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)

Time 1 hour 45 minutes

Paper reference **1CH0/2H**

Chemistry

PAPER 2

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 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.
- 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 ▶

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Q:1/1/1/1/1/

P 6 9 4 8 7 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 (a) Titanium dioxide nanoparticles are used in some sunscreens.

(i) State one property of titanium dioxide nanoparticles that make them suitable for use in sunscreens.

(1)

.....

.....

(ii) Suggest one possible risk associated with using nanoparticles.

(1)

.....

.....

(b) Figure 1 shows the surface area to volume ratio for different diameters of spherical nanoparticles.

diameter of nanoparticle in nm	surface area : volume ratio
10	3 : 5
20	3 : 10
30	3 : 15
40	3 : 20
50	3 : 25

Figure 1

(i) State the trend shown by the data in Figure 1.

(1)

.....

.....

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(ii) What is the surface area : volume ratio for a spherical nanoparticle with a diameter of 80 nm?

(1)

- ☒ **A** 3 : 35
- ☒ **B** 3 : 40
- ☒ **C** 3 : 45
- ☒ **D** 3 : 50

(c) A different nanoparticle is cube shaped, as shown in Figure 2.

The length of one side of this cube is 60 nm.

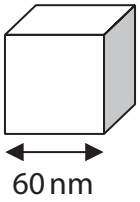

Figure 2

Show that the surface area : volume ratio for this cube is 1 : 10.

(3)

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.....

(Total for Question 1 = 7 marks)

2 A student used the apparatus in Figure 3 to investigate the rate of the reaction between a metal and dilute hydrochloric acid.

Pieces of the metal were placed in dilute hydrochloric acid in the flask, and the total volume of gas produced was measured every minute.

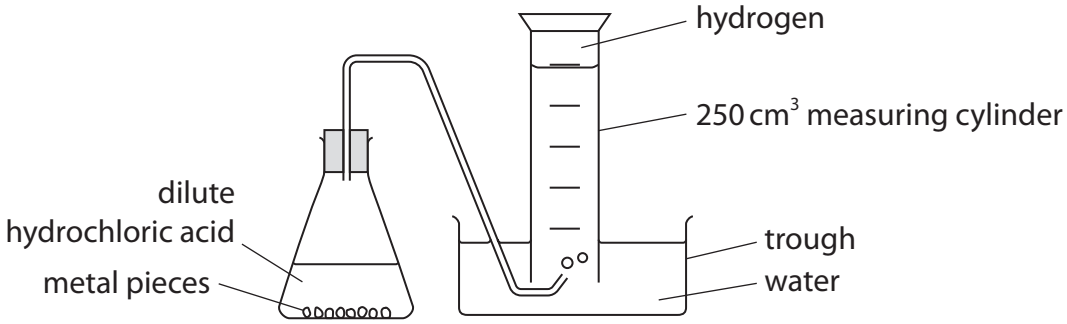

Figure 3

(a) Figure 4 shows a graph of the student's results.

