Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel Level 1/Level 2 GCSE (9–1)

Tuesday 13 June 2023

Morning (Time: 1 hour 10 minutes)

Paper reference **1SC0/2CH**

Combined Science

PAPER 5

Higher Tier

You must have:
Calculator, ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- Calculators may be used.
- Any diagrams may NOT be accurately drawn, unless otherwise indicated.
- You must **show all your working out** with **your answer clearly identified** at the **end of your solution**.

Information

- The total mark for this paper is 60.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*
- In questions marked with an **asterisk** (*), marks will be awarded for your ability to structure your answer logically, showing how the points that you make are related or follow on from each other where appropriate.
- There is a periodic table on the back cover of the paper.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

P72563A

N:1/1/1/

P 7 2 5 6 3 A 0 1 2 0

Pearson

Answer ALL questions. Write your answers in the spaces provided.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 A student used the apparatus shown in Figure 1 to investigate the reaction between marble chips and dilute hydrochloric acid.

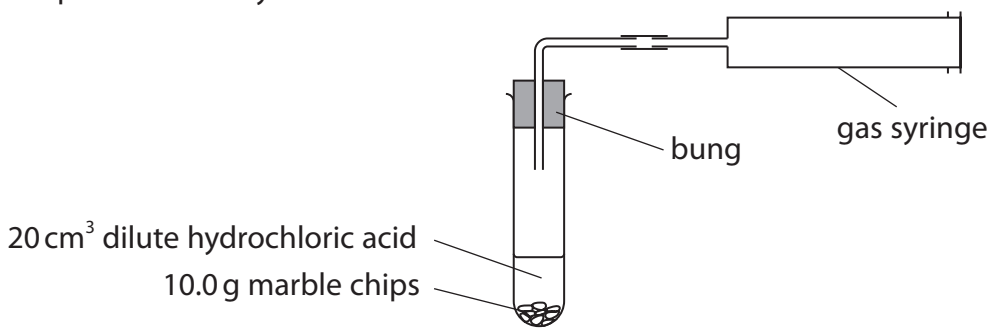


Figure 1

The student recorded the volume of gas every minute as shown in Figure 2.

