Write your name here

Surname	Other names

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

Centre Number | Candidate Number

Chemistry

Paper 2

Higher Tier

Wednesday 13 June 2018 – Morning
Time: 1 hour 45 minutes

Paper Reference
1CH0/2H

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 100.
- 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.
- A periodic table is printed on the back cover of this 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 ▶

P52471A

1/1/1/1/1/1/

P 5 2 4 7 1 A 0 1 3 2

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 The Earth's atmosphere contains several gases.

(a) Figure 1 shows the relative amounts of gases thought to be in the Earth's early atmosphere.

gas	relative amount in Earth's early atmosphere
oxygen	small
carbon dioxide	large
nitrogen	small
water vapour	large

Figure 1

The amount of water vapour in today's atmosphere is much less than the amount in the Earth's early atmosphere.

Explain why the amount of water vapour in the atmosphere has decreased.

(2)

....

....

....

....

(b) The apparatus shown in Figure 2 is used to find the percentage of oxygen in dry air.

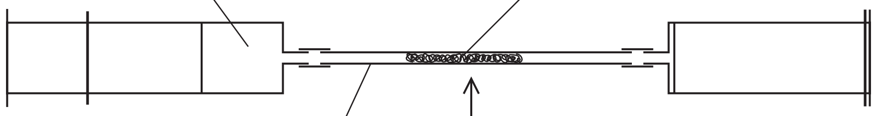


Figure 2

Syringe A contains 50 cm^3 of dry air and syringe B contains no air.
The copper in the glass tube is heated strongly.
The air in the apparatus is passed backwards and forwards over the copper until all the oxygen has been removed.

(i) The following results were obtained

initial volume of air in apparatus = 50 cm^3

final volume of gas in apparatus = 40 cm^3

Calculate the percentage of oxygen in this sample of dry air.

(2)

....

....

....

percentage oxygen in the air = ...

(ii) At the end of the experiment, the apparatus and its contents are allowed to cool before the final volume of gas is measured.

(1)

The apparatus and its contents must be allowed to cool because

☒ **A** reading the volume while the apparatus is hot is dangerous

☒ **B** the glass tube may crack when it is hot and allow air into the apparatus

☒ **C** the gas has expanded when it is hot

☒ **D** the copper reacts with other gases in the air when it is hot

(c) The Earth's earliest rocks contained iron sulfide and no iron oxide.
Later the rocks contained iron oxide as well as iron sulfide.

Explain what happened to allow this change to occur.

(2)

....

....

....

....

....

(Total for Question 1 = 7 marks)

BLANK PAGE

2 (a) A chlorine atom contains 17 electrons, 18 neutrons and 17 protons.

(i) State the mass number of this chlorine atom.

(1)

....

(ii) Give the electronic configuration of this chlorine atom.

(1)

....

(b) Describe what you would **see** if damp, blue litmus paper is placed into chlorine gas.

(2)

....

....

....

....

(c) Chlorine exists as diatomic molecules.

In a molecule, two chlorine atoms are joined by a covalent bond.

(i) Describe what is meant by a **covalent bond**.

(2)

....

....

....

(ii) Explain why chlorine is a gas, rather than a liquid, at room temperature.

(2)

....

....

....

....

DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA

(d) When the gas hydrogen chloride, HCl, is dissolved in water, a solution forms.
Blue litmus paper dipped in this solution turns red.

State why the litmus paper turns red.

(1)

....

....

(Total for Question 2 = 9 marks)

3 Lithium, sodium and potassium are reactive metals in group 1 of the periodic table.

(a) Sodium metal tarnishes in air to form a layer of sodium oxide on its surface. 0.92 g of sodium combined with 0.32 g of oxygen in this oxide.

Calculate the empirical formula of this sodium oxide.
(relative atomic masses: O = 16, Na = 23)

You must show your working.

(3)

....

....

....

....

....

....

empirical formula of sodium oxide = ...

