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 45 minutes)

Paper reference **1CH0/2F**

Chemistry

PAPER 2

Foundation 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 ▶

P72632A

N:1/1/1/1/1/

P 7 2 6 3 2 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 Figure 1 shows the structure of a molecule of each of four compounds, **A**, **B**, **C** and **D**.

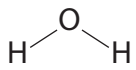
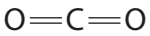
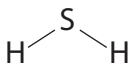
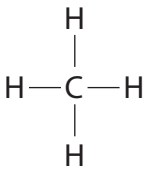
compound A	compound B	compound C	compound D
			

Figure 1

(a) The formula of a molecule of compound **A** is H_2O.

Give the formula of a molecule of compound **D**.

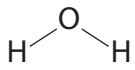
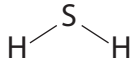
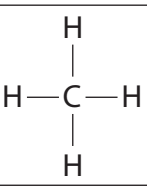
(1)

.....

(b) The names of two of the compounds in Figure 1 are shown below.

Draw one straight line from each name to the structure of a molecule of that compound.

(2)

name of compound	structure of molecule
carbon dioxide	
methane	
	
	

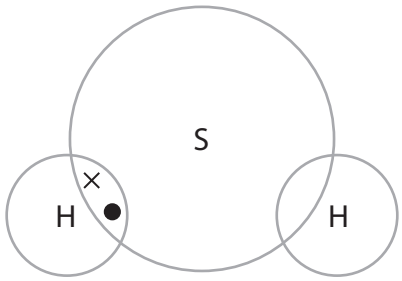
(c) Figure 2 shows information about the number of electrons in the outer shell of each of the different atoms in a molecule of compound **C**.

symbol of element	number of electrons in outer shell of the atom
H	1
S	6

Figure 2

Use the information in Figure 2 to complete the dot and cross diagram for a molecule of compound **C**.

(2)



(d) The atomic number of phosphorus, P, is 15.

One atom of phosphorus has a relative atomic mass of 31.

Give the number of protons, neutrons and electrons in this atom of phosphorus.

(3)

number of protons = ...

number of neutrons = ...

number of electrons = ...

(Total for Question 1 = 8 marks)

2 A student investigated the temperature change that took place when different salts were dissolved in water.

The student used the following method.

step 1 pour 50 cm^3 of water into a polystyrene cup and record the temperature of the water

step 2 find the mass of an empty boiling tube

step 3 add 2 spatula measures of a salt to the boiling tube and find its new mass

step 4 add the salt to the water

step 5 stir the mixture and record the temperature after 2 minutes.

Figure 3 shows the apparatus used.

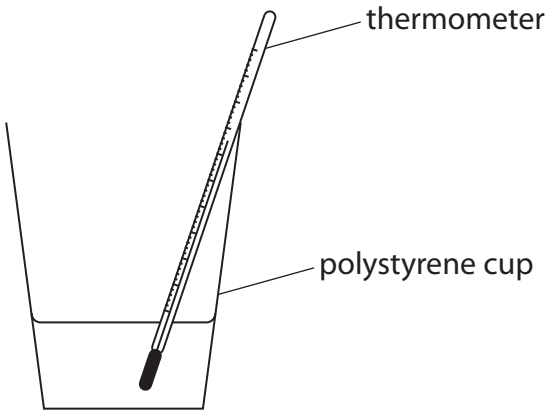


Figure 3

(a) For steps 2 and 3, the student obtained the mass measurements shown in Figure 4 for the first salt.

mass of empty boiling tube in g	22.52
mass of boiling tube + 2 spatula measures of a salt in g	24.16

Figure 4

Use the mass measurements in Figure 4 to calculate the mass of salt, in grams, added to the water.

(1)

.....

mass of salt = ... g

(b) The student repeated the method for three different salts, **A**, **B** and **C**.

The same mass of each salt was used.

Figure 5 shows the temperature readings obtained for the three different salts.

salt	starting temperature of the water in °C	temperature of the mixture after 2 minutes in °C	temperature change in °C
A	20.5	25.6	+5.1
B	20.5	19.8	–0.7
C	20.5	29.2	

Figure 5

(i) Calculate the temperature change for salt **C**.