time in minutes	0	1	2	3	4	5	6
volume of gas in cm³	0	52	78	91	97	100	100

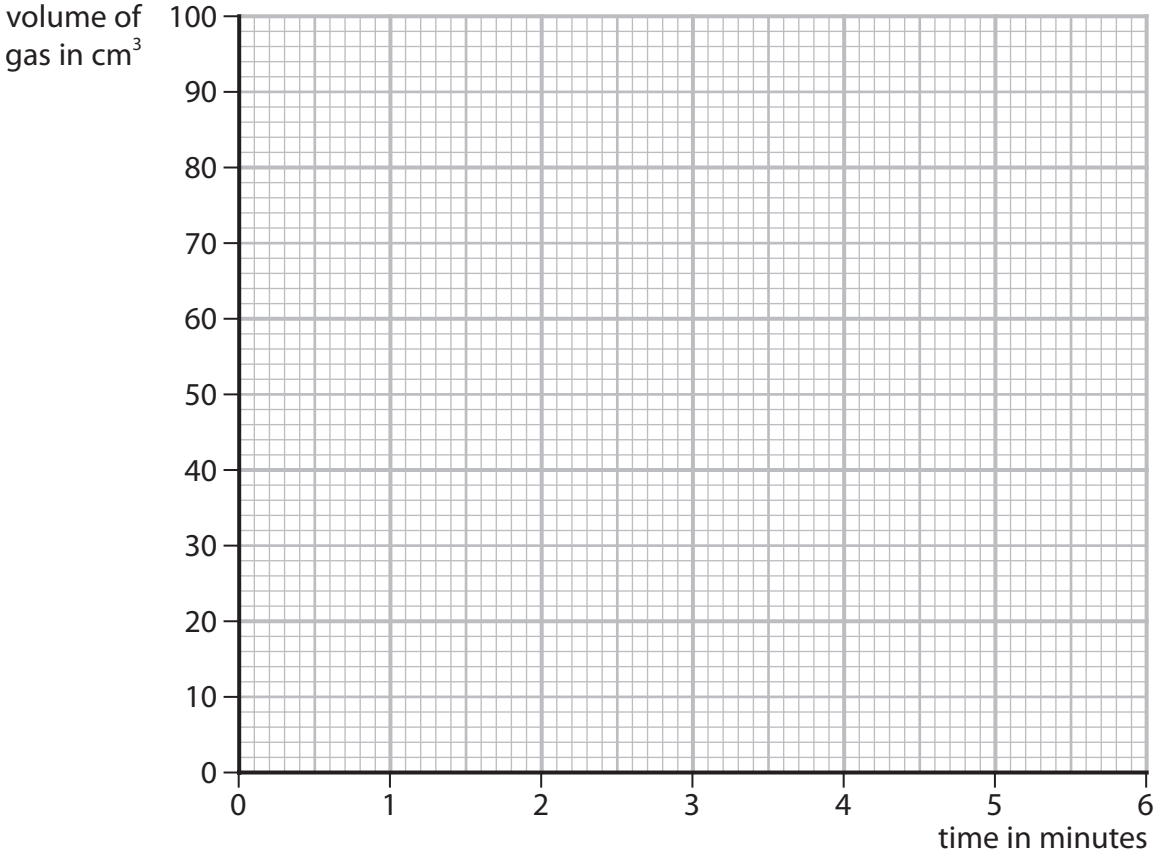
Figure 2

(a) On the grid, plot the results shown in Figure 2.

Draw a curve of best fit.

6 or 7 points plotted correctly (2)
or
4 or 5 points plotted correctly (1)
best fit curve starting at (0,0)

(3)



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(b) Rate of reaction can be calculated using

$$\text{rate of reaction} = \frac{\text{volume of gas produced in 1 minute}}{\text{1 minute}}$$

Figure 3 shows the rates of reaction calculated from the results of this experiment.

The rate of reaction for the time interval 2 to 3 minutes is missing.

time interval	0 to 1 minute	1 to 2 minutes	2 to 3 minutes	3 to 4 minutes	4 to 5 minutes
rate of reaction in $cm^3\ min^{-1}$	52	26		6	3

Figure 3

(i) Calculate the rate of reaction for the time interval 2 to 3 minutes.

(1)

rate of reaction = 13 $cm^3\ min^{-1}$

(ii) State and explain what happens to the rate of reaction as the acid reacts with the marble chips in this experiment.

(3)

rate of reaction decreases / reaction is slower
• as {reactants /acid/ marble chips} are used up
• so less frequent collisions

(c) The student repeated the experiment using the same volume of acid and the same mass of marble chips but used smaller marble chips.

All other conditions remained the same.

The student found that the reaction with the smaller marble chips was faster to start with but produced the same volume of gas.

Using this information, draw a line on the grid to show the results for the reaction with the smaller marble chips.

Label this line 'C'.

initial line steeper and to the left
• line levelling off at 100 cm3 before 5 minutes

(2)

(Total for Question 1 = 9 marks)

2 Figure 4 shows some information about the group 1 metals.

group 1 metal	atomic number	relative atomic mass
lithium	3	7
sodium	11	23
potassium	19	39
rubidium	37	85
caesium	55	133

Figure 4

(a) Explain, in terms of their electronic configurations, why these metals are placed in group 1 of the periodic table.

(2)

• 1 electron
• in outer shell(s)

(b) Which row shows two correct properties of group 1 metals?

(1)

		properties of group 1 metals	
☒	**A**	compounds are white in colour	high density
☒	**B**	low melting points	compounds are blue in colour
☒	**C**	soft enough to be cut by a knife	low melting points
☒	**D**	high density	conduct electricity

(c) The word equation for the reaction of potassium with bromine is

potassium + bromine → potassium bromide

Add the missing state symbol and balance the equation for this reaction.

(2)

2 K(s) + Br_2(g) → 2 KBr(s)

(d) A sample of potassium contains three isotopes, potassium-39, potassium-40 and potassium-41.

(i) Explain the meaning of the term **isotopes**.

(2)

atoms) {of same element / with same number of protons} / all contain 19 protons / same atomic number
• different number of neutrons / different mass number / have 20, 21, 22 neutrons

(ii) This sample of potassium contains

93.25% potassium-39

0.02% potassium-40

6.73% potassium-41

Calculate the relative atomic mass of this sample of potassium.

(2)

39.1348/39.135/ 39.13/ 39.1 with or without working scores 2
93.25 x 39 + 40 x 0.02 + 6.73 x 41 = 3913.48
3913.48 = 39.1348
100

relative atomic mass = ...