(b) Sodium reacts with water to form sodium hydroxide solution and hydrogen.

Complete the balancing of the equation for this reaction and add the state symbols for each substance.

(3)

$$\ldots\ldots Na(\ldots\ldots) + 2H_2O(\ldots\ldots) \rightarrow \ldots\ldots NaOH(\ldots\ldots) + H_2(\ldots\ldots)$$

(c) In an experiment equal-sized pieces of lithium, sodium and potassium are added to separate samples of water.

A flame is produced only with potassium because potassium

(1)

☒ **A** is the softest metal

☒ **B** has the lowest melting point

☒ **C** is the most reactive

☒ **D** is the only flammable metal

(d) Explain, in terms of electronic configurations, the increase in reactivity from lithium to sodium to potassium.

(2)

....

....

....

....

....

....

(Total for Question 3 = 9 marks)

4 Ethanol can be used as a liquid fuel.

A student investigates how much heat energy is released when a known mass of ethanol is burned.

The apparatus is set up as shown in Figure 3.

A known volume of water is placed in a metal can.
The temperature of the water is measured.
The ethanol is ignited and placed under the beaker so that the flame is touching the beaker.
The water is heated by the flame.
The flame is extinguished.
The final temperature of the water is measured.

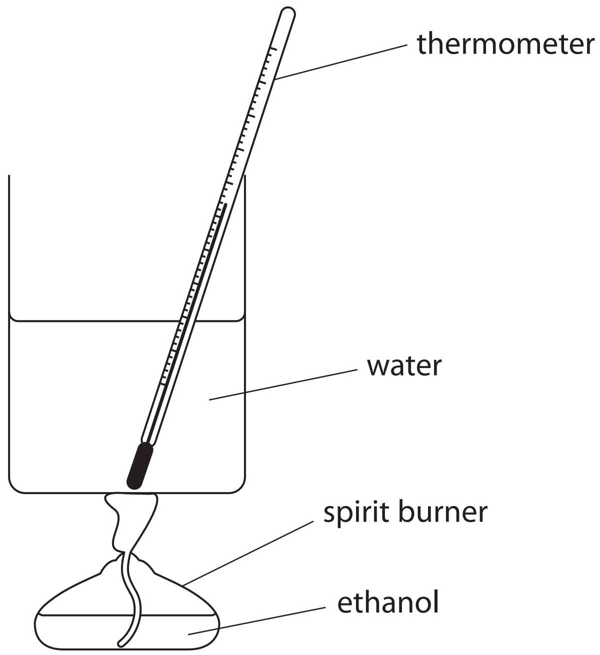


Figure 3

(a) The theoretical temperature rise for burning a given mass of ethanol is 82.4 °C.

In the experiment the actual temperature rise for burning this mass of ethanol was only 34.8 °C.
One reason why the temperature rise is less than expected is that the ethanol does not burn completely.

(i) Give a reason why, even if the ethanol burns completely, the actual temperature rise is much less than the theoretical value.

(1)

....

(ii) Explain how the method described above could be improved to give a temperature rise closer to the theoretical value.

(2)

....

....

....

....

(iii) The amount of heat energy used to raise the temperature of the water by 34.8 °C can be calculated using

heat energy = 210 × temperature rise

Calculate the amount of heat energy used.

(2)

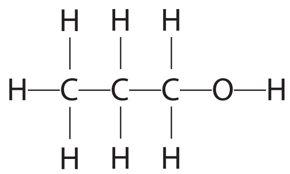
....

....

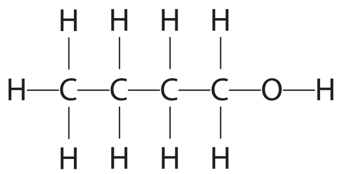
....

heat energy = ... (energy units)

(b) Propanol and butanol are both members of the same homologous series as ethanol.



propanol



butanol

Propanol and butanol can also be burned in the apparatus shown in Figure 3.

