OXFORD CAMBRIDGE AND RSA EXAMINATIONS
GCSE

B741/02

GATEWAY SCIENCE
CHEMISTRY B

Chemistry modules C1, C2, C3
(Higher Tier)

THURSDAY 23 MAY 2013: Morning

DURATION: 1 hour 15 minutes
plus your additional time allowance

MODIFIED ENLARGED

Candidate forename		Candidate surname	

Centre number						Candidate number				

Candidates answer on the Question Paper.
A calculator may be used for this paper.

OCR SUPPLIED MATERIALS:

None

OTHER MATERIALS REQUIRED:

Pencil
Ruler (cm/mm)

READ INSTRUCTIONS OVERLEAF

DC (NF/SW) 2286678241 79736/1
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INSTRUCTIONS TO CANDIDATES

- **Write your name, centre number and candidate number in the boxes on the first page. Please write clearly and in capital letters.**
- **Use black ink. HB pencil may be used for graphs and diagrams only.**
- **Answer ALL the questions.**
- **Read each question carefully. Make sure you know what you have to do before starting your answer.**
- **Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).**

INFORMATION FOR CANDIDATES

- **Your quality of written communication is assessed in questions marked with a pencil (✎).**
- **The Periodic Table can be found on page 43.**
- **The number of marks is given in brackets [ ] at the end of each question or part question.**
- **The total number of marks for this paper is 75.**
- **Any blank pages are indicated.**

BLANK PAGE

Answer ALL the questions.

SECTION A – MODULE C1

1 This question is about the gases in the air.

(a) Clean air is a mixture of gases.

Complete the table to show the percentage of gases in clean air.

Gas	Percentage
_____	78%
_____	21%
carbon dioxide	_____

[2]

(b) (i) Carbon monoxide and oxides of nitrogen are pollutants found in air.

Explain why it is important that atmospheric pollution is controlled.

_____

_____

_____ **[2]**

(ii) Catalytic converters are fitted to cars to help reduce air pollution from carbon monoxide, CO, and nitrogen monoxide, NO.

What happens in a catalytic converter?

Include a BALANCED SYMBOL equation in your answer.

_____

_____

_____

_____ **[3]**

(c) Air quality in the UK has improved over the last 60 years.

In December 1952, air pollution was so bad in London that sometimes people could not see their own feet.

Look at the graph opposite.

It shows the number of deaths each day in London, between 3 December and 15 December 1952.

It also shows the concentrations of smoke and sulfur dioxide.

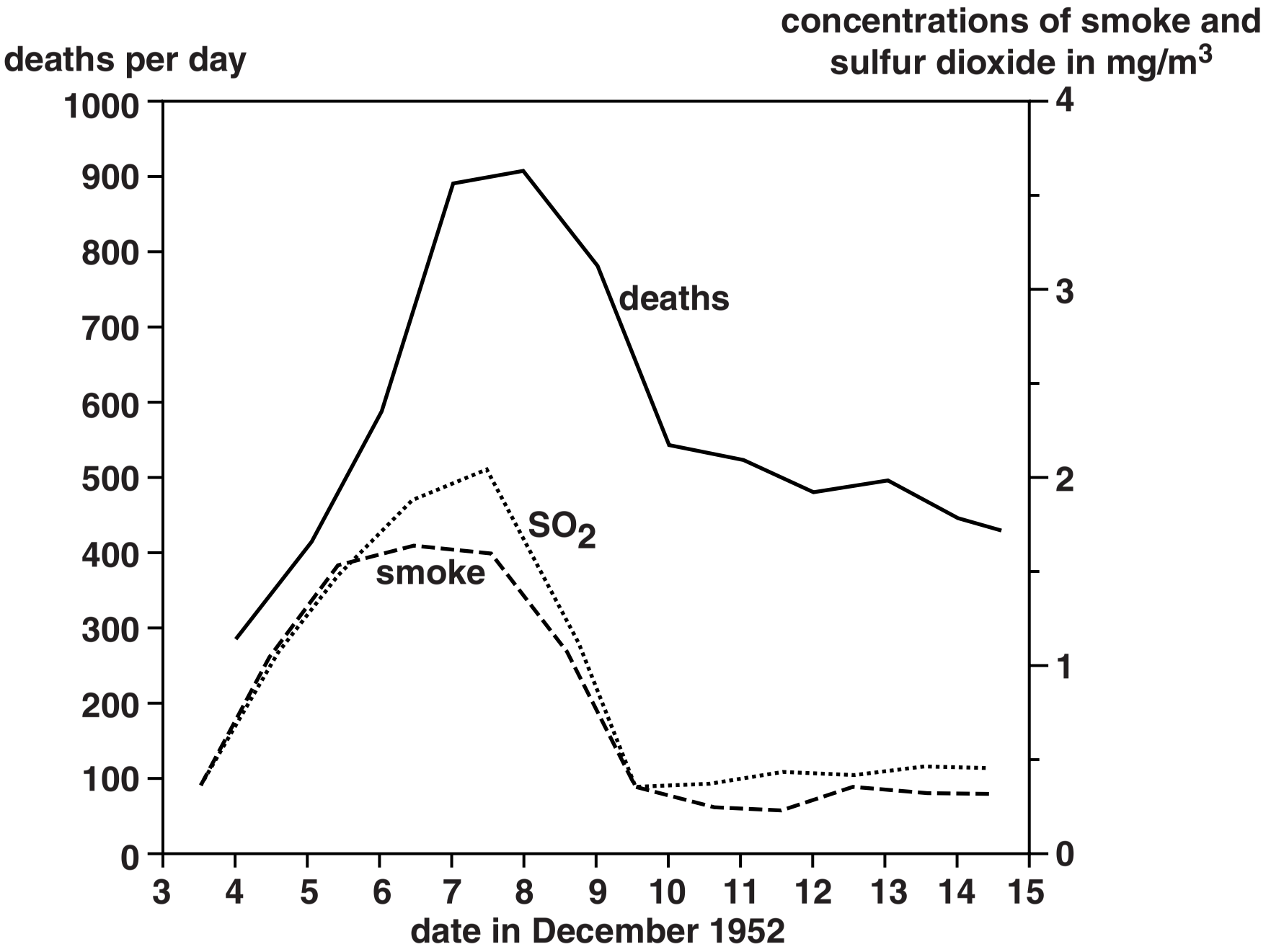
Describe the relationship between the number of deaths and the concentrations of smoke and sulfur dioxide.

