



1.

A student investigated the mass of copper oxide produced by heating copper carbonate. This is the method used.

1. Weigh an empty test tube.
2. Weigh 2.00 g of copper carbonate into the test tube.
3. Heat the copper carbonate until there appears to be no further change.
4. Re-weigh the test tube and copper oxide produced.
5. Subtract the mass of the empty tube to find the mass of copper oxide.
6. Repeat steps 1–5 twice.
7. Repeat steps 1–6 with different masses of copper carbonate.

The table below shows the student's results.

Mass of copper carbonate in g	Mass of copper oxide in g			
	Trial 1	Trial 2	Trial 3	Mean
2.00	1.29	1.27	1.31	1.29
4.00	2.89	2.57	2.59	2.58
6.00	3.85	3.90	3.87	3.87
8.00	5.12	5.15	5.09	X
10.00	6.42	6.45	6.45	6.44

The equation for the reaction is:



- (a) Complete the sentence.

The state symbol shows carbon dioxide is a _____ .

(1)

- (b) Why do the contents of the test tube lose mass in the investigation?

(1)



(c) Calculate the mean mass **X** in the table above.

X = _____ g

(1)

(d) One of the results in the table above is anomalous.

Which result is anomalous?

Mass of copper carbonate _____ g Trial _____

(1)

(e) Suggest how the investigation could be improved to make sure the reaction is complete.

(2)

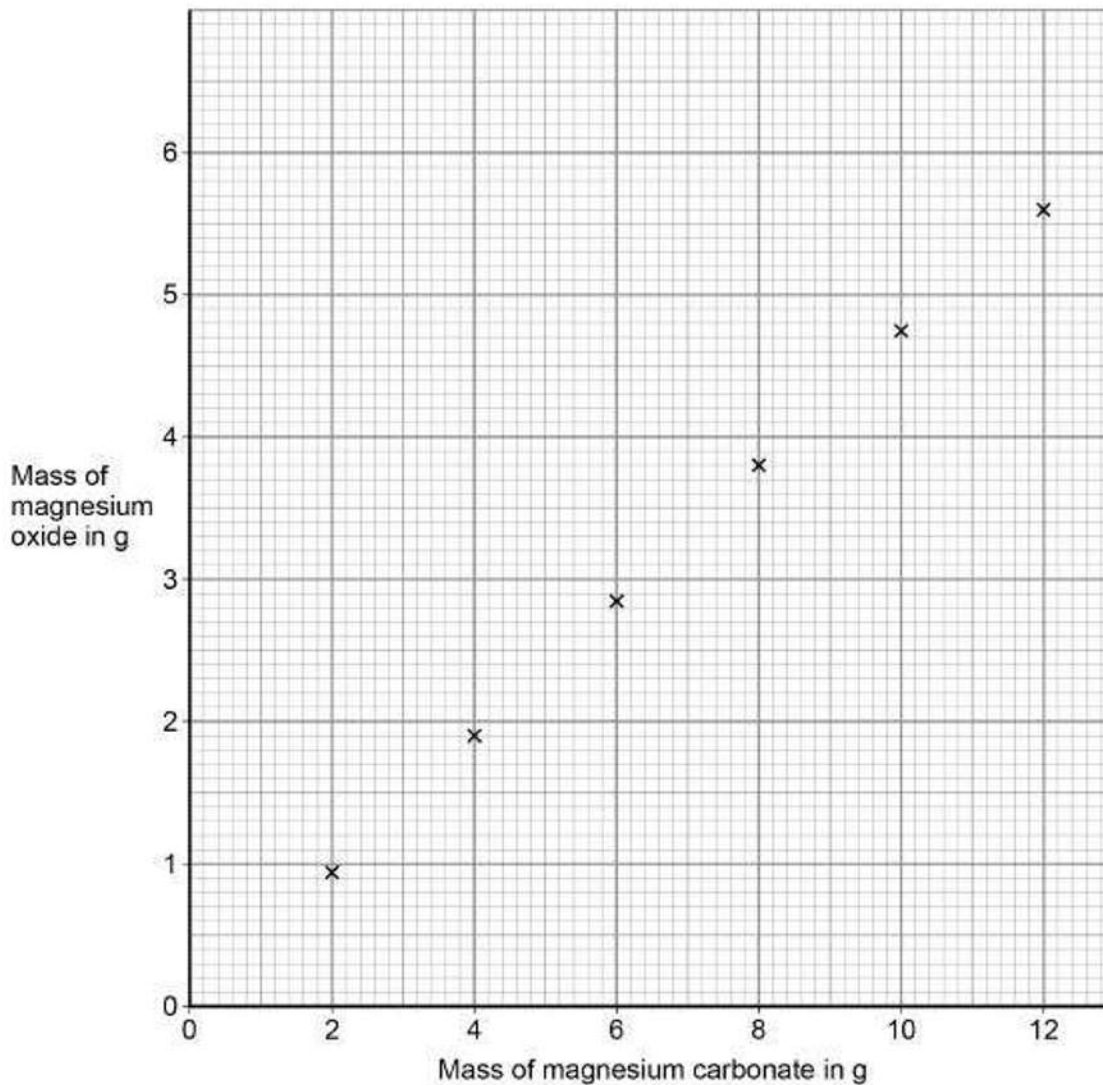
Another student repeated the investigation using magnesium carbonate instead of copper carbonate.