Include a sign to show if the temperature change is an increase or a decrease.

(2)

.....

temperature change = ... °C

(ii) Explain which salt produces the biggest exothermic change.

(2)

.....

.....

.....

.....

(c) Explain why a polystyrene cup is a better container to use for this investigation than a glass beaker.

(2)

.....

.....

.....

.....

(Total for Question 2 = 7 marks)

3 Chemical tests are used to identify unknown substances.

(a) A flame test can be used to identify metal ions in a substance.

(i) Complete step 2 of how to carry out a flame test.

(2)

step 1 dip a flame test wire in dilute hydrochloric acid and then hold the wire in a roaring Bunsen flame until the flame is colourless

step 2 .....

.....

.....

step 3 hold the wire with the substance in a roaring Bunsen burner flame.

(ii) Many metal ions produce a coloured flame in a flame test.

Draw one straight line from each metal ion to its flame colour in a flame test.

(3)

metal ion	**flame colour**
	blue-green
copper ion	lilac
potassium ion	orange-red
sodium ion	red
	yellow

(b) Some metal ions can be identified using sodium hydroxide solution.

Drops of sodium hydroxide solution were added to a solution containing iron(III) ions, Fe^{3+}.

What would be seen?

(1)

- ☒ **A** blue solution
- ☒ **B** green liquid
- ☒ **C** red-brown precipitate
- ☒ **D** yellow gas

(c) In the test for carbonate ions, dilute hydrochloric acid is added to the solid carbonate in a test tube.

A gas is given off.

(i) Give the name of this gas.

(1)

.....

(ii) Figure 6 shows the apparatus that a student set up to test for this gas.

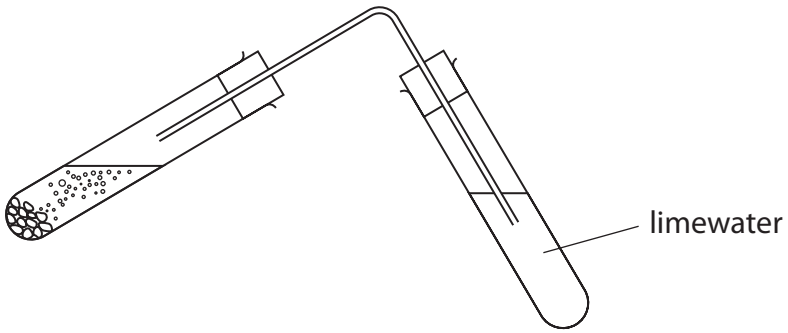


Figure 6

This apparatus will not work.

State what change is needed so that bubbles of the gas can pass through the limewater.

(1)

.....

.....

(d) A compound that contained ammonium ions was dissolved in water.

A solution was formed.

Sodium hydroxide solution was added, and the mixture was heated.

A gas was given off.

This gas was tested with a piece of damp red litmus paper.

The litmus paper turned blue.

Name the gas that was given off.

(1)

.....

(Total for Question 3 = 9 marks)