Give **three** reasons why ethanol, propanol and butanol are members of the same homologous series.

(3)

reason 1 ....

....

reason 2 ....

....

reason 3 ....

....

(c) Ethanol can oxidise when exposed to air to produce ethanoic acid and water. Propanol can also oxidise in a similar reaction when it is exposed to air.

(i) Write the word equation for the reaction when **propanol** oxidises when it is exposed to air.

(2)

....

....

(ii) What is the formula of the functional group in carboxylic acids?

(1)

☒ **A** –OH

☒ **B** $-CH_3$

☒ **C** –COOH

☒ **D** $-CO_2$

(Total for Question 4 = 11 marks)

5 (a) Figure 4 shows information about a ceramic and a metal.

	ceramic	**metal**
flexibility	low	high
hardness	medium	low
reaction with water	no reaction	very slow reaction
density	medium	high

Figure 4

The ceramic, rather than the metal, is a more suitable material for washbasins.

Give a reason for this, using a property from Figure 4.

(1)

....

....

....

(b) Poly(propene) is an example of a polymer.

The structure of a poly(propene) molecule is shown in Figure 5.

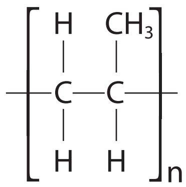


Figure 5

This polymer is made from a monomer.

Draw the structure of the monomer molecule showing all covalent bonds.

(2)

(c) A layer of poly(chloroethene) (PVC) is used to surround the copper in electrical cables.

Explain why poly(chloroethene) is a suitable material for this purpose.

(2)

....

....

....

(d) Some polymers are polyesters.

What type of reaction takes place when polyesters are formed?

(1)

☒ **A** addition

☒ **B** condensation

☒ **C** neutralisation

☒ **D** precipitation

DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA

(e) The repeating unit in a polyester molecule is shown in Figure 6.

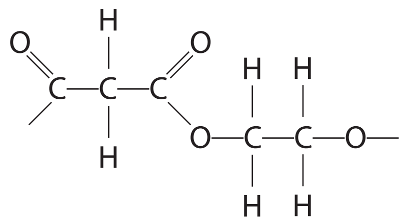


Figure 6

(i) This polymer is made from two different monomers.

Draw a molecule of each monomer showing all covalent bonds.

(2)

(ii) Give the name or formula of the small molecule formed when the monomer molecules react to form an ester link.

(1)

....

(Total for Question 5 = 9 marks)

6 Crude oil is a complex mixture of substances.

(a) Crude oil can be separated into useful fractions by fractional distillation.

Figure 7 shows a fractional distillation column and the fractions produced when a sample of crude oil is distilled.

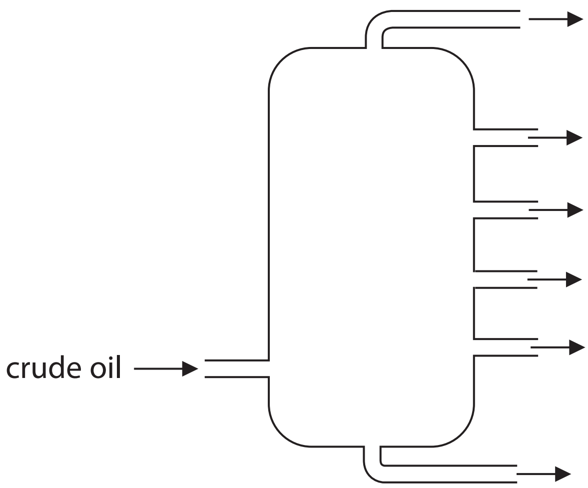


Figure 7

The properties of these fractions vary from the top of the column to the bottom of the column.

Which of the following is a trend in a property of the fractions obtained from the top of the column to those obtained from the bottom?

(1)

☒ **A** the average number of carbon atoms in molecules present decreases

☒ **B** the ease of ignition increases

☒ **C** the boiling points decrease

☒ **D** the viscosities increase

(b) Most of the substances in crude oil are alkanes.