_____

_____

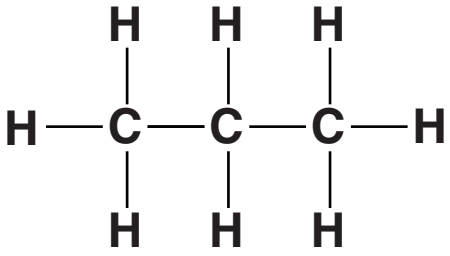
_____ **[2]**

[TOTAL: 9]

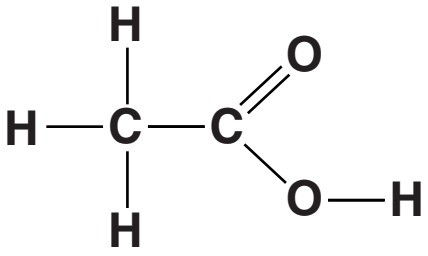

deaths per day
concentrations of smoke and sulfur dioxide in mg/m3
1000
900
800
700
600
500
400
300
200
100
0
4
3
2
1
0
deaths
SO2
smoke
3
4
5
6
7
8
9
10
11
12
13
14
15
date in December 1952

2 Look at the displayed formulas of some compounds.

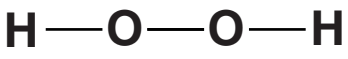
compound A



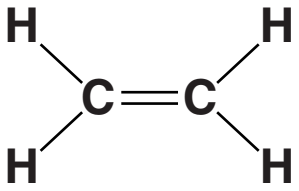
compound B



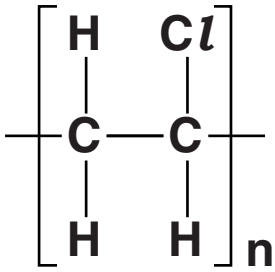
compound C



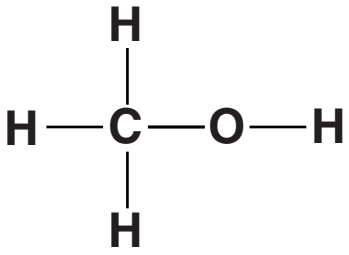
compound D



compound E



compound F



(a) Compound F is NOT a hydrocarbon.

Explain how you can tell from the displayed formula.

_____

_____ **[1]**

(b) Which compound is an UNSATURATED hydrocarbon?

Choose from A, B, C, D, E or F.

_____ **[1]**

(c) Which compound is a POLYMER?

Choose from A, B, C, D, E or F.

_____ **[1]**

(d) Compound D makes an addition polymer.

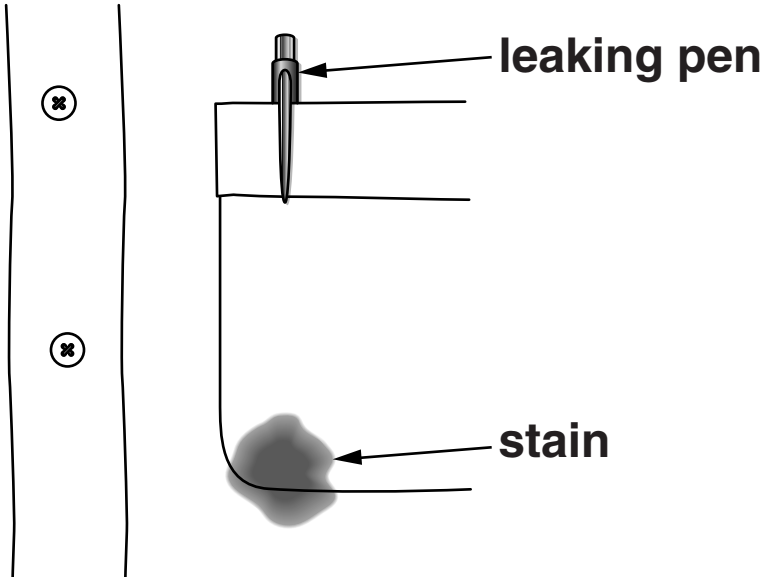
Draw the DISPLAYED FORMULA of this addition polymer.

[1]

[TOTAL: 4]

3 Chemicals called esters can be used as SOLVENTS.

Sarah investigates how good four different solvents are at removing a stain from cotton.



Look at her results.

Solvent	Percentage of stain removed		Effect on cotton
	At 40°C	At 60°C	
A	0%	35%	colour fades
B	10%	60%	none
C	85%	100%	cotton shrinks
D	75%	95%	none

(a) Which solvent is the most suitable for removing stains from cotton?

_____

Explain your choice.

_____

_____

_____ **[2]**

(b) Sarah thinks her results do not provide sufficient evidence to make a firm conclusion.

Explain what further tests would help to make her conclusion more secure.

_____

_____

_____ **[2]**

[TOTAL: 4]

4 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.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____ **[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]

SECTION B – MODULE C2

5 This question is about fertilisers.

(a) Ammonium sulfate is used as a fertiliser.