BLANK PAGE

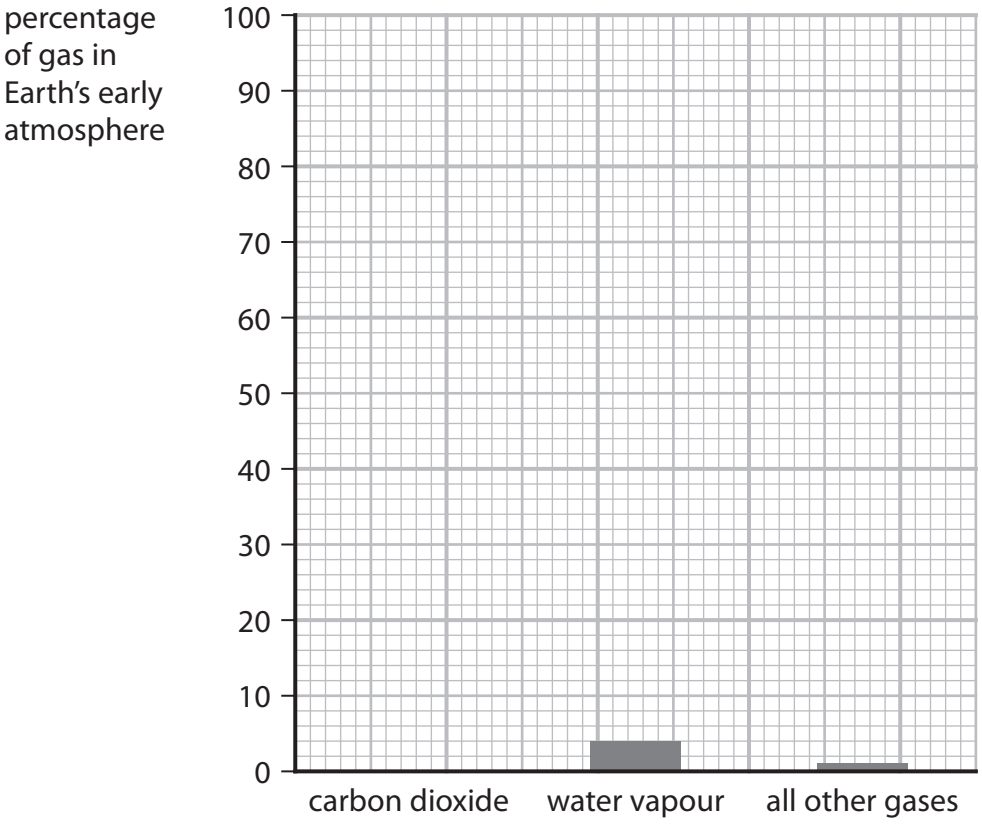
4 A scientist produced the information in Figure 7 about the Earth's atmosphere and the Earth's average surface temperature.

Earth's atmosphere 3 billion years ago		Earth's atmosphere today	
gas	**%**	**gas**	**%**
carbon dioxide	95	nitrogen	78.00
water vapour	4	oxygen	21.00
all other gases	1	carbon dioxide	0.04
		all other gases including water vapour	0.96
average surface temperature 3 billion years ago		**average surface temperature today**	
above 400 °C		20 °C	

Figure 7

(a) Complete the bar chart showing the composition of the Earth's atmosphere 3 billion years ago by adding a bar to show the percentage of carbon dioxide.

(1)



(b) (i) Use words from the box to complete the following sentence.

(1)

has decreased	has increased	has stayed the same

Over the past 3 billion years the average surface temperature of the Earth

.....

(ii) The Earth's atmosphere 3 billion years ago contained much more water vapour than today's atmosphere.

Explain what happened to the water vapour.

(2)

.....

.....

.....

.....

(c) Scientists think that the decrease in percentage of carbon dioxide was partly due to this gas being used in the growth of primitive plants.

(i) Carbon dioxide was used in the growth of primitive plants and produced oxygen.

Give the name of the process in plants that takes in carbon dioxide and produces oxygen.

(1)

.....

(ii) Which of the following tests would show that a gas is oxygen?

(1)

☒ **A** put a lighted splint into the gas and it burns with a pop

☒ **B** put a glowing splint into the gas and it relights

☒ **C** put a lighted splint into the gas and it relights

☒ **D** put a glowing splint into the gas and it burns with a pop

(d) Many people are concerned by the increasing amount of carbon dioxide in the atmosphere.

(i) The amount of carbon dioxide in the atmosphere is measured in parts per million (ppm).

Figure 8 shows the amount of carbon dioxide in the atmosphere in June 2001 and in June 2021.

	amount of carbon dioxide in ppm
June 2001	371.17
June 2021	416.56

Figure 8

Calculate the increase in the amount of carbon dioxide, in ppm, from June 2001 to June 2021.

Give your answer to the nearest whole number.

(2)

.....

.....

.....

increase in amount of carbon dioxide = ... ppm

(ii) State **one** possible effect that could be caused by the increasing amount of carbon dioxide in the atmosphere.

(1)

.....

.....

