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* ▶

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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**.

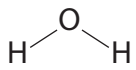
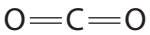
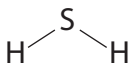
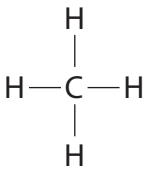
| compound A | compound B | compound C | compound D |
|---|---|---|---|
|  |  |  |  |

**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.

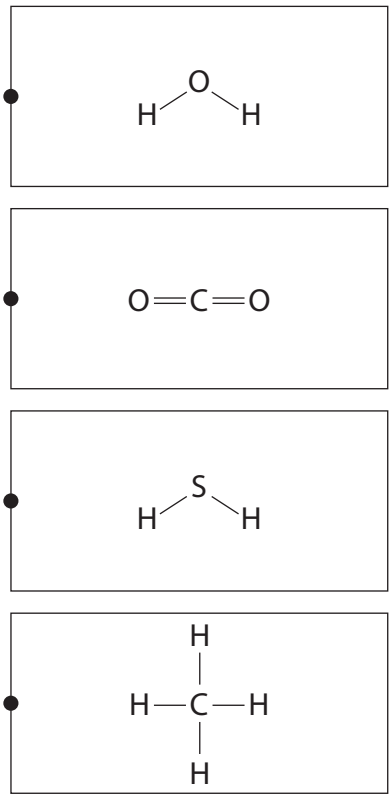
**(2)**

**name of compound**

carbon dioxide

methane

**structure of molecule**



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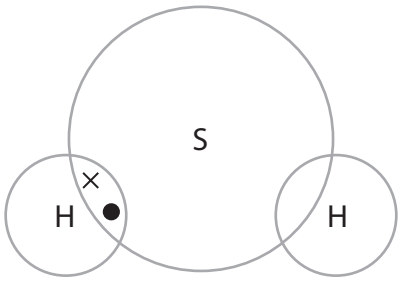
(c) Figure 2 shows information about the number of electrons in the outer shell of each of the different atoms in a molecule of compound **C**.

| 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)**

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**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.

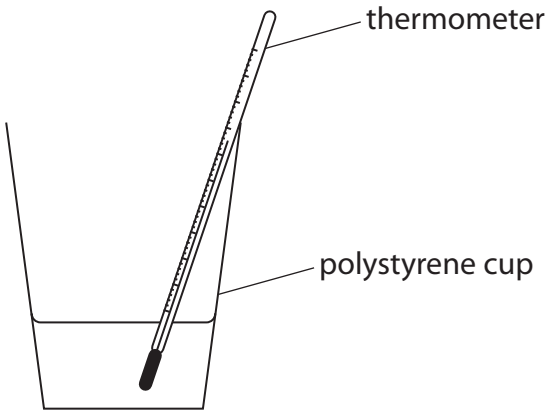



**Figure 3**

(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

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(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)**

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**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 |

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(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.

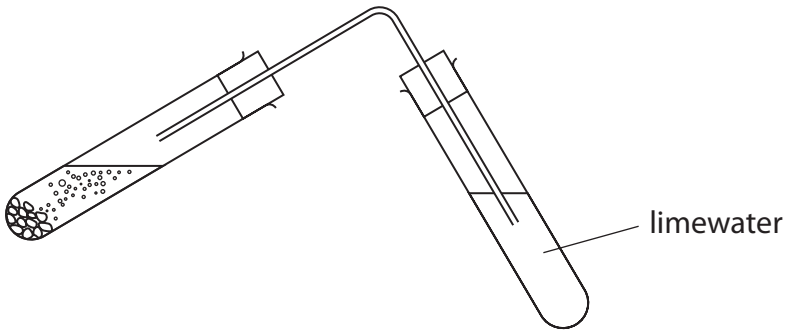



**Figure 6**

This apparatus will not work.

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

**(1)**

.....

.....