The formula for ammonium sulfate is $(NH_4)_2SO_4$.

(i) Write down the number of DIFFERENT ELEMENTS in ammonium sulfate.

answer _____ [1]

(ii) Write down the number of ATOMS in this formula.

answer _____ [1]

(b) Amy and Chris decide to make some SOLID AMMONIUM SULFATE by neutralisation.

They use an acid and an alkali.

Name the acid and alkali they use and describe the experimental method they use.

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

_____

_____

_____

_____

_____

_____

_____

_____

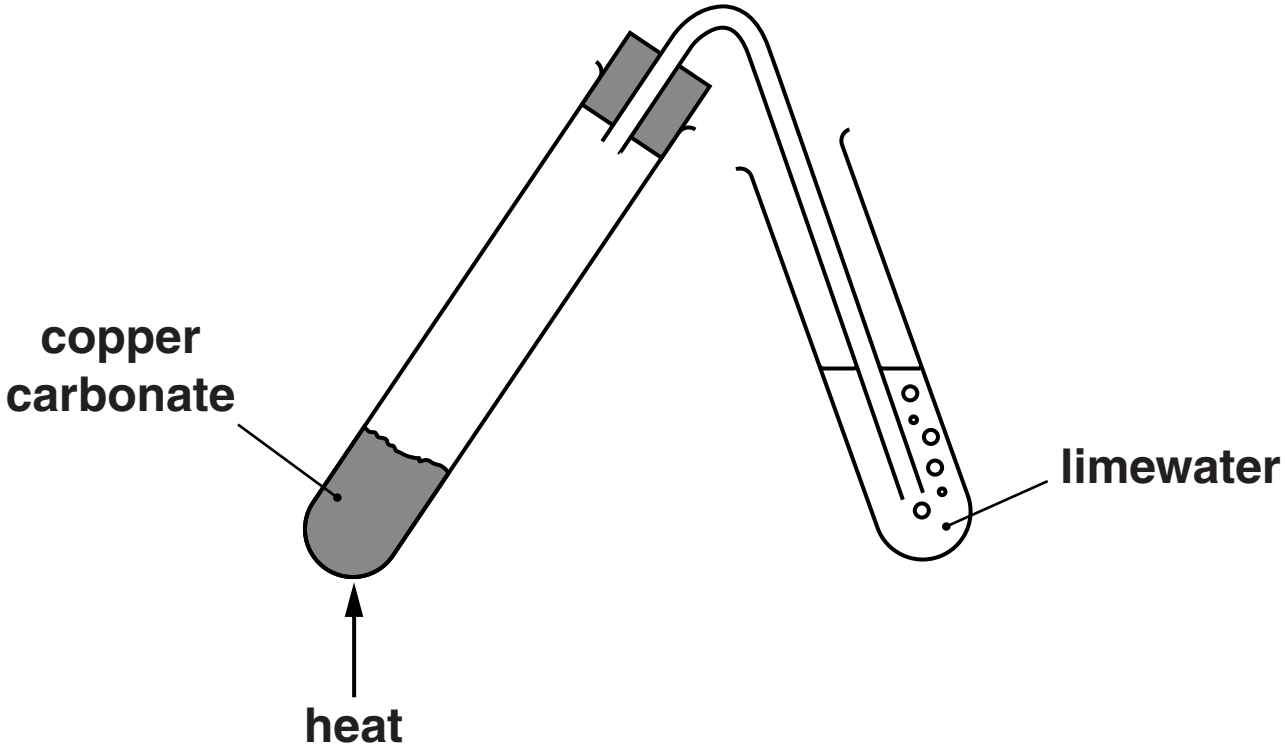
_____

_____ **[6]**

[TOTAL: 8]

6 (a) (i) **Sam investigates the action of heat on copper carbonate.**

Look at the diagram. It shows the apparatus he uses.



Look at the word equation for the reaction

COPPER CARBONATE → COPPER OXIDE + CARBON DIOXIDE

This is a THERMAL DECOMPOSITION reaction.

Explain why.

_____

_____ **[1]**

(ii) Sam makes some copper.

Sam heats copper oxide, CuO, with carbon, C.

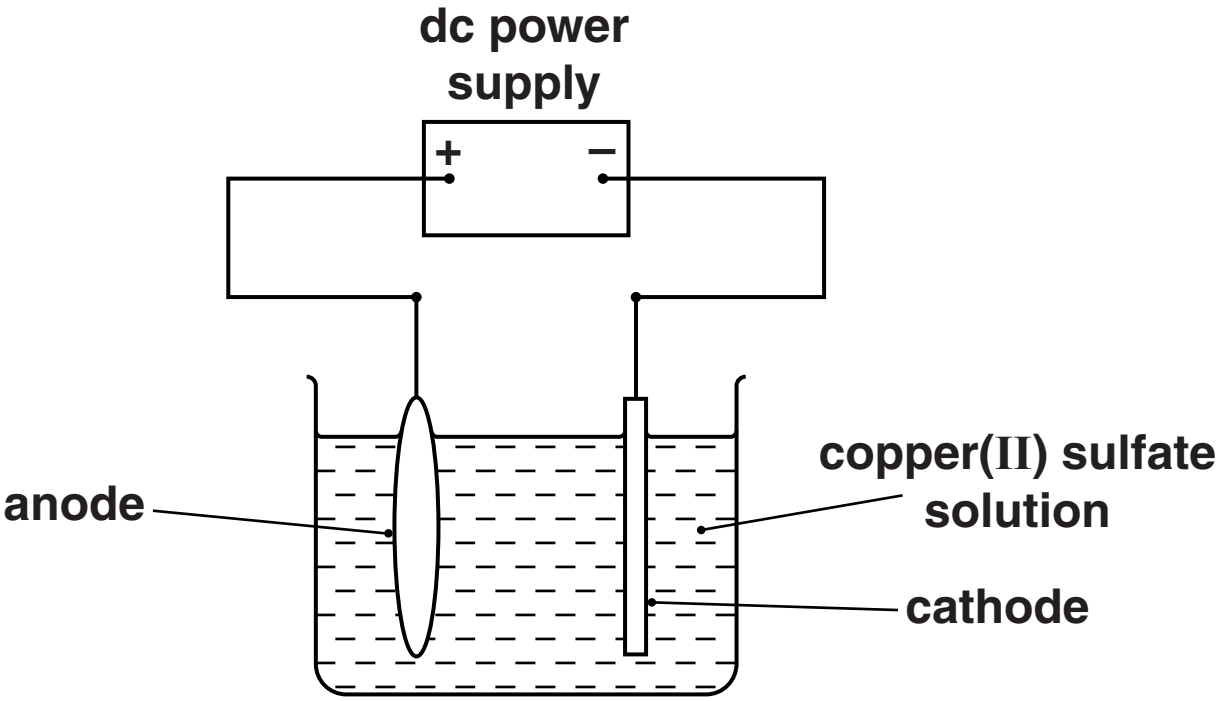
Copper, Cu, and carbon dioxide, CO_2, are made.