(Total for Question 2 = 9 marks)

3 (a) Figure 5 shows the percentage of three gases, **X**, **Y** and **Z**, in the Earth's early atmosphere.

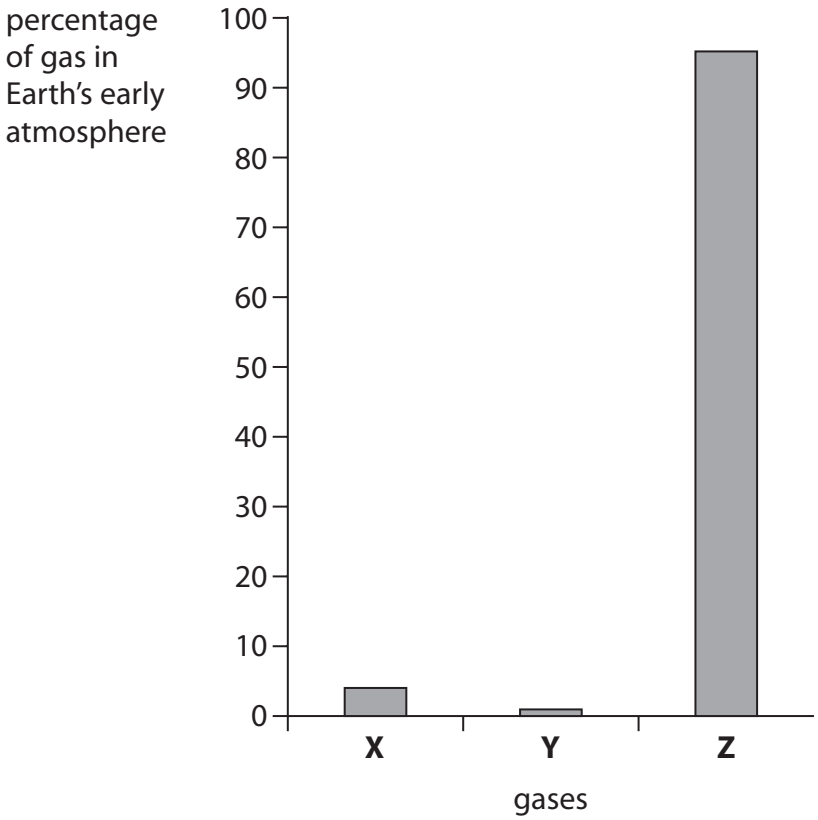

Figure 5

What is the name of gas **Z**?

(1)

- ☒ **A** argon
- ☒ **B** carbon dioxide
- ☒ **C** nitrogen
- ☒ **D** oxygen

(b) It is thought that small quantities of hydrogen sulfide, H_2S, were also in the Earth's early atmosphere.

Draw the dot and cross diagram for a molecule of hydrogen sulfide.

Show outer electrons only.

(2)

(c) Acid rain is caused by some pollutant gases present in the atmosphere.

Explain how impurities in fossil fuels can result in acid rain.

(3)

• sulfur/ S (is present as an impurity)
• (when fuel burns) {impurity/sulfur} is {burned/ combusted/ oxidised/ reacts with oxygen}
• sulfur dioxide/ SO2 (formed)

(d) A student investigates the effect of acid rain on cress plants.

The student uses this method.

step 1 grow 20 cress plants in each of two dishes, **A** and **B**

step 2 water the cress plants in dish **A** with 10 cm^3 of dilute hydrochloric acid with a pH of 2

step 3 water the cress plants in dish **B** with 10 cm^3 of pure water with a pH of 7

step 4 repeat steps 2 and 3 every day for one week

step 5 count how many plants are still alive after one week.

(i) State what piece of equipment the student could use to measure the pH of each liquid.

(1)

Ph meter

(ii) Explain **one** improvement that the student could make to the method to make the results more valid.

(2)

use {sulfuric / sulfurous} acid (rather than hydrochloric acid)
• because acid rain contains {sulfuric / sulfurous} acid / does not contain hydrochloric acid

(Total for Question 3 = 9 marks)

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4 Chlorine gas can be prepared by reacting concentrated hydrochloric acid with solid potassium manganate(VII).

Figure 6 shows the apparatus used.