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(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)**

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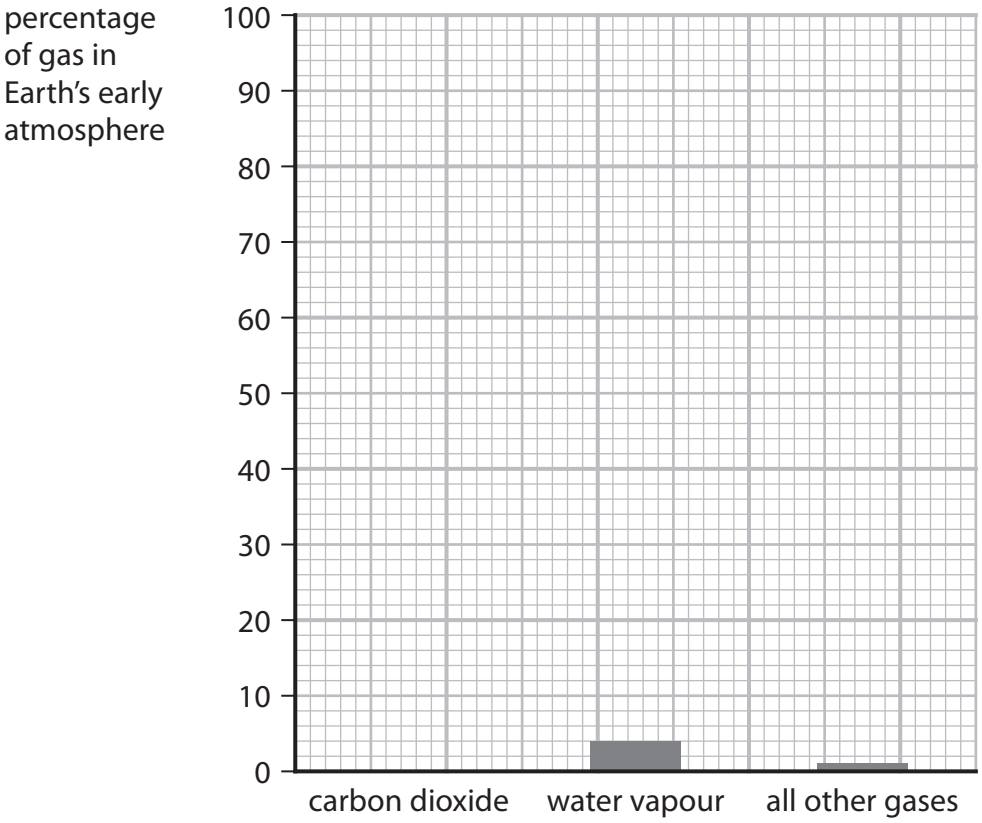
**4** A scientist produced the information in Figure 7 about the Earth's atmosphere and the Earth's average surface temperature.

| 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)**




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(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

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(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)**

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**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.

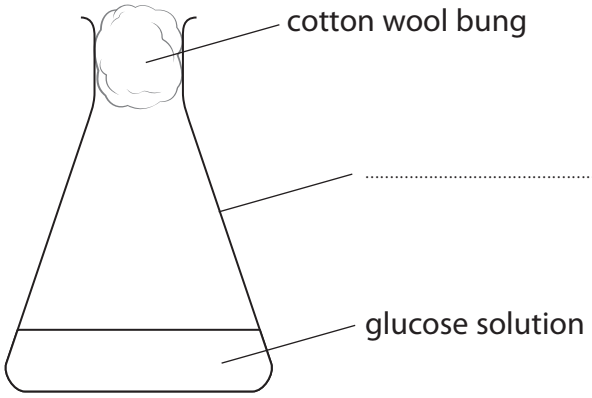



**Figure 9**

(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)**

.....

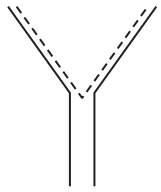
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(d) After a few days, a dilute solution of ethanol is formed.

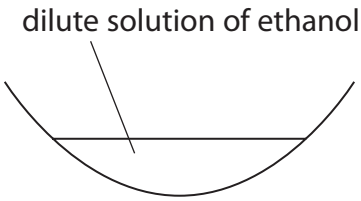
Which piece of apparatus should be used to produce a concentrated solution of ethanol from the dilute solution of ethanol by fractional distillation?

