Write your name here

Surname	Other names

Pearson Edexcel GCSE (9 - 1)

Centre Number | | | | | |

Candidate Number | | | | |

Combined Science (Chemistry) and Chemistry

GCSE to A level Transition Test

Time: 1 hour 45 minutes

Paper Reference
1SC0 / 1CH0

You must have:
Ruler, pencil

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.
- You must **show all your working out** with **your answer clearly identified** at the end of your solution.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*
- You may use a calculator.

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.

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 ▶

Pearson

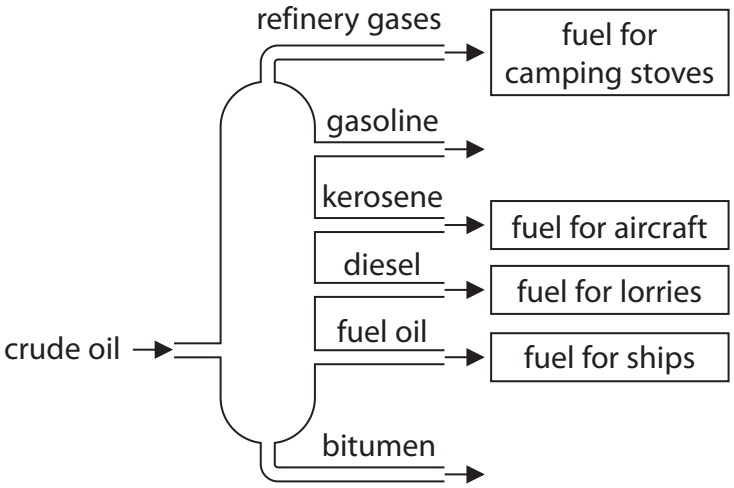
Answer ALL questions. Write your answers in the spaces provided.

SECTION A (Combined Science: Chemistry)

1 Crude oil is a liquid that contains a mixture of many hydrocarbons.

The diagram shows a fractionating column used in the distillation of crude oil.

The six fractions obtained are shown. One use for each of four of the fractions is also shown.



(a) Describe what is done to the crude oil before it enters the fractionating column.

(2)

.....

.....

(b) State how the temperature changes from the top of the column to the bottom.

(1)

.....

(c) Give a use for gasoline and a use for bitumen.

(2)

gasoline.....

bitumen.....

(d) Name the fraction that contains the largest molecules.

(1)

.....

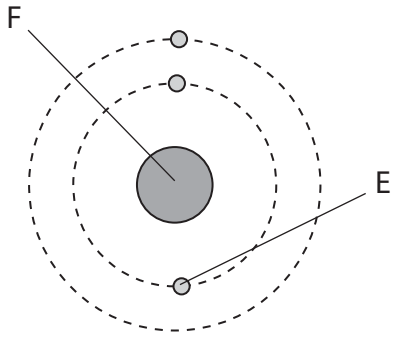
(e) State the physical property that allows the different fractions to be collected at different heights in the column.

(1)

.....

(Total for Question 1 = 7 marks)

2 The diagram shows an a om of lithium with atomic number 3 and mass number of 6.



(c) Name the two types of particle found in part F.

(2)

.....

(d) Another type of lithium atom has atomic number 3 and mass number 7.

(i) State the name given to atoms with the same atomic number but different mass numbers.

(1)

.....

(ii) Draw a diagram to show the arrangement of electrons in an atom of lithium with atomic number 3 and mass number 7.

(1)

(e) A sample of lithium contains 92.5% of atoms with mass number 7 and 7.5% of atoms with mass number 6.

Calculate the relative atomic mass of lithium.