(i) Which of the following is the general formula of an alkane?

(1)

☒ **A** C_nH_{2n}

☒ **B** C_nH_{2n+1}

☒ **C** C_nH_{2n-1}

☒ **D** C_nH_{2n+2}

(ii) Explain why alkanes are described as hydrocarbons.

(2)

....

....

....

....

(c) Figure 8 shows a graph of the boiling points of some alkanes against the number of carbon atoms in one molecule of each alkane.

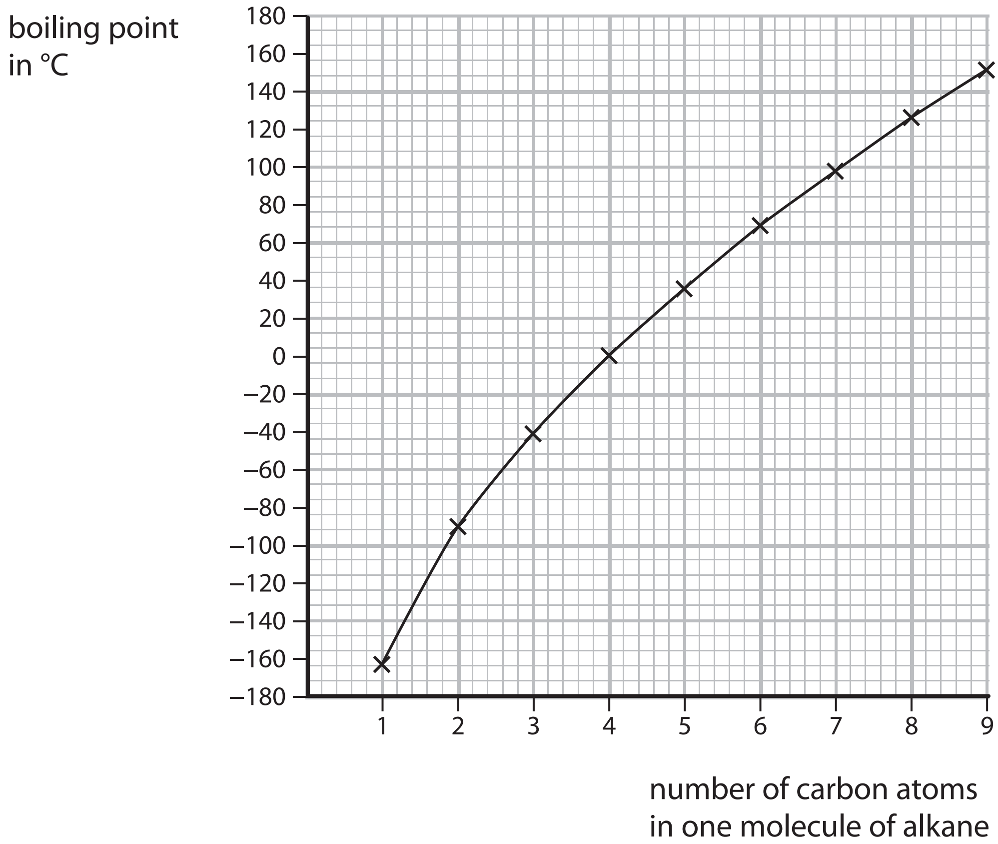


Figure 8

Explain the pattern shown by this graph.

(2)

....

....

....

....

....

(d) When crude oil is separated into fractions, the amount of each fraction obtained rarely matches the demand for that fraction.

Figure 9 shows the relative amounts of six of the fractions present in a crude oil and the relative demand for each of these fractions.