**(1)**

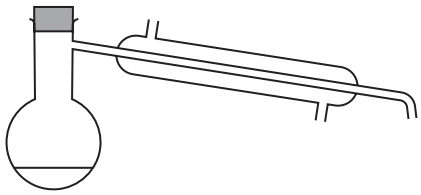
☒ **A**



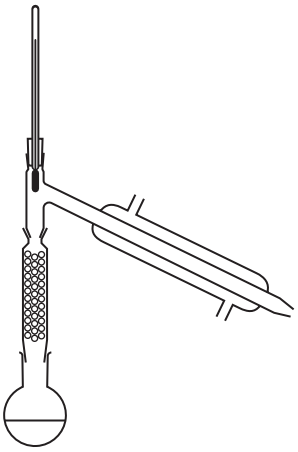
☒ **C**




☒ **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

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

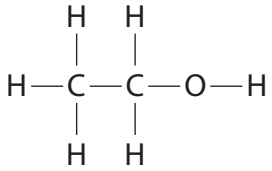
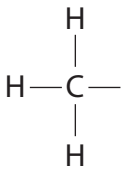


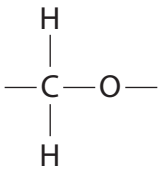
**Figure 10**

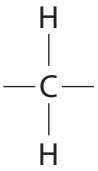
Ethanol is an example of an alcohol.

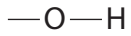
What is the functional group of an alcohol?

**(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)**

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**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)**

.....

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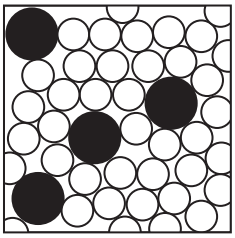
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(v) Sodium chloride is made of a giant structure of ions.

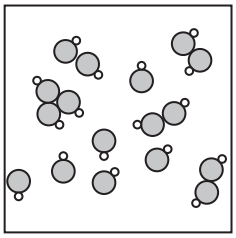
Which diagram shows the arrangement of particles in sodium chloride?

**(1)**

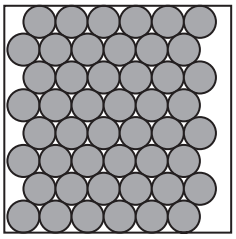
☒ **A**



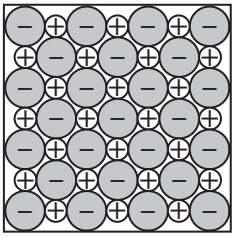
☒ **C**



☒ **B**



☒ **D**



(vi) Sodium chloride solution conducts electricity.

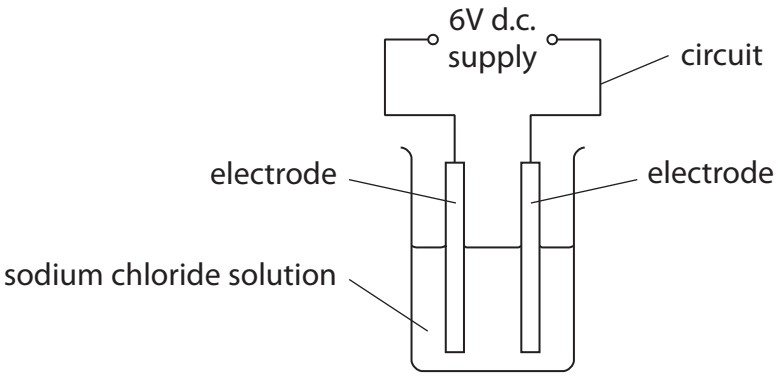



**Figure 11**

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

**(1)**

.....

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

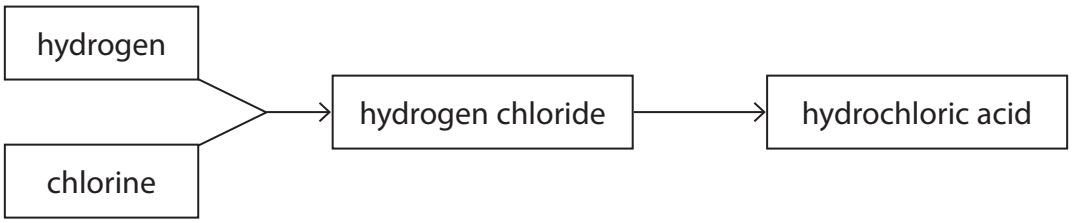



**Figure 12**

(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)**

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**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

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(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)**