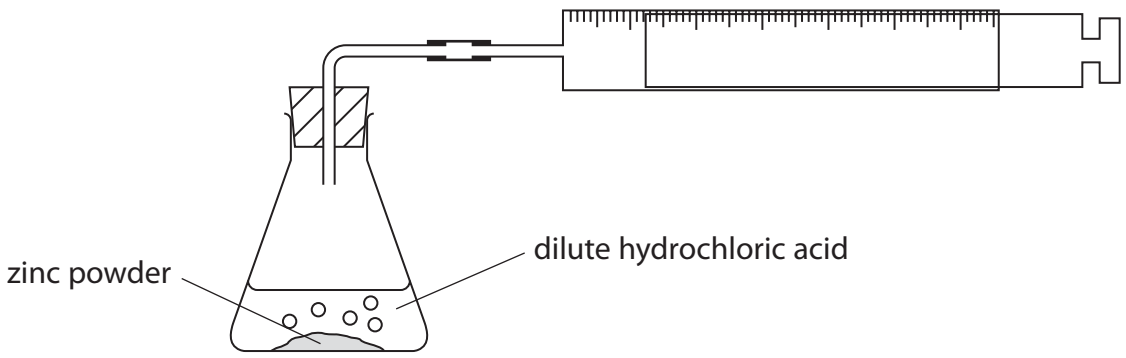
(2)

relative atomic mass = ...

(Total for Question 2 = 6 marks)

3 A student investigates the rate of reaction between zinc and hydrochloric acid, using an excess of zinc powder.

She uses this apparatus.



The student measures the volume of gas in the syringe every minute for ten minutes.

The table shows her results.

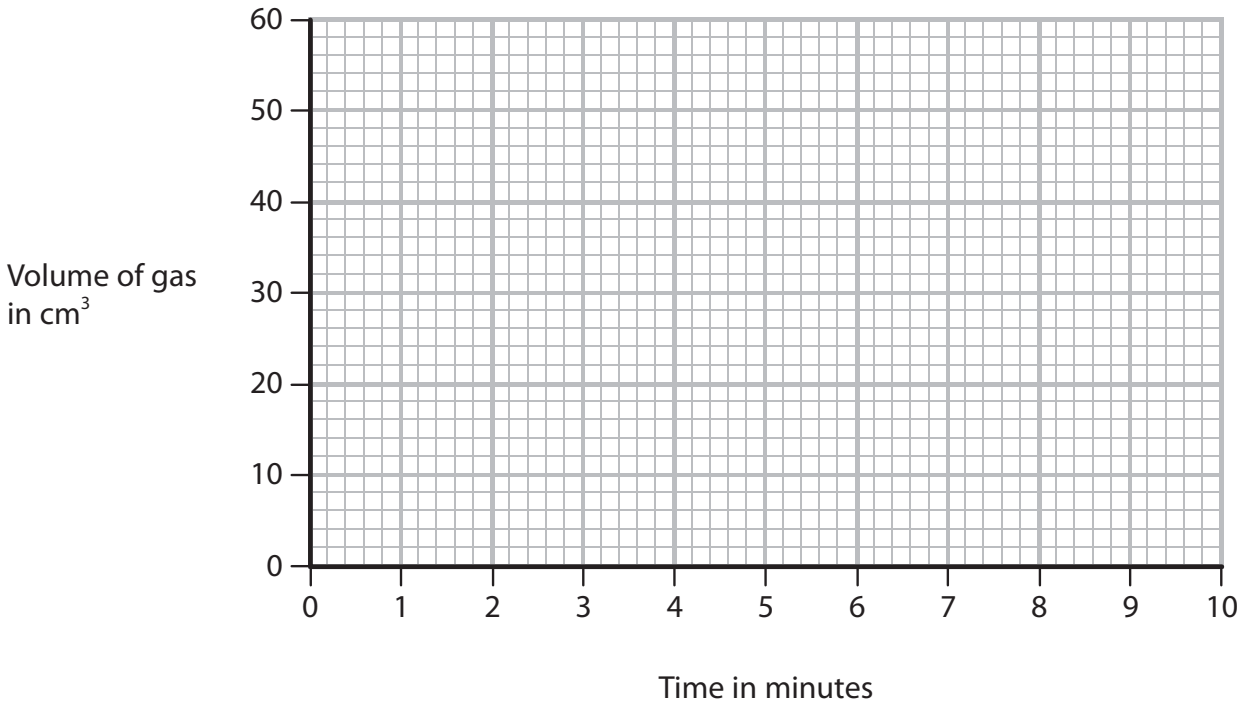
Time in minutes	0	1	2	3	4	5	6	7	8	9	10
Volume of gas in cm^3	0	14	37	40	49	54	58	60	60	60	60

(a) (i) Plot the student's results on the grid.