(Total for Question 4 = 9 marks)

BLANK PAGE

5 Ethanol can be made by fermentation of a solution of glucose, a carbohydrate.

A student used the apparatus shown in Figure 9 for the fermentation reaction.

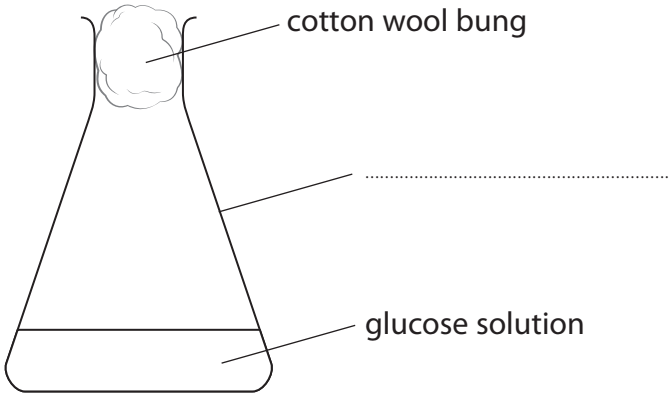


Figure 9

(a) Complete the missing label on Figure 9.

(1)

(b) The student dissolved 45 g of glucose in water to make 150 cm^3 of glucose solution.

Calculate the concentration of this solution in g dm^{-3}.

(2)

.....

.....

concentration of glucose solution = ... g dm^{-3}

(c) State what should be added to the glucose solution to cause the fermentation reaction.

(1)

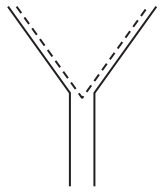
.....

(d) After a few days, a dilute solution of ethanol is formed.

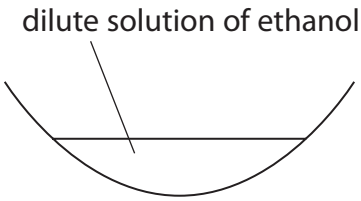
Which piece of apparatus should be used to produce a concentrated solution of ethanol from the dilute solution of ethanol by fractional distillation?

(1)

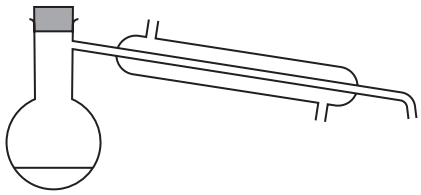
☒ **A**



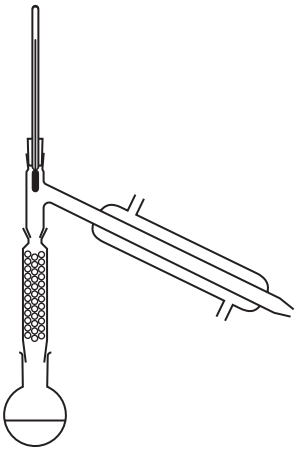
☒ **C**



☒ **B**



☒ **D**



(e) The complete fermentation of 180 g of glucose produces 92 g of ethanol.

Calculate the maximum mass of ethanol, in g, produced from the complete fermentation of 45 g of glucose.

(2)

.....

.....

.....

maximum mass of ethanol = ... g

(f) The structure of a molecule of ethanol is shown in Figure 10.

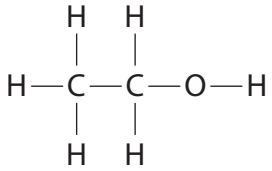
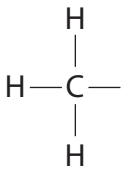


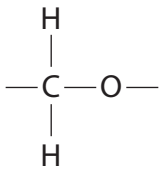
Figure 10

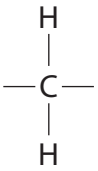
Ethanol is an example of an alcohol.

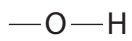
What is the functional group of an alcohol?

(1)

☒ **A** 

☒ **C** 

☒ **B** 

☒ **D** 

(g) Ethanol can be oxidised to form ethanoic acid.

State what is seen when a piece of universal indicator paper is placed in some dilute ethanoic acid.

(1)

.....

.....

(Total for Question 5 = 9 marks)

6 Chlorine is an element in group 7 of the periodic table.

(a) What name is given to group 7 of the periodic table?