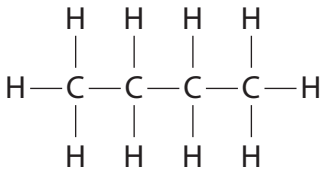
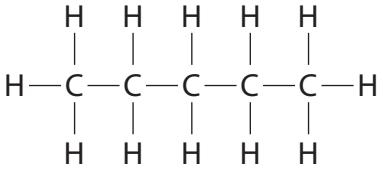
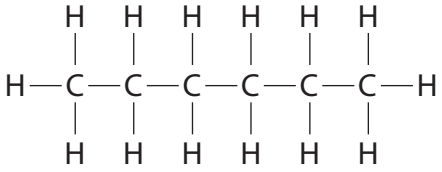
| alkane | formula | structure of one molecule |
|---|---|---|
| propane | $C_3H_8$ | ..... |
| butane | ..... |  |
| pentane | $C_5H_{12}$ |  |
| hexane | $C_6H_{14}$ |  |

**Figure 13**

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

**(1)**

.....

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*(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.

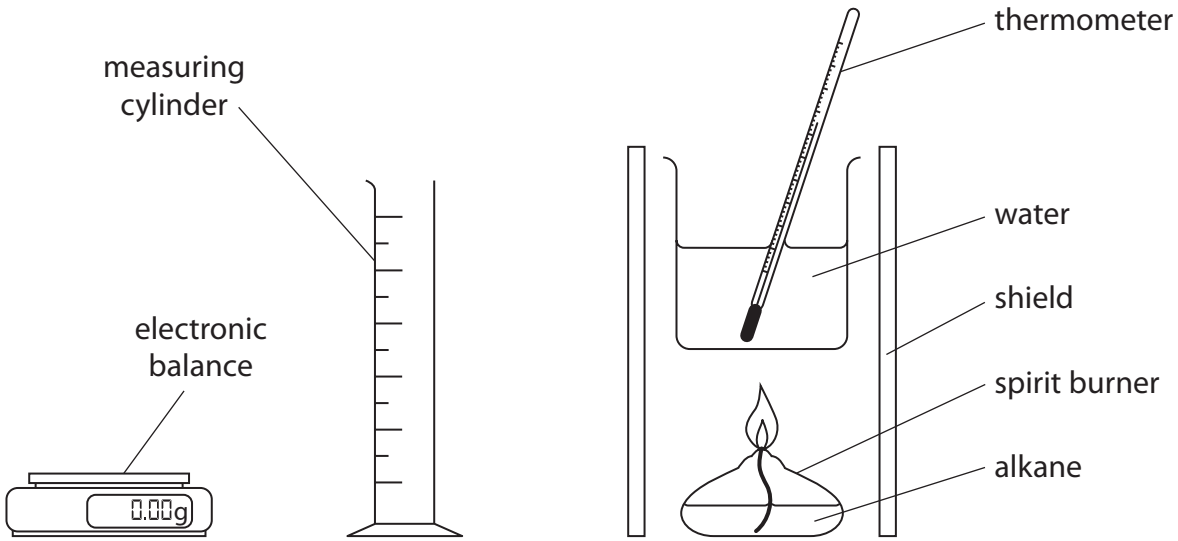



**Figure 14**

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)**

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**(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.