Write a BALANCED SYMBOL equation for this reaction.

_____ [2]

(b) The copper Sam makes is impure.

Look at the diagram. It shows the apparatus he uses to purify copper.



Look at the equations below for the electrode reactions.

The anode: $Cu - 2e^- \rightarrow Cu^{2+}$

The cathode: $Cu^{2+} + 2e^- \rightarrow Cu$

(i) Which reaction is oxidation and which is reduction?

Explain why.

_____

_____

_____ **[2]**

(ii) Use the electrode reactions to explain why the anode LOSES mass and the cathode GAINS mass.

_____

_____

_____ **[2]**

(c) Explain one ADVANTAGE and one PROBLEM of recycling copper.

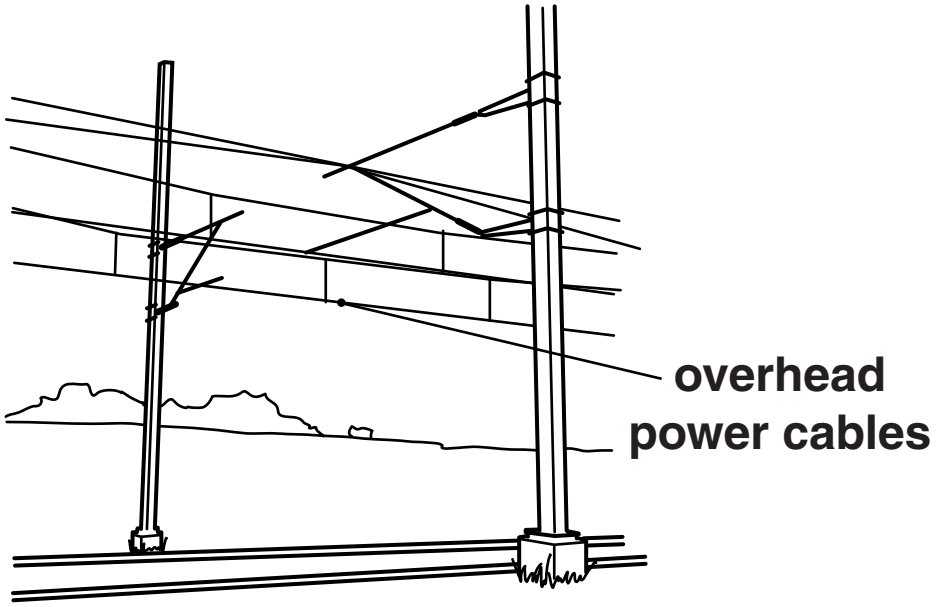
_____

_____

_____ **[2]**

(d) Look at the table opposite. It shows some properties of three metals.

Look at the picture. It shows overhead power cables used by electric trains.



Which metal would you choose to make the overhead power cables?

_____

Justify your answer.

Use the data in the table.