(2)

(ii) Draw a curve of best fit.

(1)



(b) The result at two minutes is anomalous.

(i) Suggest a mistake that the student could have made to produce this anomalous result.

(1)

.....

.....

(ii) Use your graph to estimate the volume of gas that was given off at two minutes.

Show clearly on your graph how you obtain your answer.

(2)

volume of gas = ... cm^3

(c) Explain why the last four readings for the volume of gas are the same.

(2)

.....

.....

.....

.....

(d) (i) State how the graph shows that the rate of reaction decreases during the first seven minutes.

(1)

.....

.....

(ii) Explain, in terms of the particle collision theory, why the rate of reaction decreases during the first seven minutes.

(2)

.....

.....

.....

.....

.....

.....

(Total for Question 3 = 11 marks)

4 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)

.....Na(.....) + $2H_2O$(.....) → ..... NaOH(.....) + H_2(.....)

(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

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

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

(2)

(Total for Question 4 = 9 marks)

5 A student tries to make a pure, dry sample of hydrated cobalt(II) chloride crystals.

He uses dilute hydrochloric acid and solid cobalt(II) oxide.

This is the student's method.

Step 1 pour about 50 cm^3 of dilute hydrochloric acid into a beaker

Step 2 warm the acid using a Bunsen burner

Step 3 add a small amount of cobalt(II) oxide and stir the mixture with a glass rod

Step 4 add further small amounts of cobalt(II) oxide until it stops reacting

Step 5 filter the final mixture and collect the filtrate in an evaporating basin

Step 6 leave the filtrate until all of the water has evaporated

His sample of cobalt(II) oxide contains a small amount of a solid impurity that dissolves in water, but does not react with the acid.

(a) State why it is not necessary to have a precise measurement of the volume of hydrochloric acid in step 1.

(1)

.....

.....

(b) State why the acid is warmed in step 2.

(1)

.....

.....

(c) Suggest why a glass rod, rather than a metal spatula, is used to stir the mixture in step 3.

(1)

.....

.....

(d) State how the student will know when the cobalt(II) oxide stops reacting in step 4.

(1)

.....

.....

(e) State why the method used in step 6 will not produce a pure sample of hydrated cobalt(II) chloride crystals.

(1)

.....

.....

(Total for Question 5 = 5 marks)

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6 Covalent substances can be simple molecular covalent or giant covalent.

(a) (i) Ammonia is a simple molecular, covalent substance.

Which is the most likely set of properties for ammonia?

(1)

	melting point in °C	boiling point in °C	ability to conduct electricity in liquid state
☒ **A**	1713	2950	does not conduct
☒ **B**	−78	−33	does not conduct
☒ **C**	−39	357	conducts
☒ **D**	801	1413	conducts

(ii) Ammonia, NH_3, is made by reacting nitrogen with hydrogen.

Write the balanced equation for this reaction.

(2)

(b) Oxygen, O_2, is also a simple molecular, covalent substance.

Draw a dot and cross diagram for the molecule of oxygen.

(2)

*(c) Figure 8 shows the arrangement of carbon atoms in diamond, graphene and a fullerene (C_{60}).

