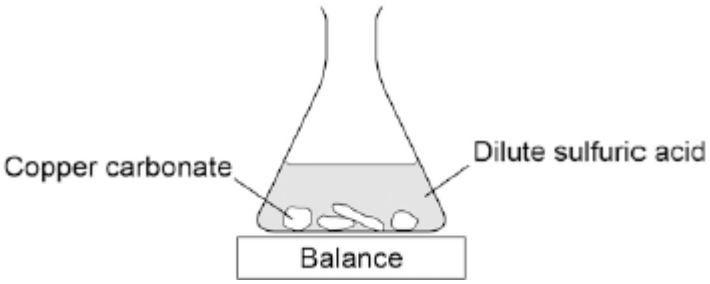
Q1.A student investigated the reaction of copper carbonate with dilute sulfuric acid.

The student used the apparatus shown in the figure below.



(a) Complete the state symbols in the equation.

$$CuCO_3\ (.....) + H_2SO_4\ (aq) \rightarrow CuSO_4\ (aq) + H_2O\ (.....) + CO_2\ (g)$$

(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)

(c) Describe a safe method for making pure crystals of copper sulfate from copper carbonate and dilute sulfuric acid. Use the information in the figure above to help you.

In your method you should name all of the apparatus you will use.

.....

.....

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(6)

(d) The percentage atom economy for a reaction is calculated using:

$$\frac{\text{Relative formula mass of desired product from equation}}{\text{Sum of relative formula masses of all reactants from equation}} \times 100$$

The equation for the reaction of copper carbonate and sulfuric acid is:

$CuCO_3 + H_2SO_4 \rightarrow CuSO_4 + H_2O + CO_2$

Relative formula masses : $CuCO_3$ = 123.5; H_2SO_4 = 98.0; $CuSO_4$ = 159.5

Calculate the percentage atom economy for making copper sulfate from copper carbonate.

.....

.....

.....

.....

.....

Atom economy = ... %

(3)

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

.....

.....

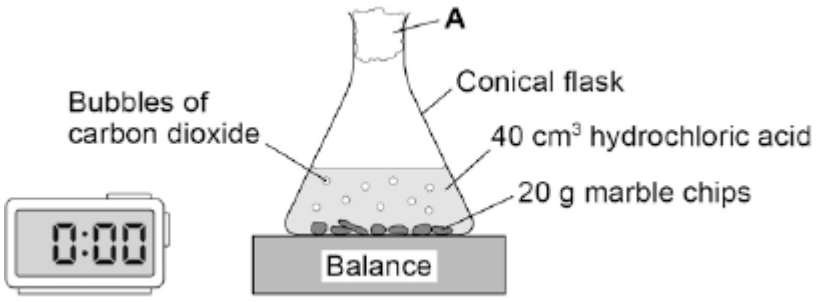
(1)

(Total 13 marks)

Q2.A student investigated the rate of reaction between marble chips and hydrochloric acid.

Figure 1 shows the apparatus the student used.

Figure 1



(a) What is **A**?

Tick **one** box.

cotton wool ☐

limestone ☐

poly(ethene) ☐

rubber bung ☐

(1)

(b) **Table 1** shows the student's results for one investigation.

Table 1

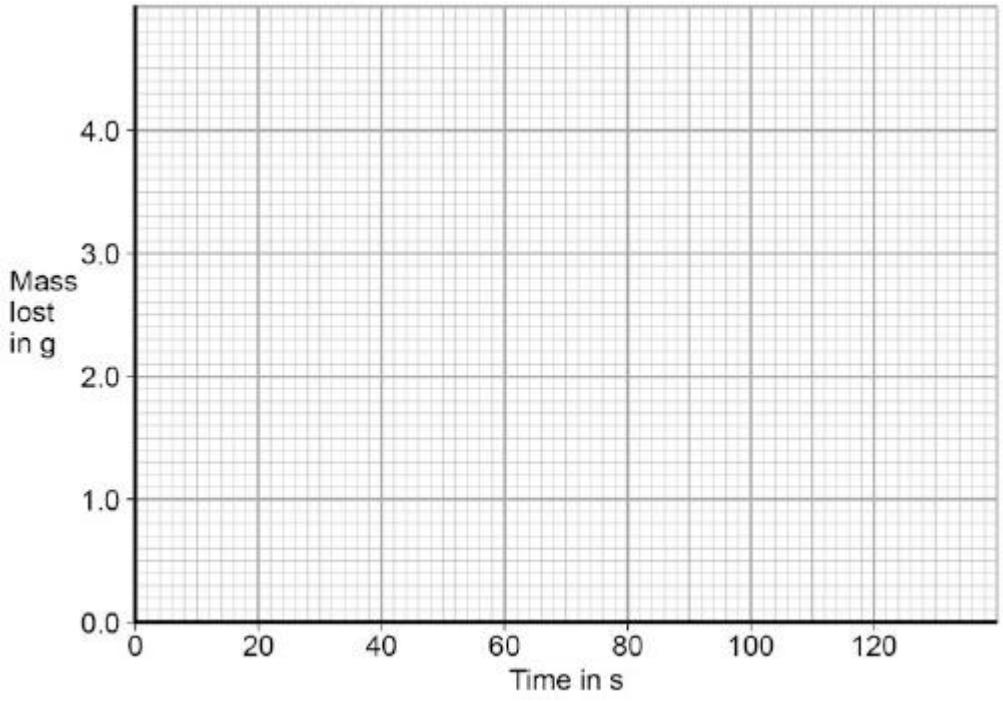
Time in s	Mass lost in g
0	0.0
20	1.6
40	2.6
60	2.9

80	3.7
100	4.0
120	4.0

On **Figure 2**:

- Plot these results on the grid.
- Draw a line of best fit.