_____

_____

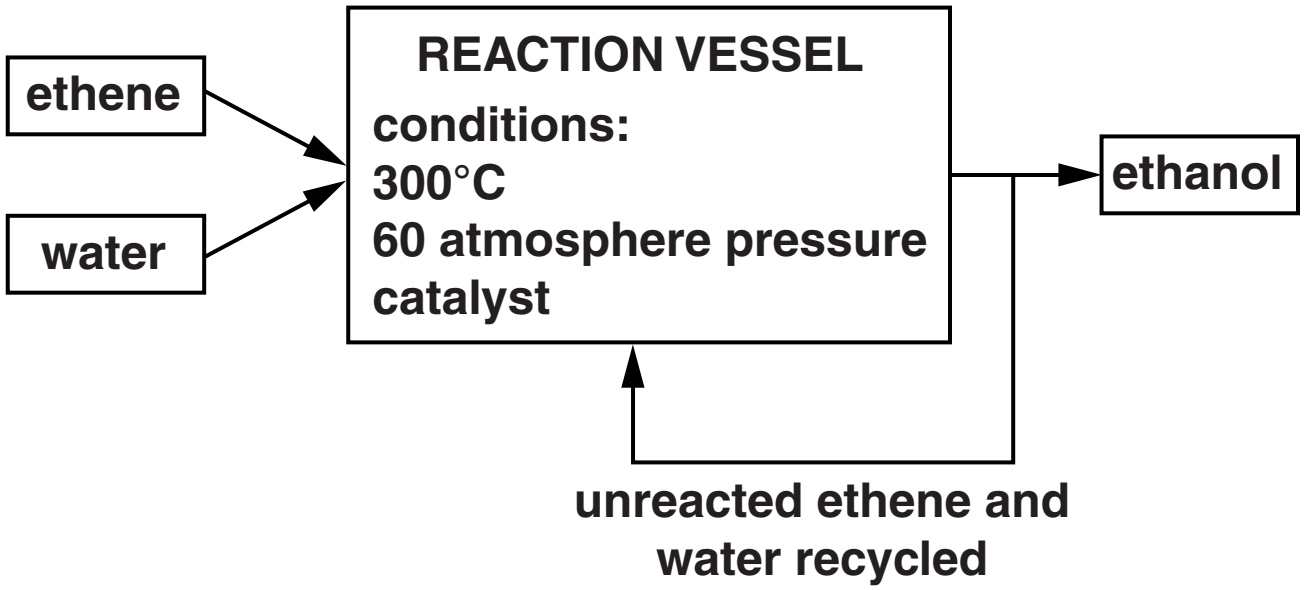
_____ **[2]**

[TOTAL: 11]

	Density in g/cm^3	Relative electrical conductivity (0 = low, 100 = high)	Relative strength (0 = weak, 1000 = very strong)	Corrosion in moist air	Cost per tonne in £
Aluminium	2.7	40	300	does not corrode	770
Copper	8.9	64	400	corrodes slowly	5900
Iron	7.9	11	600	corrodes	200

7 Ethanol can be made from ethene and water.

The flowchart shows this process.



The symbol equation for the reaction is:

$$C_2H_4 + H_2O \rightleftharpoons C_2H_6O$$

The percentage of ethanol changes as the temperature and pressure change.

Look at the table.

It shows the percentage of ethanol at different temperatures and pressures.

Pressure in atmospheres	Percentage of ethanol (%)			
	At 100°C	At 200°C	At 300°C	At 400°C
20	15	10	5	2
40	20	15	10	5
60	40	30	20	10
80	60	50	40	20

(a) Which of the following conditions gives the HIGHEST percentage of ethanol?

A high pressure with high temperature

B high pressure with low temperature

C low pressure with high temperature

D low pressure with low temperature

Choose from A, B, C or D.

answer _____ [1]

(b) The conditions used for making ETHANOL are:

300°C

60 atmospheres pressure.

Suggest why these conditions are used even though the percentage of ethanol is only 20%.

_____

_____

_____ **[2]**

[TOTAL: 3]

8 This question is about the structure of the Earth.

(a) Look at the table of densities.

Layer of Earth	Density in g/cm^3
crust	2.2 – 3.9
outer mantle	3.4 – 4.4
inner mantle	4.4 – 5.6
outer core	9.9 – 12.2
inner core	12.8 – 13.1

The lithosphere includes the crust and outer part of the mantle.

The lithosphere is made of tectonic plates.

Some scientists claim that these tectonic plates 'FLOAT' on the inner mantle.

How does the data in the table help to support this claim?

_____

_____ **[1]**

(b) In 1914, Wegener proposed a theory to explain the structure of the Earth.

This was not accepted by many scientists at the time.

His original theory has now been developed into the theory of plate tectonics.

This developed theory is more widely accepted.

Explain why developed theories are often more widely accepted.

_____

_____

_____ **[2]**

[TOTAL: 3]

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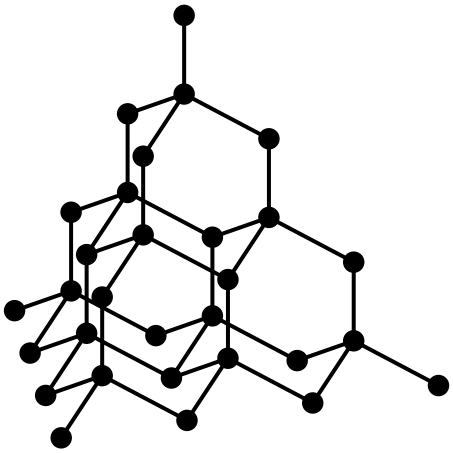
QUESTION 9 BEGINS ON PAGE 28

PLEASE DO NOT WRITE ON THIS PAGE

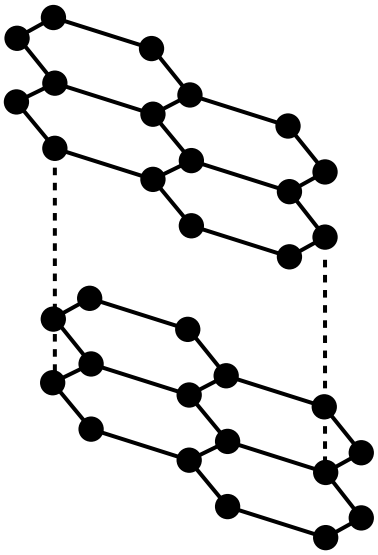
9 Carbon can exist in different solid forms.