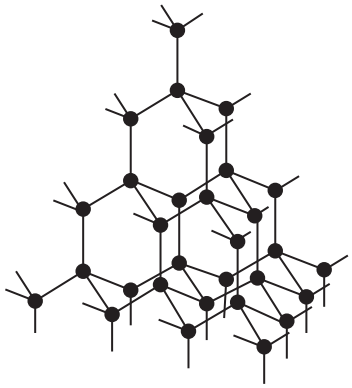
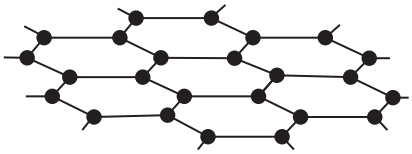
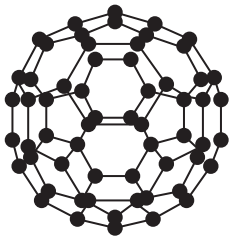
		
diamond	graphene	a fullerene, C_{60}

Figure 8

Consider these three substances.

Explain, in terms of their structures and bonding, their relative melting points, strengths and abilities to conduct electricity.

(6)

(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)

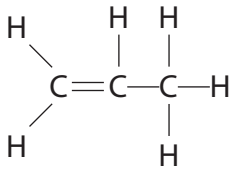
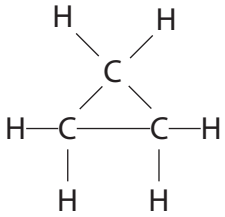
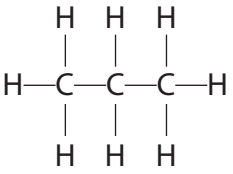
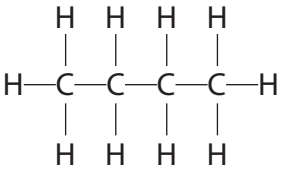
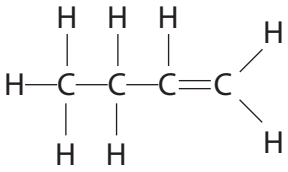
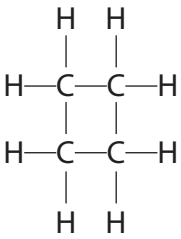
(d) A solid ionic compound is dissolved in water to form a solution.

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

(3)

(Total for Question 7 = 12 marks)

8 The table shows the displayed formulae of six hydrocarbons, Q, R, S, T, U and V.

Q 	**R** 	**S** 
T 	**U** 	**V** 

(a) Which two hydrocarbons will instantly decolourise bromine water?

(1)

☒ **A** R and V

☒ **B** Q and U

☒ **C** S and T

☒ **D** Q and T

(b) Which two hydrocarbons have the general formula C_nH_{2n+2}?

(1)

☒ **A** R and V

☒ **B** Q and U

☒ **C** S and T

☒ **D** Q and T

(c) Which hydrocarbon is an isomer of U?

(1)

☒ **A** Q

☒ **B** R

☒ **C** T

☒ **D** V

(d) Which two hydrocarbons have the empirical formula CH_2?

(1)

☒ **A** R and V

☒ **B** Q and S

☒ **C** R and S

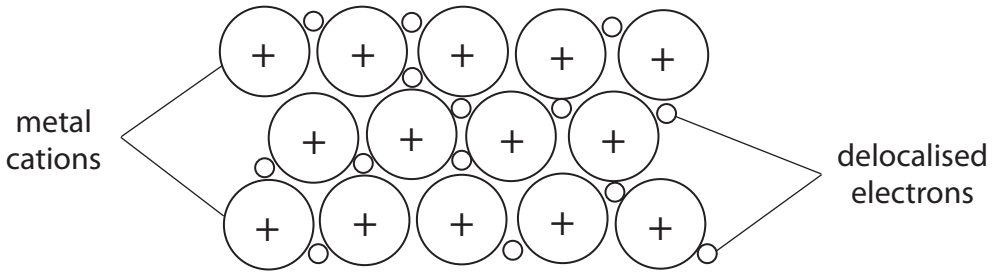
☒ **D** T and U

(Total for Question 8 = 4 marks)

9 This question is about titanium and its compounds.

(a) Titanium is a metal.

The diagram shows the arrangement of the particles in titanium.



(i) State why metals such as titanium are good conductors of electricity.