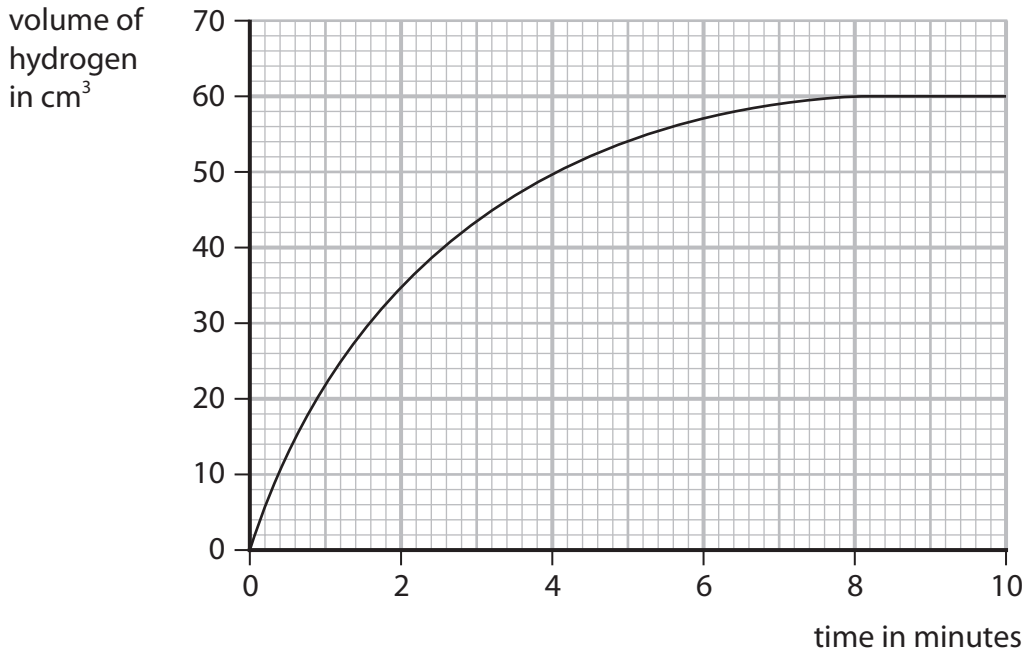

Figure 4

(i) Name a piece of apparatus that would be better to measure the volume of gas produced, instead of the 250 cm^3 measuring cylinder.

Give a reason for your answer.

(2)

name of apparatus

.....

reason

.....

.....

(ii) Calculate the mean rate of production of hydrogen over the first 90 seconds, in cm^3 per second.

(3)

.....

.....

.....

.....

rate = ... cm^3 per second

(iii) The student measured the volume of gas for 10 minutes.

State why the measurements could have been stopped at 9 minutes.

(1)

.....

.....

(b) The experiment was repeated, but with acid of a higher concentration.

The rate of reaction was faster.

(i) Explain why the rate of reaction increases when the concentration of acid is increased.

(2)

.....

.....

.....

(ii) Another student suggests four other ways of increasing the rate of this reaction.

Which one is correct?

(1)

☒ **A** use the same acid but at a lower temperature

☒ **B** use a larger trough

☒ **C** use a smaller flask

☒ **D** use the same metal but in a powdered form

(Total for Question 2 = 9 marks)

3 This question is about gases.

(a) When sodium is added to water, hydrogen gas is produced.

Which observation shows that a gas has been produced?

(1)

- ☒ **A** a white precipitate forms
- ☒ **B** effervescence is seen
- ☒ **C** the sodium sinks in the water
- ☒ **D** the water changes to a pink colour

(b) Some damp litmus paper is placed in a gas.
The litmus paper is bleached.

Which gas bleaches damp litmus paper?

(1)

- ☒ **A** carbon dioxide
- ☒ **B** chlorine
- ☒ **C** hydrogen
- ☒ **D** oxygen

(c) When calcium carbonate is heated it decomposes.

$$CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$$

When 5.000 g of calcium carbonate is heated, the mass of solid remaining is 2.800 g.

Calculate the mass of carbon dioxide that has been released.

Give your answer to three significant figures.

(2)

.....

.....

mass of carbon dioxide = ... g

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(d) A diagram of an atom of helium is shown in Figure 5.

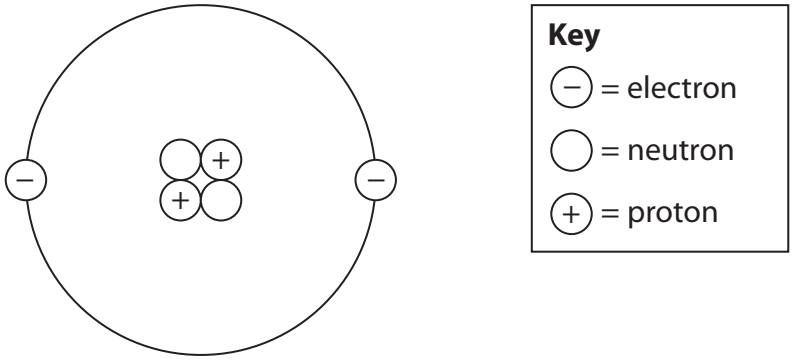

Figure 5

(i) Explain, using Figure 5, why helium is inert.