● = carbon atom

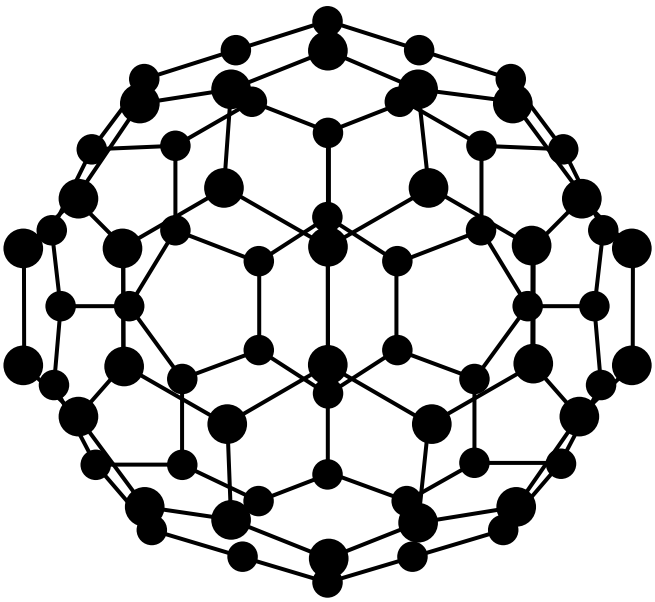
DIAMOND



GRAPHITE



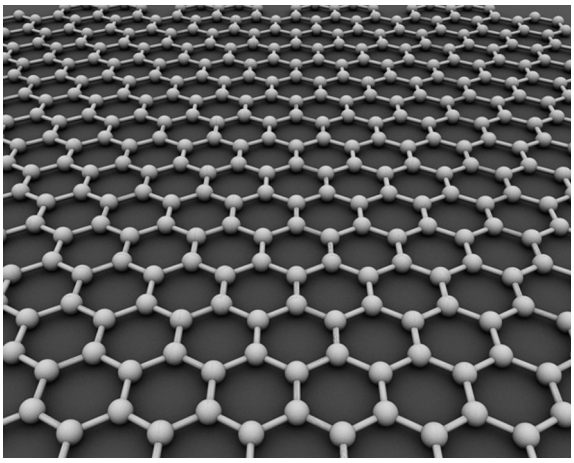
BUCKMINSTERFULLERENE



(a) What is the name given to these three forms?

_____ **[1]**

(b) Look at the diagram.



It shows the structure of a new solid form of carbon called graphene.

Graphene contains ONE LAYER of carbon atoms.

Graphene is made from graphite.

Graphene is harder than graphite.

Explain, using ideas about structure and bonding, why GRAPHENE is HARD and GRAPHITE is SLIPPERY.

_____

_____

_____

_____ **[2]**

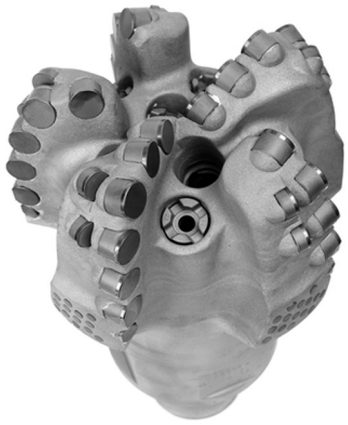
(c) Diamond and graphite have different properties and different uses.

Look at the table.

It shows some information about the properties of diamond and graphite.

Property	Diamond	Graphite
state at room temperature	solid	solid
appearance at room temperature	transparent	black
melting point	very high	very high
hardness	very hard	soft
electrical conductivity	does not conduct	good conductor

Diamond is used to make cutting tools.



The picture shows a drill bit with diamonds on its end.

This drill is used to cut through rock.

Explain why diamond is used to make cutting tools.

Use the table to help you.

_____

_____

_____

_____ **[2]**

[TOTAL: 5]

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10 Hilary investigates the reaction between magnesium, Mg, and hydrochloric acid, HC*l*.

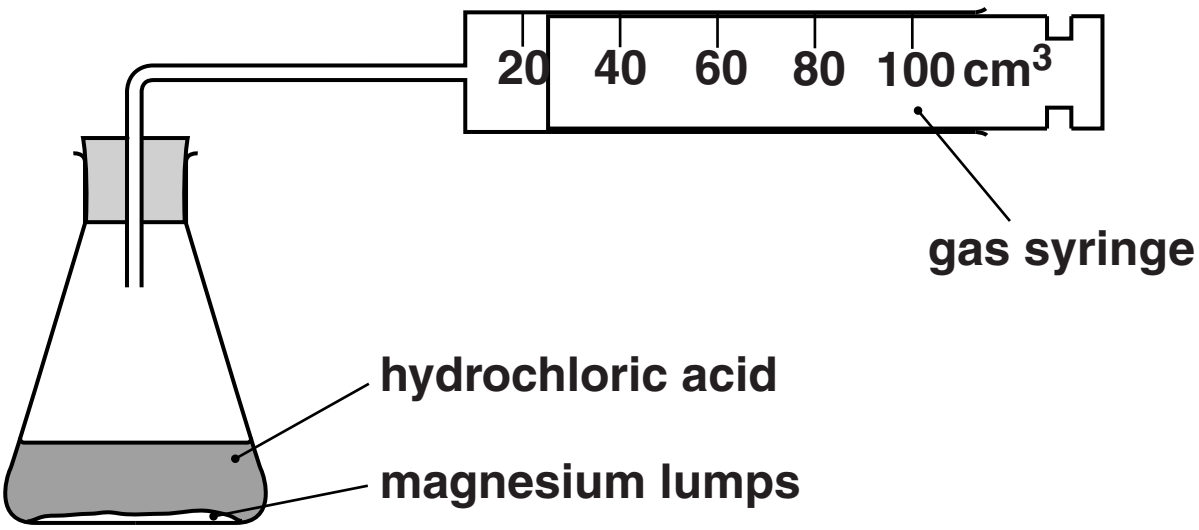
Magnesium chloride, $MgCl_2$, and hydrogen, H_2, are made.

(a) Construct the BALANCED SYMBOL equation for this reaction.

_____ **[2]**

(b) Look at the diagram.

It shows the apparatus she uses.



Hilary measures the total volume of gas in the syringe every 10 seconds.

Look at the graph on page 35. It shows her results.

