poly(propene).

[2]



8 There are many compounds that contain carbon and hydrogen only.

(a) Pentane has the formula  $\text{CH}_3(\text{CH}_2)_3\text{CH}_3$ .

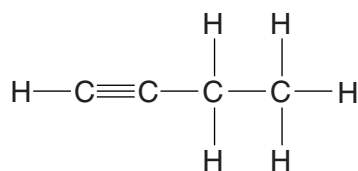
Calculate the molar mass of pentane.

The relative atomic mass,  $A_r$ , of H = 1 and of C = 12.

.....  
.....

molar mass = ..... g/mol [1]

(b) Look at the displayed formula for butyne.



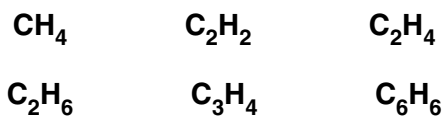
What is the **molecular formula** for butyne?

..... [1]

(c) Look at the molecular formula of some compounds.

Which **two** compounds have the same **empirical** formula?

Choose from



answer ..... and ..... [1]

**(d)** David analyses a sample of a gas.

He finds it contains 1.2 g of carbon and 0.4 g of hydrogen.

Calculate the empirical formula for this gas.

.....  
.....  
.....

empirical formula is .....

**[2]**

**[Total: 5]**

9 Ethanol can be made by the fermentation of glucose.

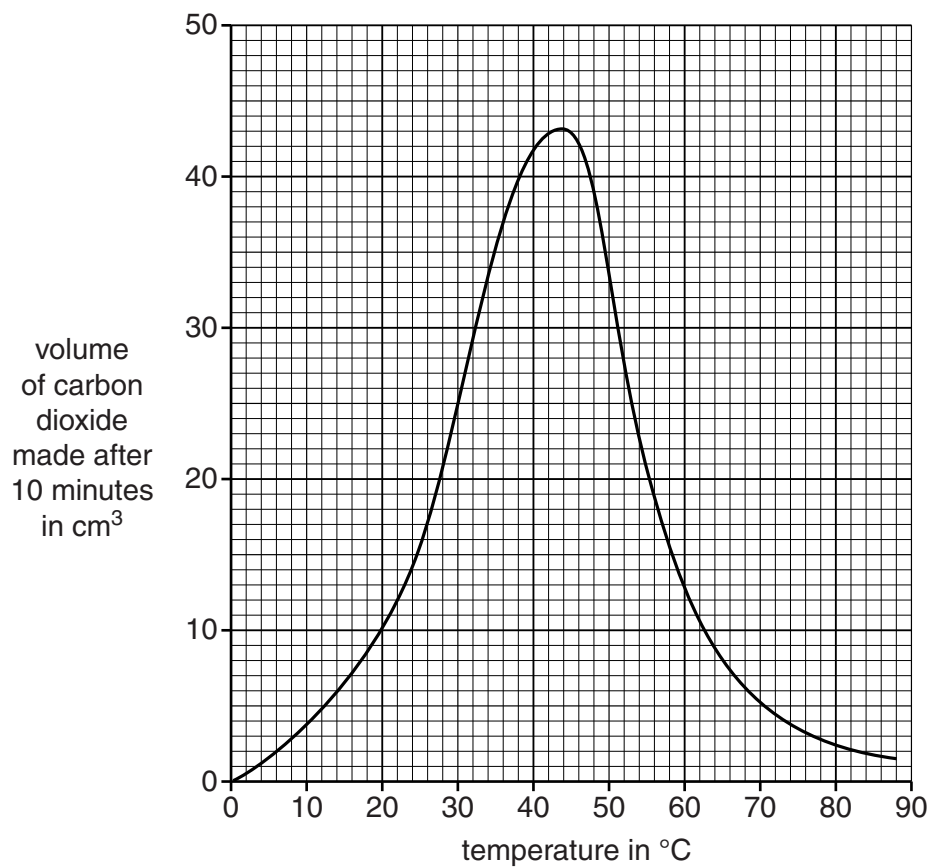
Tina and Tommy investigate the fermentation of glucose.

They use 50 cm<sup>3</sup> of glucose solution and 1 g of yeast.

Tina and Tommy measure the volume of carbon dioxide made after 10 minutes.

They do the experiment at different temperatures.

Look at the graph. It shows their results.



(a) (i) What is the volume of carbon dioxide made at **60 °C**?

answer ..... cm<sup>3</sup> [1]

(ii) At what temperature is the reaction fastest?

answer ..... °C

Explain your answer.

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

(b) Glucose reacts to make carbon dioxide and ethanol.

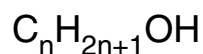
Look at the formulas.

Substance	Formula
glucose	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>
carbon dioxide	CO <sub>2</sub>
ethanol	C <sub>2</sub> H <sub>5</sub> OH

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

..... [2]

(c) The general formula for an alcohol is



Propanol contains three carbon atoms.

(i) Write the formula for propanol.

..... [1]

(ii) Draw the **displayed formula** of propanol.

[1]