(2)

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.....

(ii) Helium is used to fill balloons.

State one property of helium, apart from it being inert, that makes it suitable for filling balloons.

(1)

.....

(e) Oxygen gas has the formula O_2.

Calculate the number of oxygen **atoms** in 3.50 mol of oxygen gas.

(Avogadro constant = 6.02×10^{23})

(2)

.....

.....

.....

number of oxygen atoms = ...

(Total for Question 3 = 9 marks)

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4 (a) Some acids are used in tests for ions.

A bottle of one acid is shown in Figure 6.

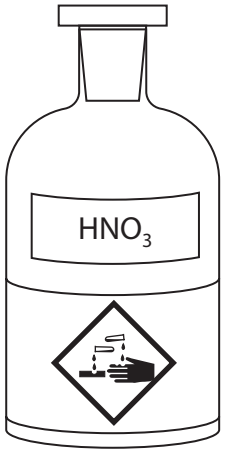

Figure 6

(i) The acid in Figure 6 can be used in the test for carbonate ions.

Explain, giving the name of the hazard symbol shown, what safety precautions should be taken when using this acid.

(2)

(ii) Give the name of the acid shown in Figure 6.

(1)

(iii) State a property of glass that makes it a suitable material to make the container for an acid.

(1)

(b) A teacher conducts a flame test to identify the metal ions in some unknown solids.

step 1 dip a flame test wire into hydrochloric acid

step 2 dip the flame test wire into the unknown solid

step 3 hold the flame test wire above a Bunsen burner flame

(i) This method did not work well.

Explain an improvement that needs to be made to **step 3** to enable a bright flame colour to be produced.

(2)

.....

.....

.....

(ii) Figure 7 shows the results of the flame tests on three compounds, **P**, **Q** and **R**.

compound	flame colour
P	red
Q	lilac
R	blue-green

Figure 7

Use Figure 7 to identify the metal ions in compounds **P**, **Q** and **R**.

(3)

P .....

Q .....

R .....

(c) A flame photometer was used to analyse samples of a solution of metal ions.

Each sample was treated with 5.00 cm^3 of dilute hydrochloric acid.
1.00 dm^3 of the acid contained 219 g of hydrogen chloride.

Calculate the mass of hydrogen chloride in the acid used to test 20 samples.

(2)

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.....

mass = ... g

(Total for Question 4 = 11 marks)

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5 (a) Figure 8 shows some information about the composition of pollutant exhaust gases from the engines of two different vehicles.

pollutant	mass of pollutant given out in g per kilometre driven	
	petrol engine	diesel engine
carbon dioxide	210	180
carbon monoxide	1.5	0.10
unburnt hydrocarbons	0.13	0.020
nitrogen oxides	0.36	2.0
particulates	0.0060	0.046
sulfur dioxide	0.0089	0.0037

Figure 8

(i) Give **two** ways in which the data in Figure 8 shows that the diesel engine is **more** damaging to the environment than the petrol engine.

(2)

.....

.....

.....

(ii) Explain, using information from Figure 8, **one** way in which the diesel engine is **less** damaging to the environment than the petrol engine.

(2)

.....

.....

.....

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(b) (i) Which statement about the members of the alkane homologous series is correct?

(1)

☒ **A** they show a trend in chemical properties

☒ **B** their boiling point decreases as the molecules get larger

☒ **C** the molecular formula of neighbouring compounds differs by CH_3

☒ **D** their viscosity increases as the molecules get larger

(ii) Which one of the following hydrocarbons belongs to the same homologous series as octane, C_8H_{18}?

(1)

☒ **A** C_4H_6

☒ **B** C_4H_8

☒ **C** C_4H_{10}

☒ **D** C_4H_{12}

(iii) Write the balanced equation for the complete combustion of octane, C_8H_{18}.

(3)

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.....

(Total for Question 5 = 9 marks)

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6 The elements in group 7 of the periodic table are known as the halogens.

(a) Name the halogen that is in period 4 of the periodic table.

(1)

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(b) Explain why chlorine is more reactive than iodine.

(3)

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(c) A piece of burning sodium is placed into a gas jar containing chlorine gas, as shown in Figure 9.