(1)

- ☒ **A** alkali metals
- ☒ **B** halogens
- ☒ **C** noble gases
- ☒ **D** transition metals

(b) Chlorine reacts with sodium to form sodium chloride.

(i) Write the word equation for this reaction.

(2)

..... → .....

(ii) Chlorine, Cl_2, is made of simple molecules.

Describe what is meant by the term **molecule**.

(2)

.....

.....

.....

.....

(iii) Sodium, like all metals, conducts electricity.

Explain how sodium conducts electricity.

(2)

.....

.....

.....

.....

(iv) Sodium chloride contains sodium ions, Na^+, and chloride ions, Cl^-.

Use this information to state the formula of sodium chloride.

(1)

.....

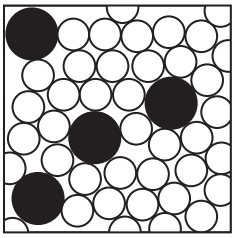
DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA

(v) Sodium chloride is made of a giant structure of ions.

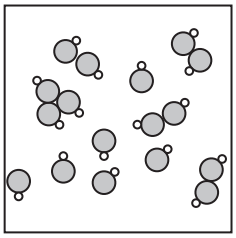
Which diagram shows the arrangement of particles in sodium chloride?

(1)

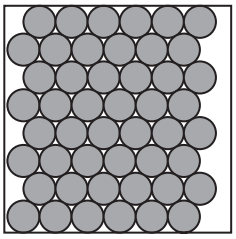
☒ **A**



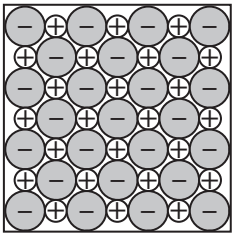
☒ **C**



☒ **B**



☒ **D**



(vi) Sodium chloride solution conducts electricity.

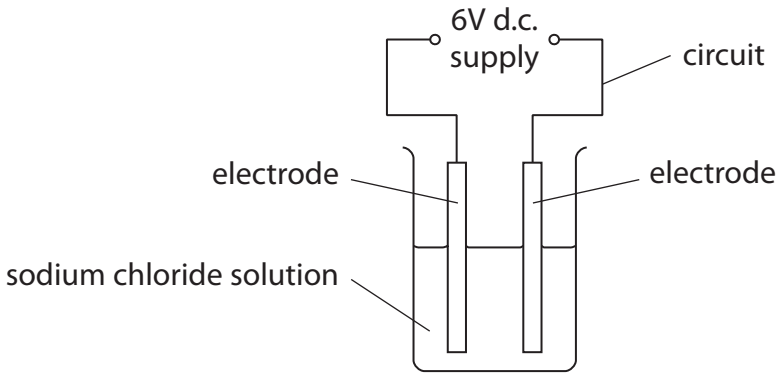


Figure 11

State what can be put into the circuit in Figure 11 to show that a current is flowing.

(1)

.....

(c) Figure 12 shows a flow diagram of how hydrochloric acid can be made.

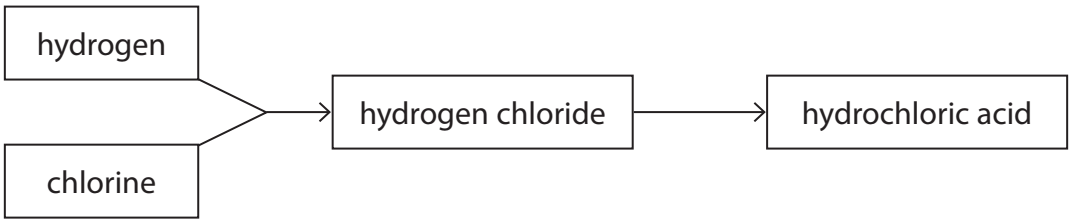


Figure 12

(i) Balance the equation for the reaction between hydrogen and chlorine to form hydrogen chloride.

(1)

$H_2 + Cl_2 \rightarrow$ ..... HCl

(ii) State how hydrogen chloride can be converted into hydrochloric acid.

(1)

.....