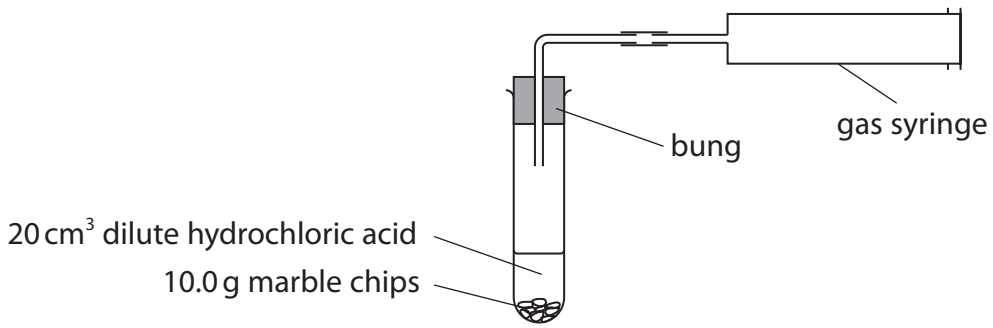



**Figure 15**

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

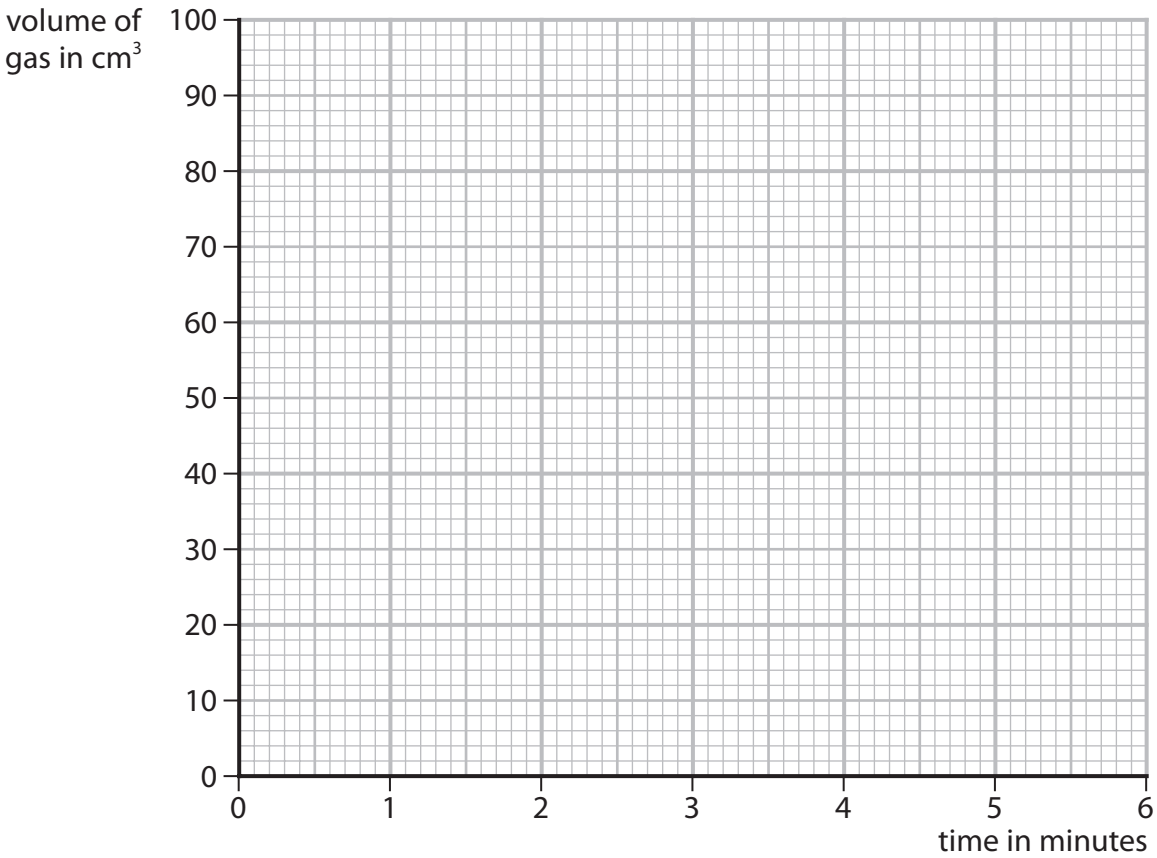
| **time in minutes** | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| **volume of gas in cm³** | 0 | 52 | 78 | 91 | 97 | 100 | 100 |

**Figure 16**

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

Draw a curve of best fit.

**(3)**




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(b) Rate of reaction can be calculated using

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

Figure 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)**

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(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)**

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**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 |

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(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)**

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**(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.

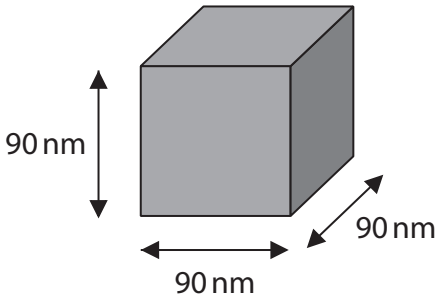



**Figure 19**

(i) What is 90 nm in metres?

**(1)**

☒ **A** $9.0 \times 10^{-5}$

☒ **B** $9.0 \times 10^{-6}$

☒ **C** $9.0 \times 10^{-8}$

☒ **D** $9.0 \times 10^{-11}$

(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 : .....