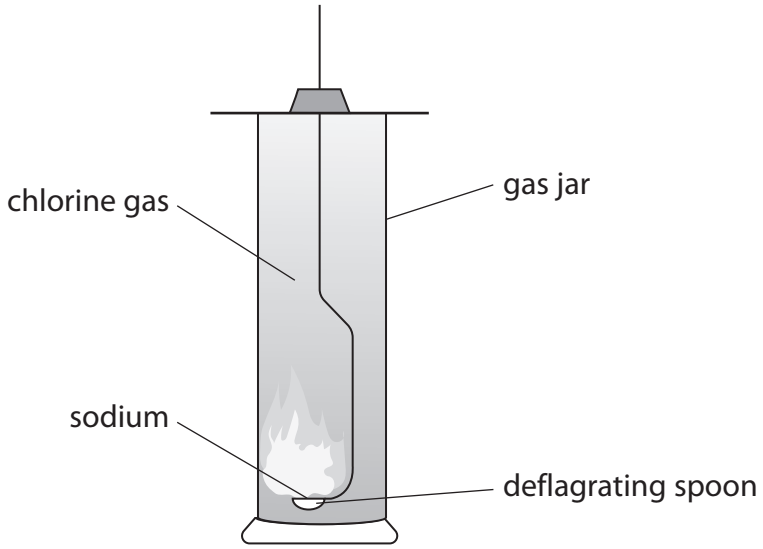

Figure 9

At the end of the reaction, the inside of the gas jar is coated with white crystals.

Identify the white crystals.

(1)

.....

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(d) Sodium also reacts with bromine.

(i) Write the balanced equation for the reaction between sodium and bromine.

(2)

.....

(ii) In another experiment, a student adds colourless sodium bromide solution to chlorine water.

State what you would **see** in this reaction.

(1)

.....

(iii) The ionic equation for the reaction between sodium bromide and chlorine is:

$$2Br^- + Cl_2 \rightarrow 2Cl^- + Br_2$$

Explain which species has been oxidised in this reaction.

(2)

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(Total for Question 6 = 10 marks)

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7 This question is about oxygen.

(a) The percentage of oxygen in today's atmosphere is greater than the percentage of oxygen in the Earth's early atmosphere.

Explain what caused this change to happen.

(2)

(b) Magnesium reacts with oxygen from the air to form magnesium oxide.

A student carries out an investigation to determine the mass of magnesium oxide formed when a known mass of magnesium reacts completely with oxygen.

This is the method the student used.

step 1 find the mass of a crucible and lid

step 2 put a known mass of magnesium into the crucible and put the lid on

step 3 heat for five minutes using a roaring Bunsen burner flame

step 4 let the crucible, lid and contents cool down

step 5 find the final mass of the crucible, lid and contents

Explain how the student could check that the magnesium had reacted completely with oxygen.

(2)

(c) In another experiment, it was found that 1.24 g of phosphorus reacted completely with 1.60 g of oxygen to form phosphorus oxide.

The relative formula mass of this phosphorus oxide is 284.

Deduce the molecular formula of this phosphorus oxide.

You must show your working.

(relative atomic masses: O = 16, P = 31)

(4)

molecular formula = ...

(d) A student uses the apparatus shown in Figure 10 to investigate the percentage of oxygen in the atmosphere.

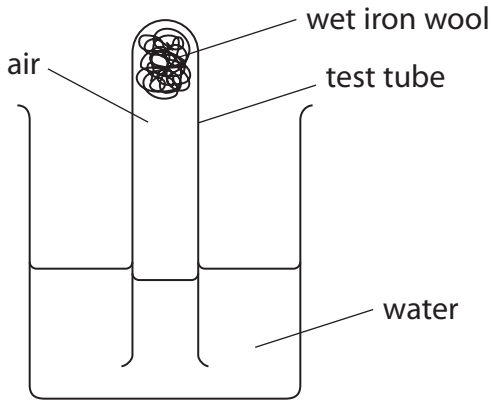

Figure 10

The apparatus was left for a few days.

(i) Explain one change the student would see after a few days.