.....

(Total for Question 6 = 12 marks)

7 In the complete combustion of alkanes, the alkane reacts with oxygen to produce carbon dioxide and water only.

(a) Pentane, C_5H_{12}, is an alkane.

The equation for the complete combustion of pentane, C_5H_{12}, can be shown as

$$C_5H_{12} + 8O_2 \rightarrow \mathbf{w}CO_2 + 6H_2O$$

(i) What is the value of **w** needed to balance the equation for the reaction?

(1)

☒ **A** 2

☒ **B** 5

☒ **C** 8

☒ **D** 12

(ii) What happens to pentane in this reaction?

(1)

☒ **A** pentane is cracked

☒ **B** pentane is distilled

☒ **C** pentane is oxidised

☒ **D** pentane is reduced

(b) Figure 13 shows some information about four alkanes.

(i) Complete Figure 13 to show the structure of one molecule of propane and the formula of butane.

(2)

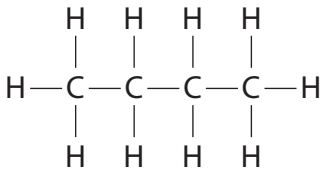
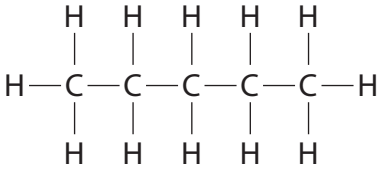
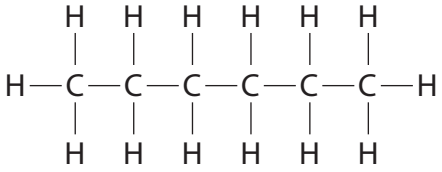
alkane	formula	structure of one molecule
propane	C_3H_8	.....
butane	.....	
pentane	C_5H_{12}	
hexane	C_6H_{14}	

Figure 13

(ii) Using the information in Figure 13, give the empirical formula of hexane.

(1)

.....

*(iii) A student is asked to compare the amount of energy released during the combustion of two alkanes, hexane and octane.

The student is given the apparatus shown in Figure 14.

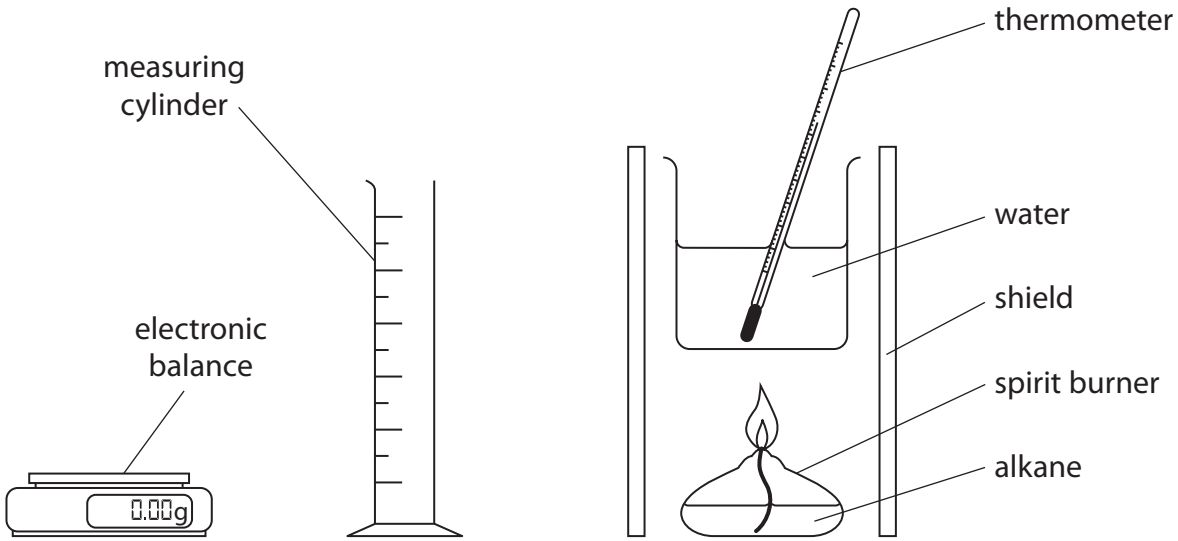


Figure 14

Using the apparatus shown, devise a plan for the student to compare the masses of hexane and octane required to raise the temperature of water by 30 °C, describing how any variables in the experiment can be controlled to make a fair comparison.