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

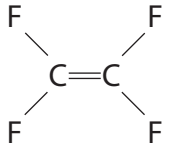



**Figure 20**

(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**

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# The periodic table of the elements

| 1 | 2 | | | | | | | | | | | 3 | 4 | 5 | 6 | 7 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 1<br>**H**<br>hydrogen<br>1 | | | | | | | | | | 4<br>**He**<br>helium<br>2 |
| 7<br>**Li**<br>lithium<br>3 | 9<br>**Be**<br>beryllium<br>4 | | | | | | | | | | | 11<br>**B**<br>boron<br>5 | 12<br>**C**<br>carbon<br>6 | 14<br>**N**<br>nitrogen<br>7 | 16<br>**O**<br>oxygen<br>8 | 19<br>**F**<br>fluorine<br>9 | 20<br>**Ne**<br>neon<br>10 |
| 23<br>**Na**<br>sodium<br>11 | 24<br>**Mg**<br>magnesium<br>12 | | | | | | | | | | | 27<br>**Al**<br>aluminium<br>13 | 28<br>**Si**<br>silicon<br>14 | 31<br>**P**<br>phosphorus<br>15 | 32<br>**S**<br>sulfur<br>16 | 35.5<br>**Cl**<br>chlorine<br>17 | 40<br>**Ar**<br>argon<br>18 |
| 39<br>**K**<br>potassium<br>19 | 40<br>**Ca**<br>calcium<br>20 | 45<br>**Sc**<br>scandium<br>21 | 48<br>**Ti**<br>titanium<br>22 | 51<br>**V**<br>vanadium<br>23 | 52<br>**Cr**<br>chromium<br>24 | 55<br>**Mn**<br>manganese<br>25 | 56<br>**Fe**<br>iron<br>26 | 59<br>**Co**<br>cobalt<br>27 | 59<br>**Ni**<br>nickel<br>28 | 63.5<br>**Cu**<br>copper<br>29 | 65<br>**Zn**<br>zinc<br>30 | 70<br>**Ga**<br>gallium<br>31 | 73<br>**Ge**<br>germanium<br>32 | 75<br>**As**<br>arsenic<br>33 | 79<br>**Se**<br>selenium<br>34 | 80<br>**Br**<br>bromine<br>35 | 84<br>**Kr**<br>krypton<br>36 |
| 85<br>**Rb**<br>rubidium<br>37 | 88<br>**Sr**<br>strontium<br>38 | 89<br>**Y**<br>yttrium<br>39 | 91<br>**Zr**<br>zirconium<br>40 | 93<br>**Nb**<br>niobium<br>41 | 96<br>**Mo**<br>molybdenum<br>42 | [98]<br>**Tc**<br>technetium<br>43 | 101<br>**Ru**<br>ruthenium<br>44 | 103<br>**Rh**<br>rhodium<br>45 | 106<br>**Pd**<br>palladium<br>46 | 108<br>**Ag**<br>silver<br>47 | 112<br>**Cd**<br>cadmium<br>48 | 115<br>**In**<br>indium<br>49 | 119<br>**Sn**<br>tin<br>50 | 122<br>**Sb**<br>antimony<br>51 | 128<br>**Te**<br>tellurium<br>52 | 127<br>**I**<br>iodine<br>53 | 131<br>**Xe**<br>xenon<br>54 |
| 133<br>**Cs**<br>caesium<br>55 | 137<br>**Ba**<br>barium<br>56 | 139<br>**La***<br>lanthanum<br>57 | 178<br>**Hf**<br>hafnium<br>72 | 181<br>**Ta**<br>tantalum<br>73 | 184<br>**W**<br>tungsten<br>74 | 186<br>**Re**<br>rhenium<br>75 | 190<br>**Os**<br>osmium<br>76 | 192<br>**Ir**<br>iridium<br>77 | 195<br>**Pt**<br>platinum<br>78 | 197<br>**Au**<br>gold<br>79 | 201<br>**Hg**<br>mercury<br>80 | 204<br>**Tl**<br>thallium<br>81 | 207<br>**Pb**<br>lead<br>82 | 209<br>**Bi**<br>bismuth<br>83 | [209]<br>**Po**<br>polonium<br>84 | [210]<br>**At**<br>astatine<br>85 | [222]<br>**Rn**<br>radon<br>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.***

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