(2)

.....

.....

(ii) Explain one change that can be made to the apparatus in Figure 10 to allow the student to calculate the percentage of oxygen in the atmosphere.

(2)

.....

.....

.....

.....

(Total for Question 7 = 12 marks)

8 (a) A precipitate is produced when an alkaline solution is added to a solution containing some metal ions.

(i) Which of these is evidence of a precipitate being produced?

(1)

☒ **A** fizzing

☒ **B** solid forms in the solution

☒ **C** the solution turns purple

☒ **D** the solution gets hot

(ii) You are given two solutions, one containing Ca^{2+} ions and the other containing Al^{3+} ions.

Devise a plan to identify which solution is which.

(4)

*(b) A scientist carries out some tests on solid **V** and on a solution of **V**.

The tests and results are shown in Figure 11.

test	result
appearance of **V**	white solid
see whether solid **V** conducts electricity	the solid does not conduct electricity
see whether a solution of **V** conducts electricity	the solution conducts electricity
heat solid **V** to 400 °C	the solid does not melt
add some sodium hydroxide solution to solid **V** and warm	a pungent gas, **W**, is released which turns damp litmus paper blue
add some dilute nitric acid, followed by drops of silver nitrate solution, to a solution of **V**	a cream precipitate, **X**, is produced

Figure 11

Use the data in Figure 11 to deduce information about **V**, **W** and **X**, explaining your deductions.

(6)

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(Total for Question 8 = 11 marks)

9 (a) In some chemical reactions, bonds are broken in the reactant molecules and new bonds are formed to make the product molecules.

(i) Which row is correct about the energy changes for these processes?

(1)

		energy change	
		breaking a bond	**making a bond**
☒	**A**	energy is released	energy is released
☒	**B**	energy is released	energy is absorbed
☒	**C**	energy is absorbed	energy is released
☒	**D**	energy is absorbed	energy is absorbed

(ii) Hydrogen reacts with fluorine.

$$H_2 + F_2 \rightarrow 2HF$$

Figure 12 shows the bond energies for the bonds in the three molecules in the equation.

bond	bond energy in kJ mol^{-1}
H—H	436
F—F	158
H—F	562

Figure 12

Calculate the energy change for this reaction.

(4)

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

*(b) The reaction profile for an uncatalysed exothermic reaction is shown in Figure 13.

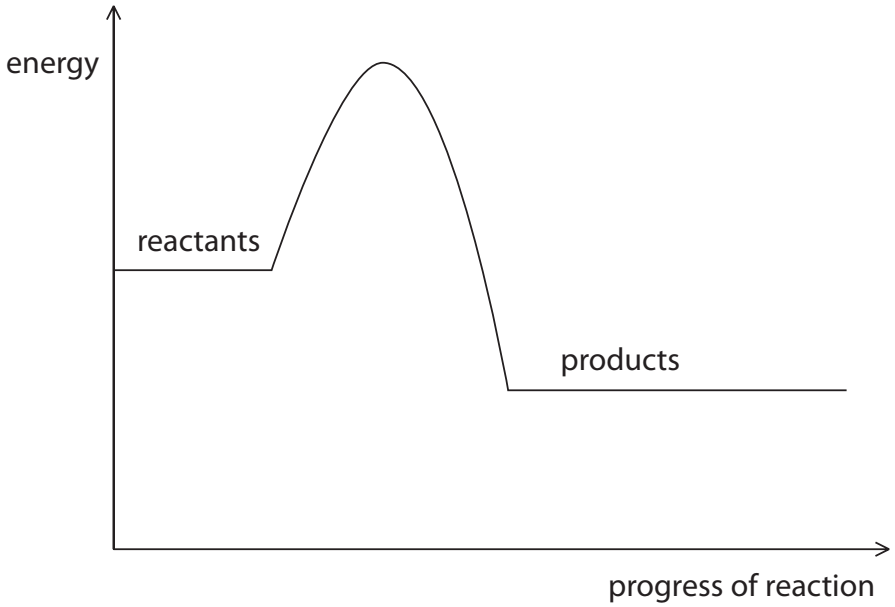

Figure 13

Using some examples of catalysts you have met in chemistry, discuss what catalysts do and their effect on the activation energy of a reaction.