(i) How long does it take for the reaction to stop?

answer _____ seconds
[1]

(ii) Calculate the RATE OF REACTION during the first 10 SECONDS of this experiment.

_____

_____

answer _____ cm^3/s [1]

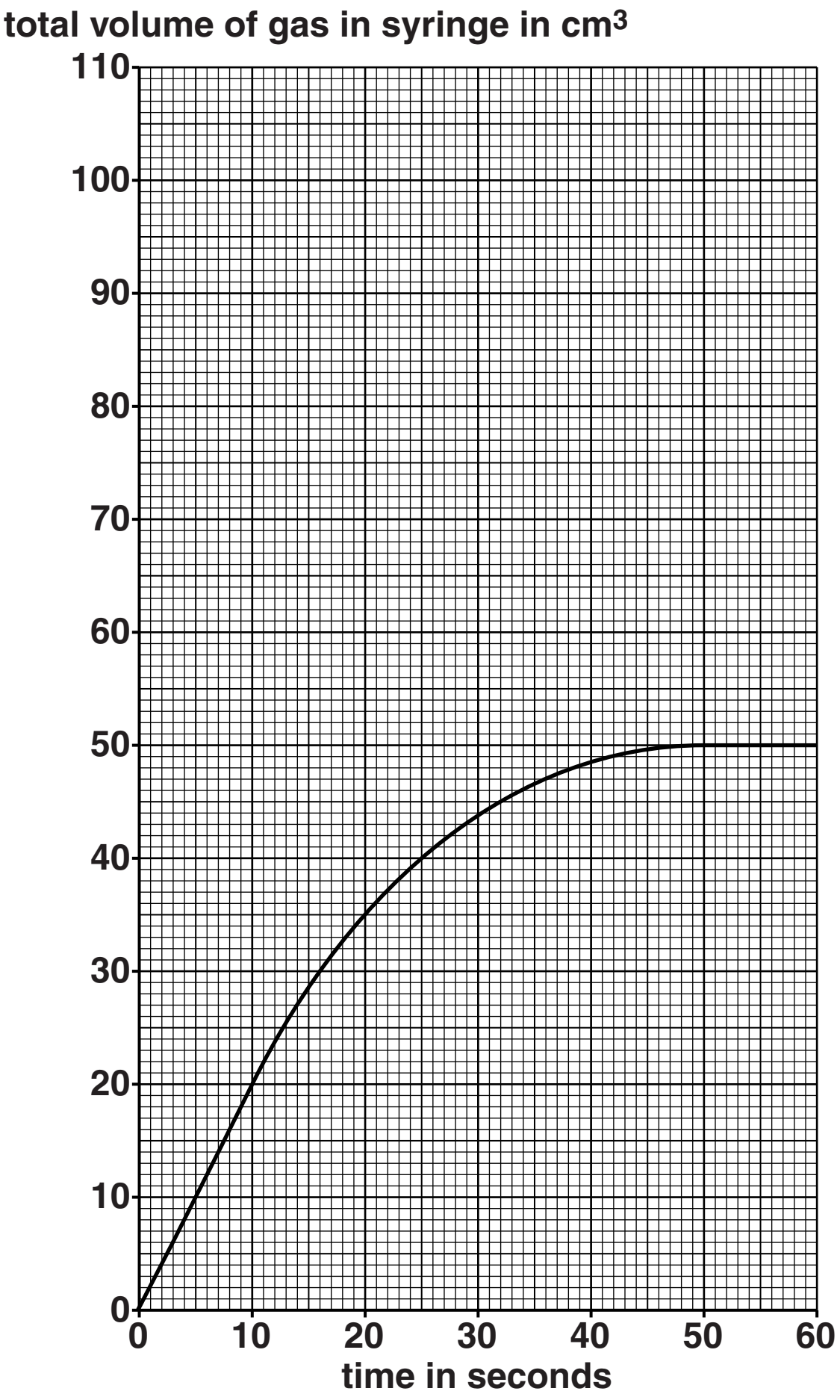
(iii) Hilary repeats the experiment.

She uses the same mass of magnesium and the same volume and concentration of acid.

This time she uses magnesium POWDER.

On the GRID sketch the curve she gets. [2]

[TOTAL: 6]


total volume of gas in syringe in cm3
110
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
time in seconds

11 Magnesium sulfate and magnesium nitrate are both used as fertilisers.

(a) Magnesium sulfate can be made in industry by a CONTINUOUS process.

Explain why batch processes are used to make some pharmaceutical drugs but continuous processes are used to make fertilisers.

_____

_____

_____ **[2]**

(b) Magnesium nitrate is made by a neutralisation reaction.

Look at the equation for the reaction.

$$2HNO_3 + MgO \rightarrow Mg(NO_3)_2 + H_2O$$

Water is a waste product.

Show that the atom economy for the reaction is 89% and explain why it is important that the atom economy for a reaction is as high as possible.

The relative atomic masses (A_r) for H = 1, N = 14, O = 16 and Mg = 24.

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

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____ **[6]**

[TOTAL: 8]

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12 This question is about energy changes during chemical reactions.

(a) Cold packs are used to treat sports injuries.

A cold pack REDUCES the temperature of the injured part of the body.

An endothermic reaction happens when the chemicals in the cold pack react.

Energy is absorbed when bonds break.

Explain, in terms of bonds between atoms, why this reaction is ENDOTHERMIC.