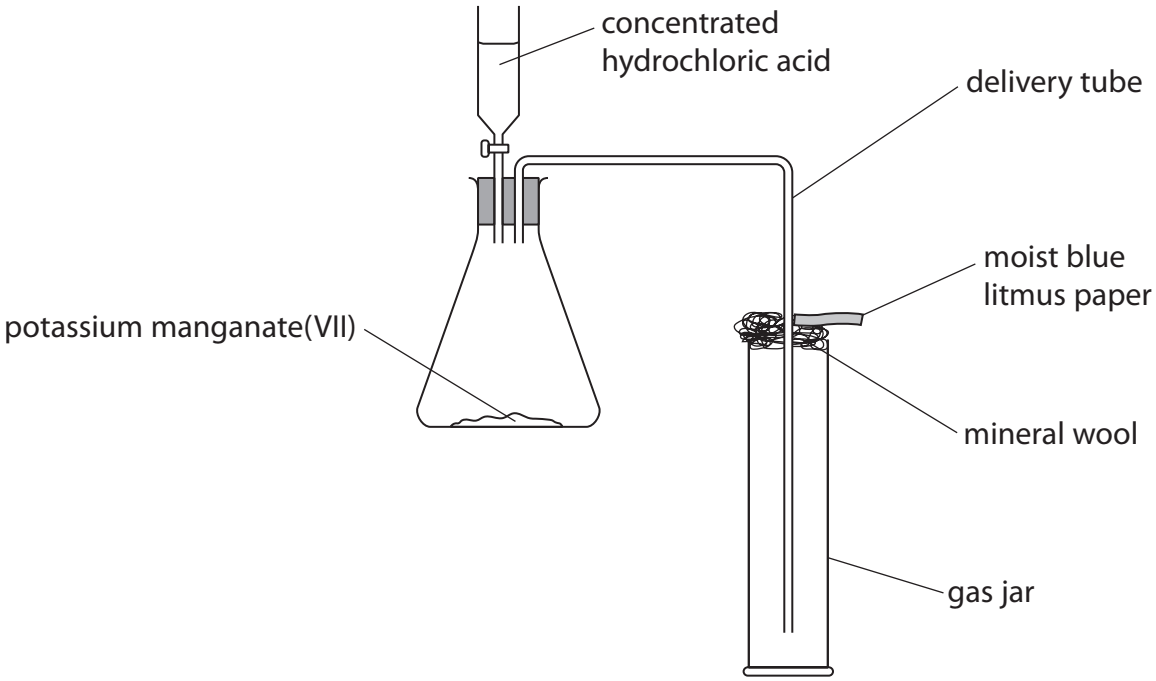


Figure 6

(a) Figure 7 shows the hazard symbols for concentrated hydrochloric acid, potassium manganate(VII) and chlorine gas.

substance	hazard symbol
concentrated hydrochloric acid	
potassium manganate(VII)	
chlorine gas	

Figure 7

Use the information in Figure 7 to help you answer (a)(i) and (a)(ii).

(i) What are the hazards associated with potassium manganate(VII)?

(1)

- ☒ **A** flammable, harmful and corrosive
- ☒ **B** flammable, toxic and hazardous to the environment
- ☒ **C** oxidising, harmful and hazardous to the environment
- ☒ **D** oxidising, toxic and corrosive

(ii) Explain **one** precaution that should be taken when preparing the sample of chlorine gas.

(2)

precaution

use a fume cupboard

reason

• because (chlorine/it) is a toxic gas

(b) State the purpose of the delivery tube.

(1)

so {gas / chlorine} moves (from flask) to gas jar

(c) Suggest why damp blue litmus is placed at the top of the gas jar.

(2)

chlorine will turn the damp litmus paper (red then) white / bleached

• so that you can see when the jar is full

(d) In the reaction, potassium manganate(VII), $KMnO_4$, reacts with hydrochloric acid to form manganese chloride, $MnCl_2$, potassium chloride, chlorine and water.

Write the balanced equation for the reaction.

(3)

$2KMnO4 + 16HCl \rightarrow 2MnCl2 + 2KCl + 5Cl2 + 8H2O$

all 6 formulae on correct sides of arrow

4 or 5 formulae on correct sides of arrow

balancing of correct formulae only

(Total for Question 4 = 9 marks)

5 Ammonia can be produced from the reaction of hydrogen with nitrogen.

(a) What is the percentage by mass of nitrogen in ammonia, NH_3?