(6)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(Total for Question 7 = 11 marks)

8 A student used the apparatus shown in Figure 15 to investigate the reaction between marble chips and dilute hydrochloric acid.

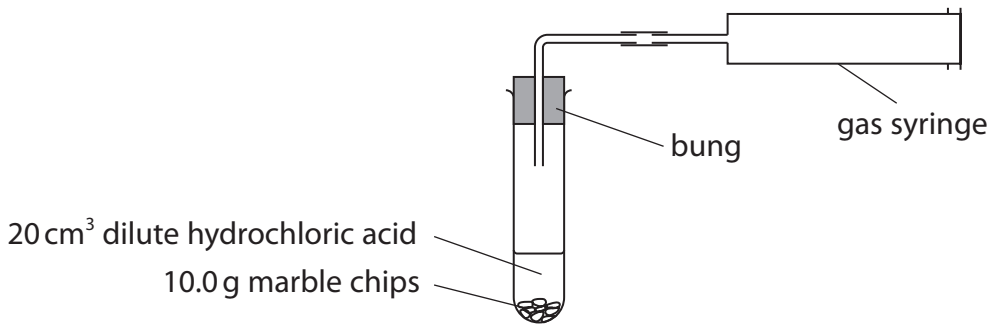


Figure 15

The student recorded the volume of gas every minute as shown in Figure 16.

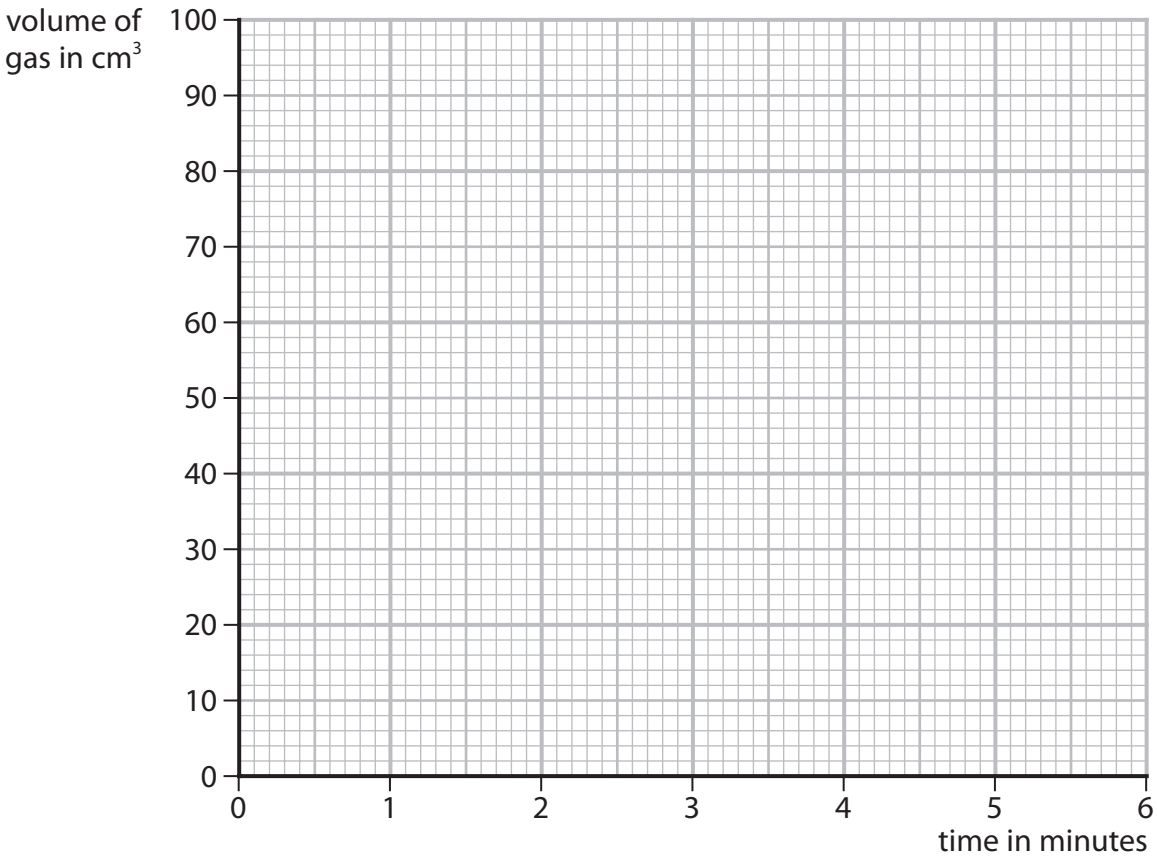
time in minutes	0	1	2	3	4	5	6
volume of gas in cm³	0	52	78	91	97	100	100