_____

_____

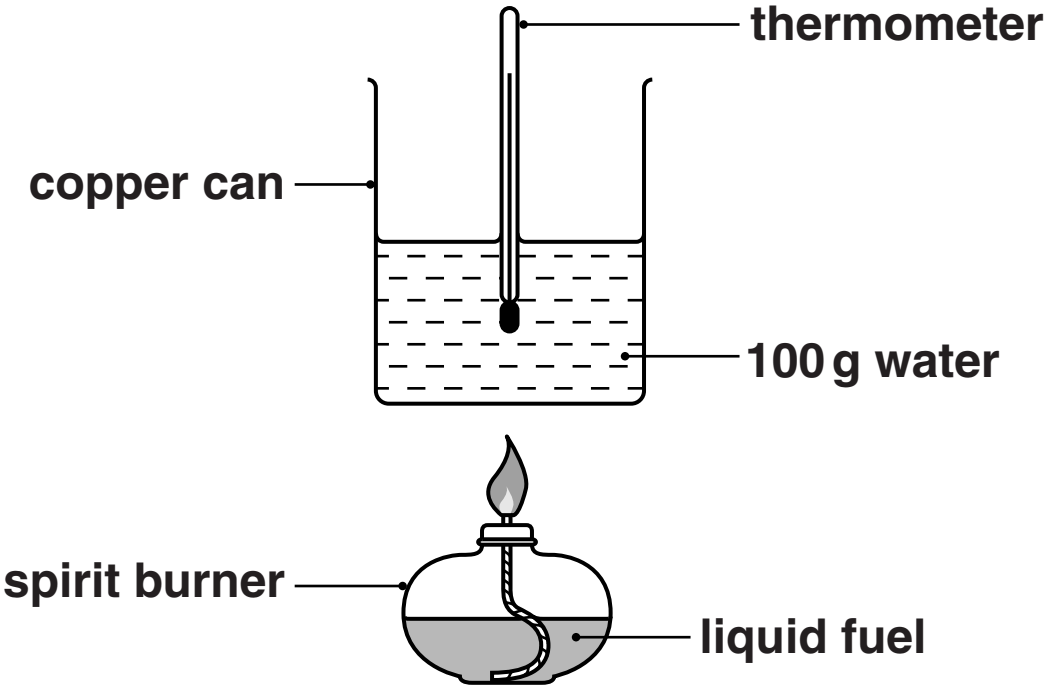
_____

_____ **[2]**

(b) Aimee and Luke investigate four liquid fuels.

They burn an amount of each liquid fuel.

Look at the diagram. It shows the apparatus they use.



Look at the table. It shows their results.

Liquid fuel	Mass of fuel burnt in g	Temperature at start in °C	Temperature at end in °C
ethanol	2.2	20	40
methylated spirits	2.4	21	39
paraffin	1.9	22	45
propanol	2.1	22	44

(i) Calculate the energy transferred by ETHANOL.

ENERGY TRANSFERRED = MASS × SPECIFIC HEAT CAPACITY × TEMPERATURE CHANGE

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

_____

_____

_____

answer _____ J [2]

(ii) Aimee thinks PARAFFIN gives out the MOST energy per gram.

Use the results to show that she is correct.

_____

_____

_____ **[2]**

[TOTAL: 6]

END OF QUESTION PAPER

The Periodic Table of the Elements

1	2											3	4	5	6	7	0
							1 **H** hydrogen 1										4 **He** helium 2
7 **Li** lithium 3	9 **Be** beryllium 4											11 **B** boron 5	12 **C** carbon 6	14 **N** nitrogen 7	16 **O** oxygen 8	19 **F** fluorine 9	20 **Ne** neon 10
23 **Na** sodium 11	24 **Mg** magnesium 12											27 **Al** aluminium 13	28 **Si** silicon 14	31 **P** phosphorus 15	32 **S** sulfur 16	35.5 **Cl** chlorine 17	40 **Ar** argon 18
39 **K** potassium 19	40 **Ca** calcium 20	45 **Sc** scandium 21	48 **Ti** titanium 22	51 **V** vanadium 23	52 **Cr** chromium 24	55 **Mn** manganese 25	56 **Fe** iron 26	59 **Co** cobalt 27	59 **Ni** nickel 28	63.5 **Cu** copper 29	65 **Zn** zinc 30	70 **Ga** gallium 31	73 **Ge** germanium 32	75 **As** arsenic 33	79 **Se** selenium 34	80 **Br** bromine 35	84 **Kr** krypton 36
85 **Rb** rubidium 37	88 **Sr** strontium 38	89 **Y** yttrium 39	91 **Zr** zirconium 40	93 **Nb** niobium 41	96 **Mo** molybdenum 42	[98] **Tc** technetium 43	101 **Ru** ruthenium 44	103 **Rh** rhodium 45	106 **Pd** palladium 46	108 **Ag** silver 47	112 **Cd** cadmium 48	115 **In** indium 49	119 **Sn** tin 50	122 **Sb** antimony 51	128 **Te** tellurium 52	127 **I** iodine 53	131 **Xe** xenon 54
133 **Cs** caesium 55	137 **Ba** barium 56	139 **La*** lanthanum 57	178 **Hf** hafnium 72	181 **Ta** tantalum 73	184 **W** tungsten 74	186 **Re** rhenium 75	190 **Os** osmium 76	192 **Ir** iridium 77	195 **Pt** platinum 78	197 **Au** gold 79	201 **Hg** mercury 80	204 **Tl** thallium 81	207 **Pb** lead 82	209 **Bi** bismuth 83	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **Rn** radon 86
[223] **Fr** francium 87	[226] **Ra** radium 88	[227] **Ac*** actinium 89	[261] **Rf** rutherfordium 104	[262] **Db** dubnium 105	[266] **Sg** seaborgium 106	[264] **Bh** bohrium 107	[277] **Hs** hassium 108	[268] **Mt** meitnerium 109	[271] **Ds** darmstadtium 110	[272] **Rg** roentgenium 111	Elements with atomic numbers 112-116 have been reported but not fully authenticated						

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

**** The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.***

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.

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