(relative atomic masses: H = 1.0, N = 14)

(1)

- ☒ **A** 18%
- ☒ **B** 42%
- ☒ **C** 51%
- ☒ **D** 82%

(b) The reaction between hydrogen and nitrogen is exothermic.

Figure 8 shows the reaction profile of this exothermic reaction.

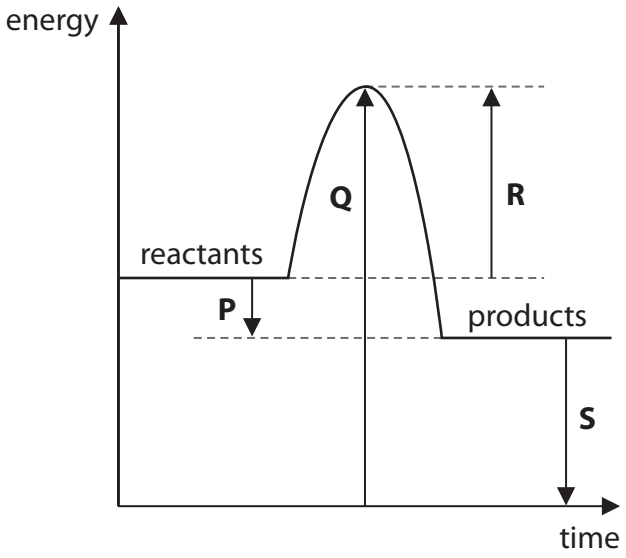


Figure 8

(i) Which arrow represents the activation energy for the reaction?

(1)

- ☒ **A** arrow **P**
- ☒ **B** arrow **Q**
- ☒ **C** arrow **R**
- ☒ **D** arrow **S**

(ii) Describe what the reaction profile shows about the energy involved in bond breaking and bond making in this reaction.

(2)

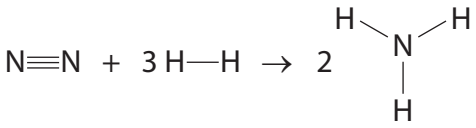
any two for 1 mark
all three for 2 marks
• energy is taken in breaking bonds
(in the reactants)
• energy is given out making bonds
(in the products)
• more energy is given out than
taken in

(iii) Figure 9 shows the energies of some bonds.

bond	bond energy in kJ mol^{-1}
N≡N	944
H—H	436
H—N	388

Figure 9

The equation for the reaction between nitrogen and hydrogen to form ammonia is



Calculate the energy change, in kJ mol^{-1}, for this reaction.

(4)

-76 with or without working scores 4
BROKEN
944 + (3 x 436) = 2252
MADE
2 x (3x388) = 2328
DIFFERENCE
(broken) 2252 – (made) 2328
ANSWER
= - 76 (1)

energy change = ... kJ mol^{-1}

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(c) Ammonia, NH_3, and silicon dioxide, SiO_2, are both compounds that are made of two non-metallic elements.

Ammonia has a boiling point of –33 °C.
Silicon dioxide has a boiling point of 2230 °C.

Explain why the boiling points of ammonia and silicon dioxide are so different.

(3)

AMMONIA
ammonia {is simple molecular / has weak intermolecular forces}
SILICON DIOXIDE
silicon dioxide is {giant covalent / has strong covalent bonds} (1)
DIFFERENCE
more {heat / energy} to break bonds in silicon dioxide than intermolecular forces in ammonia

(Total for Question 5 = 11 marks)

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6 Crude oil is a mixture of hydrocarbons.

Crude oil can be separated into useful fractions by the process of fractional distillation in a fractionating column.

(a) Figure 10 shows a fractionating column, the fractions obtained and the trend in viscosity of the fractions.