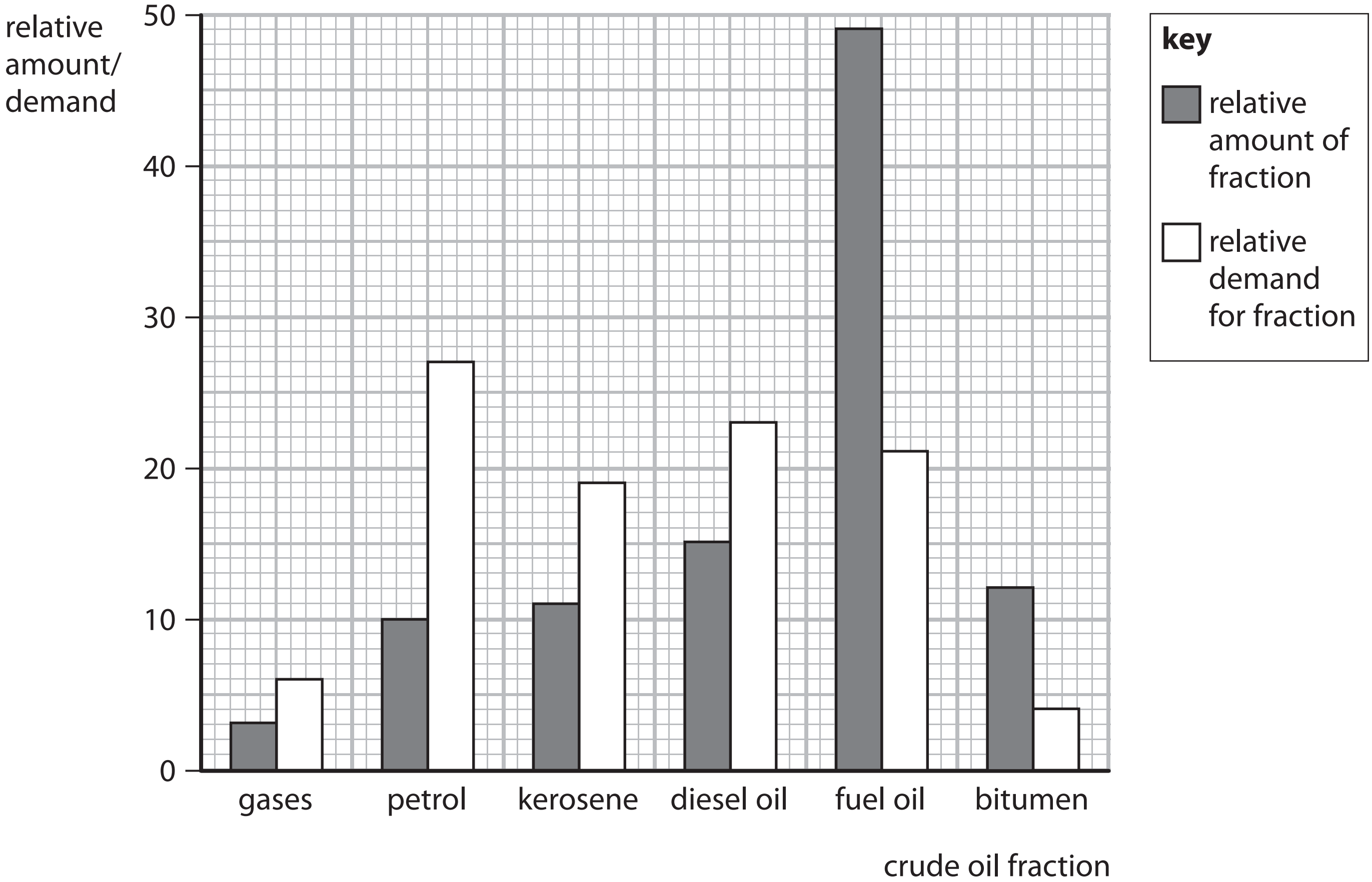


Figure 9

Cracking is used to match the relative amount of a fraction of crude oil to the demand for that fraction.

(i) Use the information in Figure 9 to give the name of the fraction that is most likely to need to be cracked.