(1)

.....

.....

(ii) Explain why metals such as titanium are malleable.

(2)

.....

.....

.....

.....

.....

.....

(Total for Question 9 = 3 marks)

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10 (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.

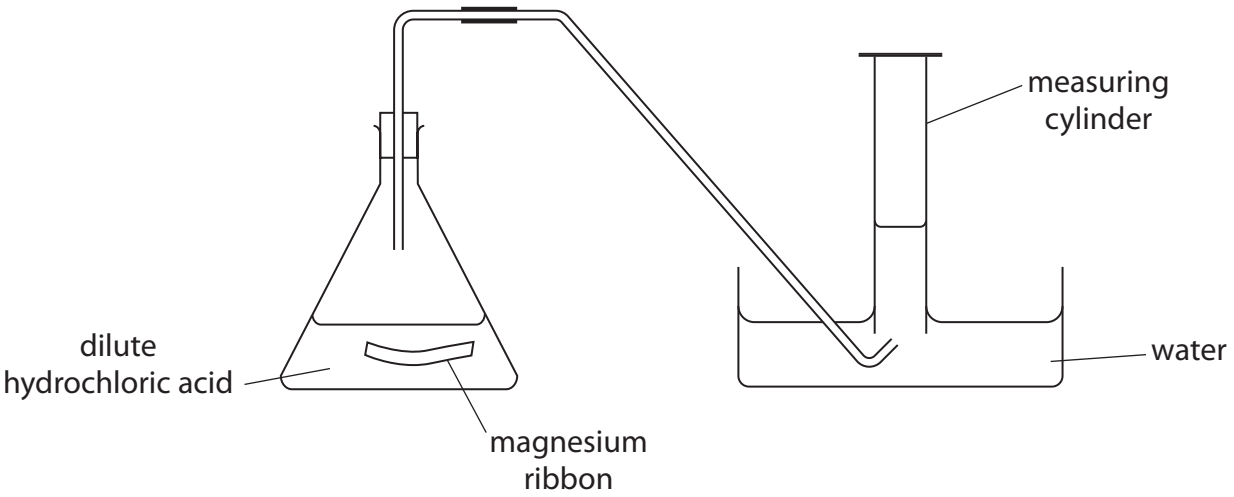


Figure 11

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

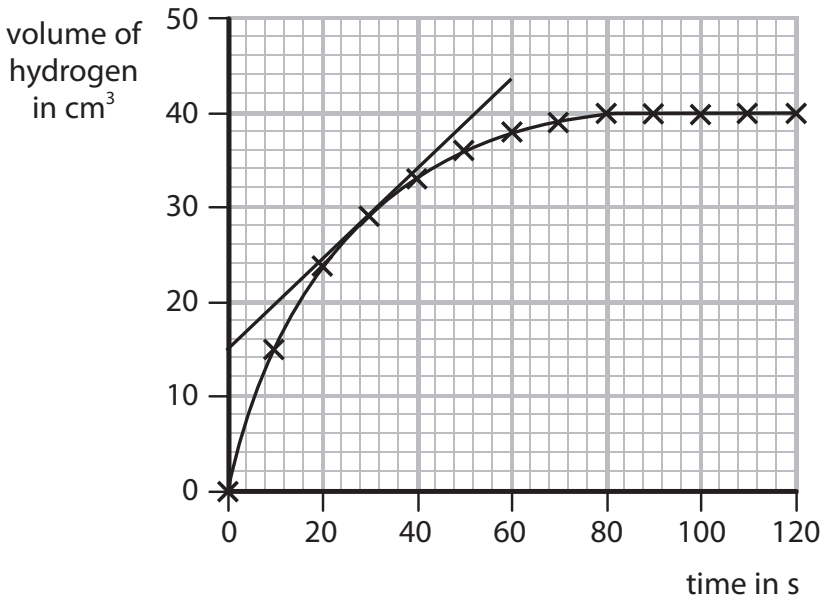


Figure 12

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

(1)

.....