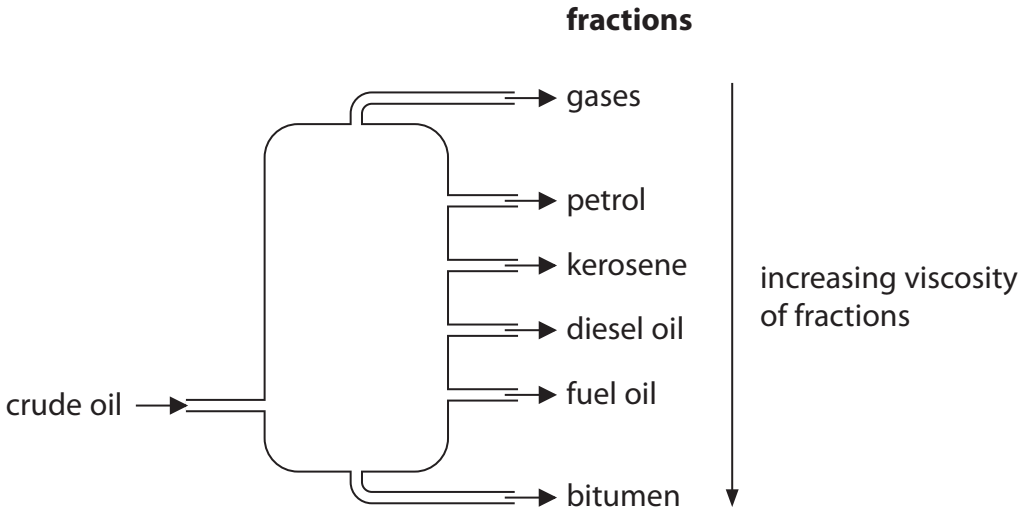

Figure 10

(i) Which row shows the correct uses for bitumen, diesel oil and fuel oil?

(1)

		bitumen	diesel oil	fuel oil
☒	**A**	fuel for large ships	surfacing roads	fuel for trains
☒	**B**	fuel for large ships	fuel for trains	surfacing roads
☒	**C**	surfacing roads	fuel for trains	fuel for large ships
☒	**D**	surfacing roads	fuel for large ships	fuel for trains

(ii) Explain the trend in the viscosity of the fractions.

(2)

• (viscosity increases down the column) as molecules are {larger/ longer/ more carbons}
• because there are stronger {intermolecular forces / forces between molecules}

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(b) Hydrocarbon **X** was cracked to form one molecule of hexane, C_6H_{14}, and one molecule of alkene **Y**.

$$\mathbf{X} \rightarrow C_6H_{14} + \mathbf{Y}$$

The relative formula mass of **Y** is 56.
The empirical formula of **Y** is CH_2.

Deduce the molecular formula of hydrocarbon **X**.

Show your working.

(relative atomic masses: H = 1.0, C = 12)

(4)

Mr of CH2 = 12 + (2x1) = 14
56 = 4
14
formula of Y = 4 x CH2 = C4H8
formula of X = (C6H14 + C4H8 =) C10H22

molecular formula of **X** = ...

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*(c) Large quantities of methane are used as a fuel.

Figure 11 shows a Bunsen burner.

Methane can be used as fuel for the Bunsen burner.

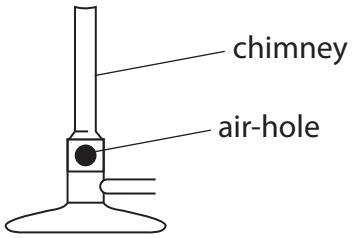

Figure 11

The air-hole on the chimney of the Bunsen burner can be opened and closed.

Explain the effect of opening and closing the air-hole of the Bunsen burner on the products of combustion of methane and the harm that using large quantities of methane as a fuel can cause.

(6)

Ignore any issues with methane itself e.g. it is a greenhouse gas.
Ignore different colours of flame with open/ closed air hole.
OPEN AIR-HOLE
• air-hole open, allows lots of oxygen to mix with methane
• therefore complete combustion takes place
• $CH_4 + 2O_2 \rightarrow 2H_2O + CO_2$
• carbon dioxide and water are produced.
CLOSED AIR-HOLE
• air-hole closed, less oxygen can enter to mix with methane
• therefore incomplete combustion takes place
• e.g $2CH_4 + 3O_2 \rightarrow 2CO + 4H_2O$ (allow other correct examples)
• carbon monoxide can be produce
HARMFUL EFFECTS
• CO is odourless and colourless
• carbon monoxide combines with haemoglobin in place of oxygen/ reduces capacity of blood for oxygen
• therefore toxic
• carbon/ soot can also be produced
• can aggravate asthma / respiratory problems
• soot makes buildings dirty
• carbon dioxide and water are greenhouse gases
• absorb heat energy radiated from Earth which is re-radiated back into the atmosphere
• increases greenhouse effect
• causes global warming/ climate change
• melt polar ice caps / sea levels rise

(Total for Question 6 = 13 marks)

TOTAL FOR PAPER = 60 MARKS

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

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

**** The elements with atomic numbers from 58 to 71 are omitted from this part of the periodic table.***

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