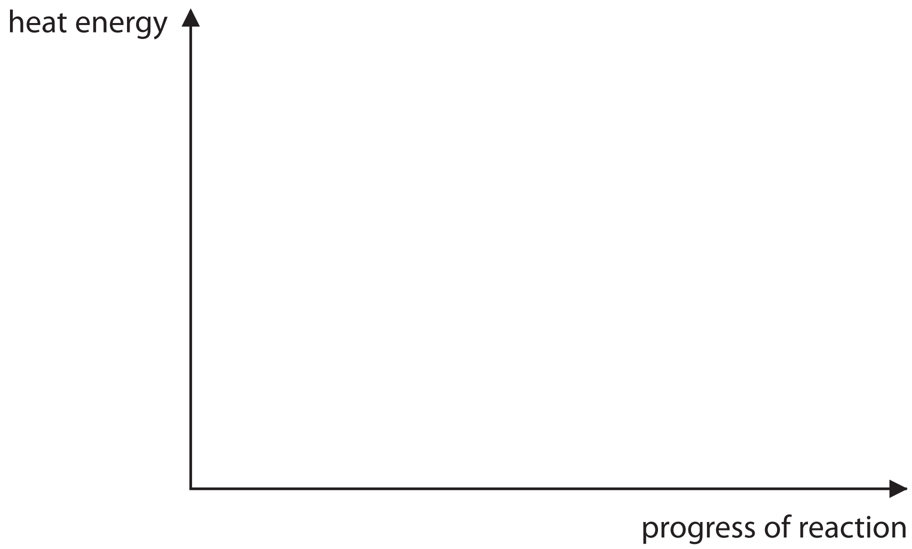
(1)

....

(ii) In a cracking reaction, reactants are heated to form products.
This reaction is endothermic.

On the axes provided, draw the reaction profile of this reaction.
Label the energy of the reactants, the energy of the products and the activation energy of the reaction.

(3)



(iii) Dodecane, $C_{12}H_{26}$, can be cracked to form useful products.

Complete the equation for the cracking of dodecane by filling in the formula of the single molecule needed to balance the equation.

(1)

$$C_{12}H_{26} \rightarrow \text{..........................} + 3C_2H_4$$

(Total for Question 6 = 11 marks)

7 (a) Describe what is **seen** when chlorine water is added to potassium bromide solution and the mixture shaken.

(2)

....

....

....

....

(b) Chlorine reacts with potassium bromide to form potassium chloride and bromine. In this reaction chlorine forms chloride ions

$$Cl_2 + 2KBr \rightarrow 2KCl + Br_2$$

(i) In this reaction, chlorine has been reduced.

Explain, using the equation, how you know that chlorine has been reduced.

(2)

....

....

....

....

....

....

(ii) Write the half equation for the formation of bromine from bromide ions.

(2)

....

....

(c) Aluminium reacts with chlorine to form aluminium chloride.

Write the balanced equation for this reaction.

(3)

....

(d) A solid ionic compound is dissolved in water to form a solution.

Describe a simple experiment to show that charged particles are present in this solution.

(3)

....

....

....

....

....

....

(Total for Question 7 = 12 marks)

8 Qualitative tests are used to identify ions in compounds.

(a) Solid **X** contains two ions.

The tests for these ions and their results are shown in Figure 10.

test	result
flame test on solid **X**	red-orange flame
dilute nitric acid is added to an aqueous solution of **X**, followed by silver nitrate solution	white precipitate forms

Figure 10

Use the information in Figure 10 to name the cation and the anion in solid **X**.

(2)

name of cation ....

name of anion ....

(b) Another solid, **Y**, also contains two ions.

A test was carried out on solid **Y**.

A few drops of sodium hydroxide solution were added to a solution of solid **Y**.
A white precipitate formed.

(i) Give the reason why this test does not identify the cation in solid **Y**.

(1)

....

....

....

....

(ii) Give the reason why this test does not identify the anion in solid **Y**.