The word equation for the reaction is:



The graph below shows the results of the investigation.



(f) Draw a line of best fit on the graph above.

(1)

(g) Determine the mass of magnesium oxide produced by 8.4 g of magnesium carbonate.

Use the graph above.

Mass = _____ g

(1)

(h) Calculate the mass of magnesium oxide produced when 168 g of magnesium carbonate is heated.



Use your answer to part (g)

Mass of magnesium oxide produced = _____ g

(2)

(Total 10 marks)

2.

This question is about atoms.

(a) What does the number 19 represent in ${}_{9}^{19}\text{F}$?

(1)

(b) How many atoms are present in one mole of fluorine atoms?

Tick (✓) **one** box.

2.03×10^{26}

2.06×10^{23}

6.02×10^{23}

6.02×10^{26}

(1)



- (c) The plum pudding model of the atom was replaced by the nuclear model.
The nuclear model was developed after the alpha particle scattering experiment.
Compare the plum pudding model with the nuclear model of the atom.

(4)

- (d) An element has three isotopes.
The table shows the mass numbers and percentage of each isotope.

	Isotope 1	Isotope 2	Isotope 3
Mass number	24	25	26
Percentage (%)	78.6	10.1	11.3

Calculate the relative atomic mass (A_r) of the element.

Give your answer to 3 significant figures.

Relative atomic mass = _____

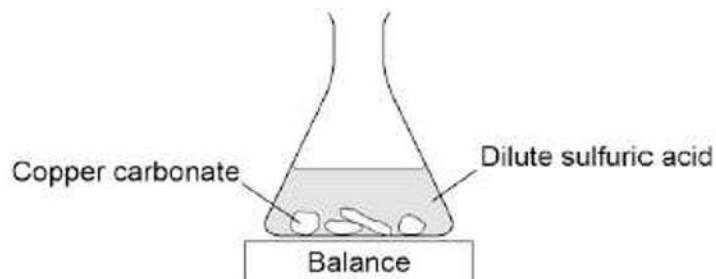
(2)

(Total 8 marks)

3.

A student investigated the reaction of copper carbonate with dilute sulfuric acid.

The student used the apparatus shown in the figure below.



(a) Complete the state symbols in the equation.



(2)

(b) Why did the balance reading decrease during the reaction?

Tick **one** box.

The copper carbonate broke down.

A salt was produced in the reaction.

A gas was lost from the flask.

Water was produced in the reaction.

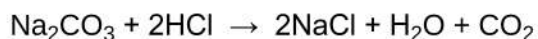
(1)

(e) Give **one** reason why is it important for the percentage atom economy of a reaction to be as high as possible.



(1)
(Total 13 marks)

4. Sodium carbonate reacts with dilute hydrochloric acid:

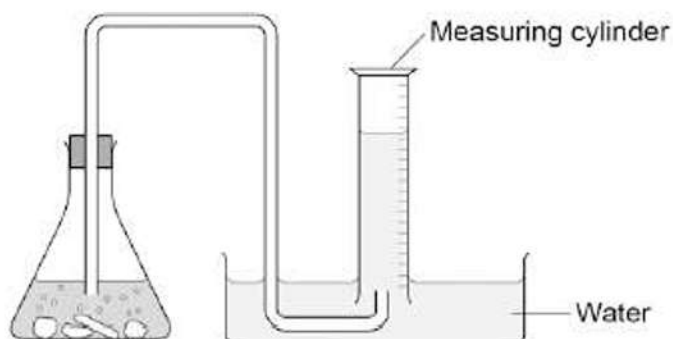


A student investigated the volume of carbon dioxide produced when different masses of sodium carbonate were reacted with dilute hydrochloric acid.

This is the method used.

1. Place a known mass of sodium carbonate in a conical flask.
2. Measure 10 cm³ of dilute hydrochloric acid using a measuring cylinder.
3. Pour the acid into the conical flask.
4. Place a bung in the flask and collect the gas until the reaction is complete.

(a) The student set up the apparatus as shown in the figure below.



Identify the error in the way the student set up the apparatus.

Describe what would happen if the student used the apparatus shown.

(2)



(b) The student corrected the error.

The student's results are shown in the table below.