.....

(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)

(Total for Question 10 = 6 marks)

11 (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}

(Total for Question 11 = 4 marks)

SECTION B (Chemistry)

12 The industrial production of sulfuric acid involves several steps.

One of these steps is the reaction of sulfur dioxide, SO_2, with oxygen to form sulfur trioxide, SO_3.

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$$

(a) What volume of sulfur trioxide, in dm^3, is produced by the complete reaction of 750 dm^3 of sulfur dioxide?
(all volumes of gases are measured under the same conditions of temperature and pressure)

(1)

☒ **A** 375.5

☒ **B** 750

☒ **C** 1125.5

☒ **D** 1500

(b) Calculate the volume of oxygen needed to react completely with 750 dm^3 of sulfur dioxide.
(all volumes of gases are measured under the same conditions of temperature and pressure)

(1)

volume of oxygen = ... dm^3

(c) Calculate the mass, in kilograms, of 750 dm^3 of sulfur dioxide, measured at room temperature and pressure.
(relative formula mass: SO_2 = 64;
1 mol of any gas at room temperature and pressure occupies 24 dm^3)

(3)

mass of sulfur dioxide = ... kg

*(d) The reaction to produce sulfur trioxide reaches an equilibrium.

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$$

The forward reaction is exothermic.
The rate of attainment of equilibrium and the equilibrium yield of sulfur trioxide are affected by pressure and temperature.

A manufacturer considered two sets of conditions, A and B, for this reaction.
In each case sulfur dioxide is mixed with excess oxygen.
The manufacturer changed the temperature and the pressure and only used a catalyst in B.
The sets of conditions A and B are shown in Figure 7.

set of conditions	pressure in atm	temperature in °C	catalyst
A	2	680	no catalyst used
B	4	425	catalyst used

Figure 7

The manufacturer chooses set of conditions B rather than set of conditions A.

Explain, by considering the effect of changing the conditions on the rate of attainment of equilibrium and on the equilibrium yield of sulfur trioxide, why the manufacturer chooses the set of conditions B rather than the set of conditions A.

(6)

(Total for Question 12 = 11 marks)

13 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.

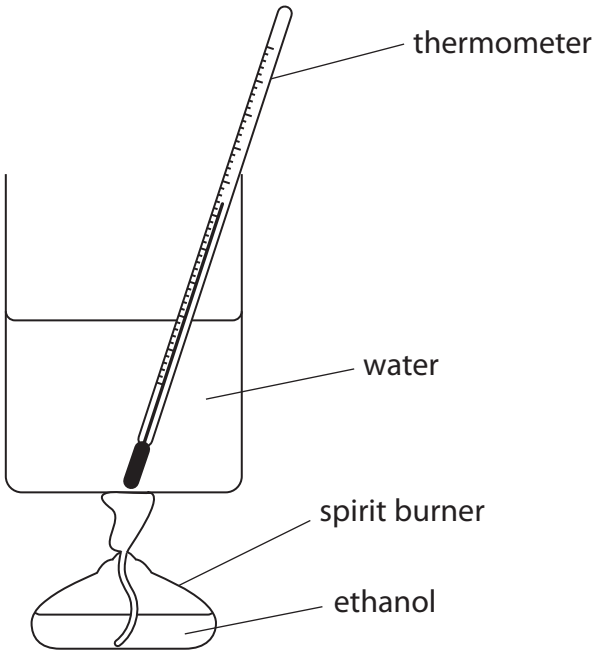


Figure 3

(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)

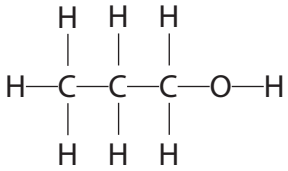
.....

.....

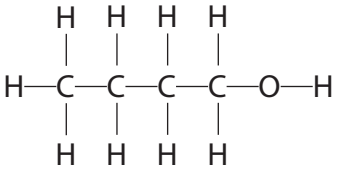
.....

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 13 = 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.