You can use Figure 13 to illustrate your answer.

(6)

(Total for Question 9 = 11 marks)

10 (a) Figure 14 shows the structure of a molecule of hydrocarbon **Z**, C_4H_8.

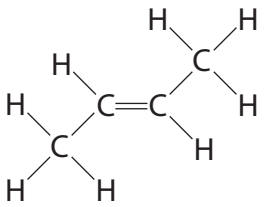

Figure 14

(i) Give the name of hydrocarbon **Z** shown in Figure 14.

(1)

.....

(ii) Complete the balanced equation for the reaction of hydrocarbon **Z**, C_4H_8, with bromine.

(2)

C_4H_8 + ... → .....

(iii) Draw the repeating unit of the addition polymer formed when hydrocarbon **Z** undergoes polymerisation.

(2)

(b) Figure 15 shows the arrangement of atoms in a molecule of an alcohol.

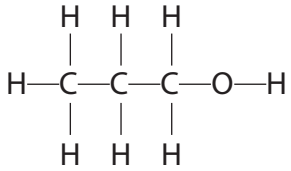

Figure 15

(i) Give the name of the carbon-containing product formed when the alcohol in Figure 15 undergoes dehydration.

(1)

(ii) Give the formula of the functional group of the product formed when the alcohol in Figure 15 undergoes oxidation.

(1)

(iii) A student wants to investigate the amount of energy released when 1.00 g of the alcohol is burned.

They set up the apparatus shown in Figure 16 to measure the temperature rise of the water.

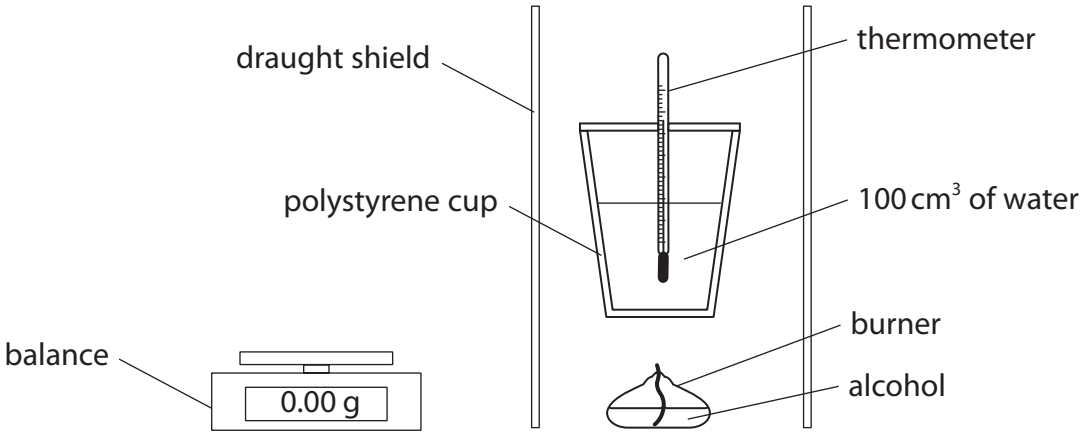

Figure 16

State why this apparatus is not suitable for use in this experiment.

(1)

(c) Some alcohols can react with some carboxylic acids to form polyesters, which are condensation polymers.

Figure 17 shows the repeating unit of the polyester molecule formed in a reaction between a carboxylic acid and an alcohol.

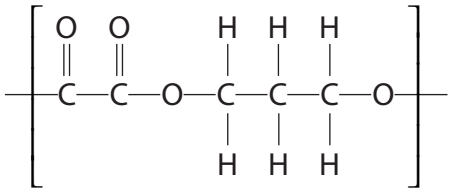

Figure 17

(i) Give the formula of the other product formed in this reaction.

(1)

.....

(ii) Draw the structure of one molecule of the alcohol used to produce the polyester shown in Figure 17, showing all covalent bonds.

(2)

(Total for Question 10 = 11 marks)

TOTAL FOR PAPER = 100 MARKS

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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.