(1)

....

....

....

....

(c) Instrumental methods are often used for analysis.

Give a reason why instrumental analysis may be better than other methods of analysis.
(1)

....

....

(d) Iron(II) sulfate solution reacts with sodium hydroxide solution to form a pale green precipitate of iron(II) hydroxide, $Fe(OH)_2$.

(i) Write the ionic equation for this reaction.
(3)

....

(ii) The green iron(II) hydroxide precipitate gradually turns brown when exposed to air.

Explain this observation.
(2)

....

....

....

....

(Total for Question 8 = 10 marks)

9 (a) The rate of reaction between magnesium ribbon and dilute hydrochloric acid at room temperature is investigated.

The apparatus used is shown in Figure 11.

The volume of hydrogen gas given off was measured at regular intervals during the reaction.

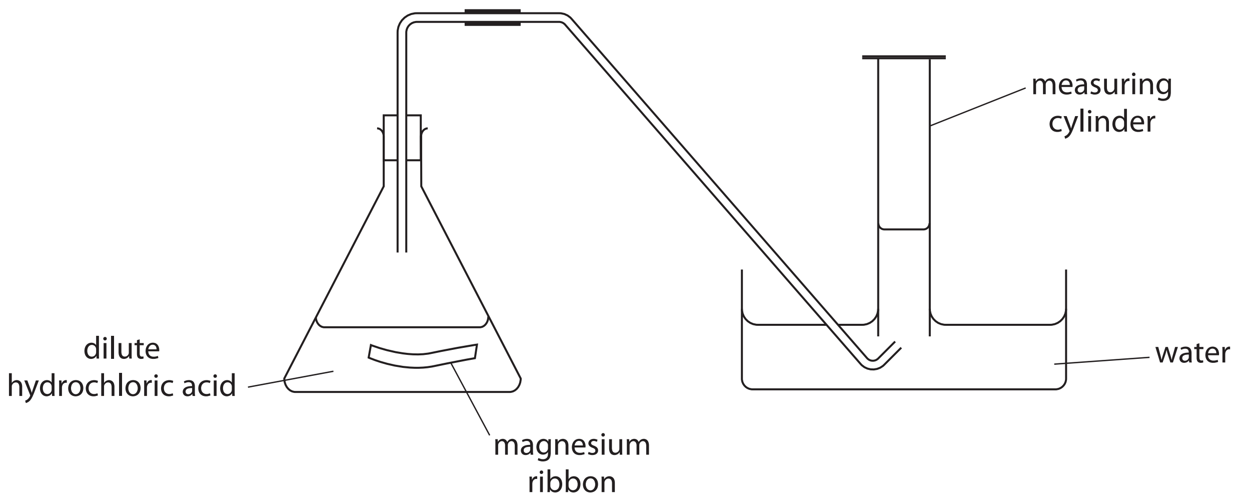


Figure 11

The graph in Figure 12 shows the results of this experiment.