Figure 16

(a) On the grid, plot the results shown in Figure 16.

Draw a curve of best fit.

(3)



(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 17 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 17

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

(1)

.....

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

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

(3)

.....

.....

.....

.....

.....

(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'.

(2)

(d) Which of the following changes would make the reaction faster?

(1)

- ☒ **A** use a larger boiling tube
- ☒ **B** use a larger volume of the dilute acid
- ☒ **C** use a more concentrated acid
- ☒ **D** use a smaller boiling tube

(e) State what could be used to measure time in the investigation.

(1)

.....

(Total for Question 8 = 11 marks)

9 Figure 18 shows some information about some 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 18

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

(2)

.....

.....

.....

.....

(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)

..... K(.....) + Br_2(g) → ..... KBr(s)

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

Explain the meaning of the term **isotopes**.

(2)

*(e) The reactivity of the group 1 metals increases from lithium to caesium.

Often, teachers demonstrate the reactions of lithium, sodium and potassium with water.

These reactions can be used to predict the behaviour and reactions of rubidium and caesium with water.

Describe the reactions of each of the group 1 metals with water including the predicted behaviour and reactions of rubidium and caesium.

You may use word equations in your answer.

(6)

(Total for Question 9 = 13 marks)

10 (a) Atoms, molecules, nanoparticles and protons are types of particle.

List these four types of particle in order of size from smallest to largest.

(2)

smallest .....

.....

.....

largest .....

(b) Nanoparticles have a large surface area to volume ratio.

Figure 19 shows a cube-shaped nanoparticle with sides of 90 nm.

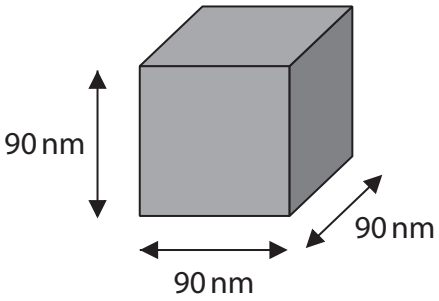


Figure 19

(i) What is 90 nm in metres?

(1)

☒ **A** 9.0×10^{-5}

☒ **B** 9.0×10^{-6}

☒ **C** 9.0×10^{-8}

☒ **D** 9.0×10^{-11}

(ii) Calculate the simplest surface area to volume ratio for the nanoparticle in Figure 19.

Show your working.

(3)

.....

.....

.....

.....

surface area to volume ratio = 1 : .....

(c) Figure 20 shows the structure of a molecule of tetrafluoroethene.

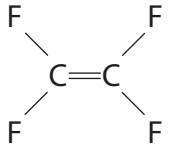


Figure 20

(i) Tetrafluoroethene can form the polymer poly(tetrafluoroethene).

Draw a diagram to show the structure of the repeating unit of this polymer.

(2)

(ii) Poly(tetrafluoroethene) is also known as Teflon™.

State one use of poly(tetrafluoroethene) and explain how one of its properties makes it suitable for that use.

(3)

use

.....

explanation

.....

.....

.....

.....

.....

(Total for Question 10 = 11 marks)

TOTAL FOR PAPER = 100 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.