Mass of sodium carbonate in g	Volume of carbon dioxide gas in cm ³
0.07	16.0
0.12	27.5
0.23	52.0
0.29	12.5
0.34	77.0
0.54	95.0
0.59	95.0
0.65	95.0

The result for 0.29 g of sodium carbonate is anomalous.

Suggest what may have happened to cause this anomalous result.

(1)

(c) Why does the volume of carbon dioxide collected stop increasing at 95.0 cm³?

(1)

(d) What further work could the student do to be more certain about the minimum mass of sodium carbonate needed to produce 95.0 cm³ of carbon dioxide?

(1)



(e) The carbon dioxide was collected at room temperature and pressure.

The volume of one mole of any gas at room temperature and pressure is 24.0 dm^3 .

How many moles of carbon dioxide is 95.0 cm^3 ?

Give your answer in three significant figures.

_____ mol

(2)

(f) Suggest **one** improvement that could be made to the apparatus used that would give more accurate results.

Give a reason for your answer.

(2)

(g) One student said that the results of the experiment were wrong because the first few bubbles of gas collected were air.

A second student said this would make no difference to the results.

Explain why the second student was correct.

(2)

(Total 11 marks)



5. This question is about carbon and gases in the air.

(a) Carbon atoms have protons, neutrons and electrons.

Complete the table by writing the relative mass of a neutron and an electron.

Name of particle	Relative mass
proton	1
neutron	
electron	

(2)

(b) What is the total number of protons and neutrons in an atom called?

Tick (✓) **one** box.

The atomic number

The mass number

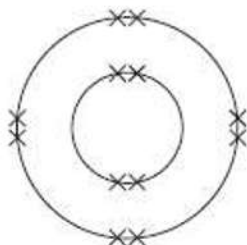
One mole of the atom

(1)

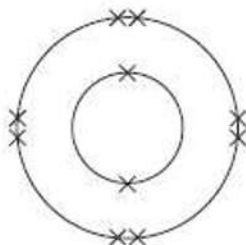
(c) An atom of carbon has six electrons.

Which structure, **A**, **B** or **C**, represents the electronic structure of the carbon atom?

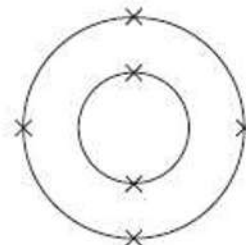
Structure A



Structure B



Structure C



The carbon atom is structure

(1)



(d) Carbon reacts with oxygen to produce carbon dioxide (CO_2).

(i) How many different elements are in one molecule of carbon dioxide?

(1)

(ii) What is the total number of atoms in one molecule of carbon dioxide?

(1)

(e) Sometimes carbon reacts with oxygen to produce carbon monoxide (CO).

(i) Calculate the relative formula mass (M_r) of carbon monoxide.

Relative atomic masses (A_r): C = 12; O = 16

M_r of carbon monoxide = _____

(1)

(ii) Calculate the percentage by mass of carbon in carbon monoxide.

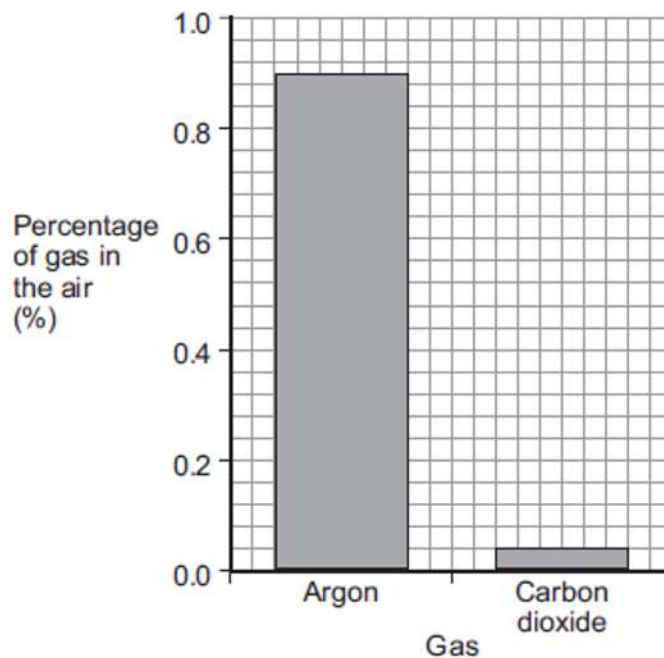
Percentage by mass of carbon in carbon monoxide = _____%

(1)



(f) Carbon dioxide is one of the gases in the air.

(i) The graph shows the percentage of argon and the percentage of carbon dioxide in the air.



What is the percentage of argon in the air?

Percentage of argon = _____ %

(1)

(ii) An instrumental method is used to measure the amount of carbon dioxide in the air.

Give **one** reason for using an instrumental method.

(1)

(Total 10 marks)