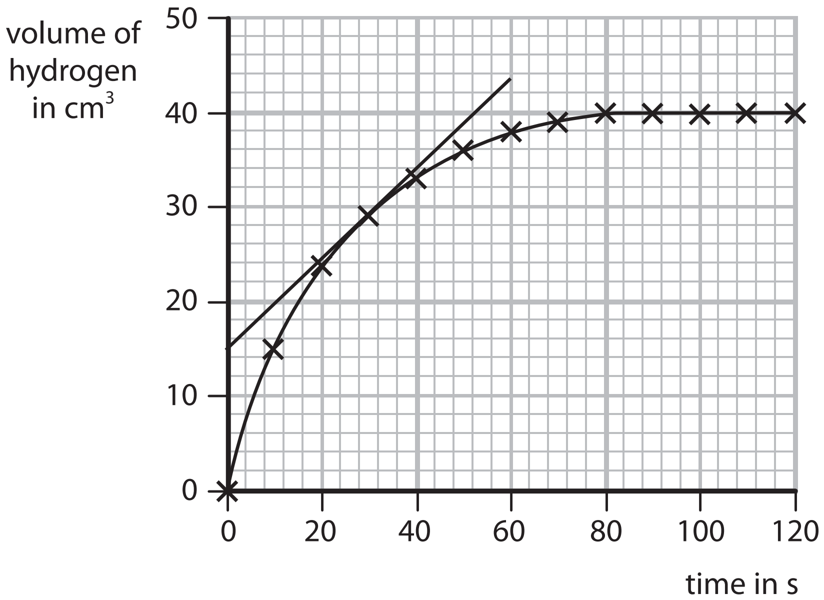


Figure 12

(i) State a change that can be made to the apparatus in Figure 11 to measure the volumes of gas more accurately.

(1)

....

....

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(ii) A tangent has been drawn to the line on the graph in Figure 12.

Calculate the rate of reaction at this point.

(2)

....

....

....

....

rate of reaction = ... $cm^3\ s^{-1}$

(iii) On the graph in Figure 12, draw the line you would expect to obtain if the magnesium ribbon in this experiment was replaced with an equal mass of powdered magnesium. All other conditions are kept the same.

(1)

(b) The balanced equation for this reaction is

$$Mg + 2HCl \rightarrow MgCl_2 + H_2$$

(i) In another experiment, 0.1 moles of hydrochloric acid, HCl, were reacted with 0.1 g of magnesium ribbon.

Calculate the number of moles of magnesium, Mg, in the 0.1 g sample of magnesium ribbon.
(relative atomic mass: Mg = 24)

(1)

....

....

....

number of moles = ...

(ii) In a further experiment, 0.5 mol of hydrochloric acid, HCl, were mixed with 0.5 mol of magnesium, Mg.

Use the equation to show that, in this experiment, the magnesium is in excess.

(1)

....

....

*(c) Two substances, **A** and **B**, each form a colourless solution.
If the solutions are mixed in a beaker, **A** and **B** react to form a coloured product.
The rate of the reaction between **A** and **B** can be investigated by placing the beaker containing the mixture on a cross on a piece of paper and timing how long it takes for enough coloured product to be produced to make the cross invisible when viewed from above, through the solution.

	experiment 1	**experiment 2**	**experiment 3**
concentration of **A in solution** in g dm^{-3}	10	10	40
temperature in °C	20	40	40
time for cross to become invisible in s	320	80	20

Figure 13

Use the results of these experiments to explain, in terms of the behaviour of particles, the effect of changing temperature and the effect of changing the concentration of **A** in solution on the rate of this reaction.

(6)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(Total for Question 9 = 12 marks)

BLANK PAGE

10 (a) Hydrogen reacts with oxygen to form steam.

$$2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$$

Bond energies are shown in Figure 14.

bond	bond energy in kJ mol^{-1}
H—H	435
O=O	500
O—H	460

Figure 14

Calculate the energy change for the reaction of 2 mol of hydrogen gas, H_2, with 1 mol of oxygen gas, O_2, to give 2 mol of steam, H_2O.

(4)

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

*(b) A student is provided with unlabelled samples of three liquids.
The three liquids are known to be

hexane, C_6H_{14}, a liquid alkane
hexene, C_6H_{12}, a liquid alkene
butanoic acid, $C_4H_8O_2$, a carboxylic acid, in aqueous solution

Aqueous solutions of carboxylic acids contain hydrogen ions and undergo reactions typical of acids with indicators and carbonates.

Describe, in detail, using the information given and your knowledge of the reactions of these liquids, tests the student should carry out to identify each of the three liquids.

You should include balanced equations for any chemical reactions described.

(6)

(Total for Question 10 = 10 marks)

TOTAL FOR PAPER = 100 MARKS

The periodic table of the elements

Key

relative atomic mass **atomic symbol** name atomic (proton) number

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

***** 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.