Figure 2



(3)

(c) Use **Figure 2** to complete **Table 2**.

Table 2

Mass lost after 0.5 minutes	..... g
Time taken to complete the reaction	..... s

(2)

(d) The equation for the reaction is:

$2HCl(aq) + CaCO_3(s) \rightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$

Explain why there is a loss in mass in this investigation.

.....

.....

.....

.....

(2)

(e) Another student investigated the rate of a different reaction.

Table 3 shows the results from the different reaction.

Table 3

Mass lost when the reaction was complete	9.85 g
Time taken to complete the reaction	2 minutes 30 seconds

Calculate the mean rate of the reaction using **Table 3** and the equation:

$$\text{mean rate of reaction} = \frac{\text{mass lost in g}}{\text{time taken in s}}$$

Give your answer to two decimal places.

.....

.....

Mean rate of reaction = ... g / s

(2)

(f) The student measured the change in mass of the reactants.

Describe another method, other than measuring the change in mass of the reactions, that the student could have used to find the rate of the reaction between marble chips and

hydrochloric acid.

.....

.....

.....

.....

(2)

(g) Another student planned to investigate the effect of temperature on the rate of reaction. The student predicted that the rate of reaction would increase as the temperature was increased.

Give **two** reasons why the student's prediction is correct.

Tick **two** boxes.

The particles are more concentrated.	☐
The particles have a greater mass.	☐
The particles have a larger surface area.	☐
The particles have more energy.	☐
The particles move faster.	☐

(2)
(Total 14 marks)

Q3. Copper is a transition metal.

(a) (i) Where is copper in the periodic table?

Tick (✓) **one** box.

in the central block ☐

in Group 1 ☐

in the noble gas group ☐

(1)

(ii) What is a property of copper?

Tick (✓) **one** box.

breaks easily ☐

conducts electricity ☐

does not conduct heat ☐

(1)

(b) Copper ores are quarried by digging large holes in the ground, as shown in **Figure 1**.

Figure 1



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Give **two** reasons why quarrying is bad for the environment.

.....

.....

.....

.....

(2)

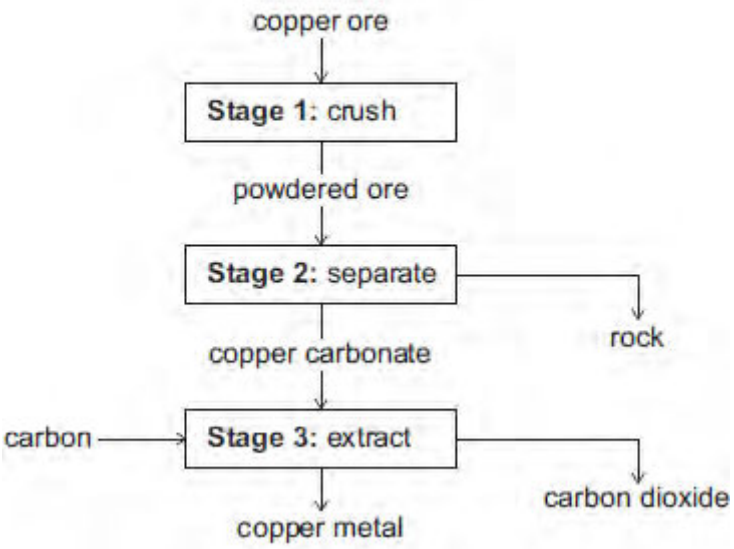
(c) Some copper ores contain only 2% copper.

Most of the ore is rock that is not needed.

In one ore, the main compound is copper carbonate ($CuCO_3$).

Figure 2 shows the stages used in the extraction of copper from this ore.

Figure 2



(i) Why is **Stage 2** important?

.....

.....

(1)

(ii) The equation for the reaction in **Stage 3** is:

$$2\ CuCO_3 + C \longrightarrow 2\ Cu + 3\ CO_2$$

From the symbol equation, a company calculated that 247 tonnes of copper carbonate are needed to produce 127 tonnes of copper and 132 tonnes of carbon dioxide are released.

Calculate the mass of carbon needed to make 127 tonnes of copper.

copper carbonate	+	carbon	⟶	copper	+	carbon dioxide
247 tonnes		..... tonnes		127 tonnes		132 tonnes

.....

.....

(2)

(iii) Suggest **one** reason why it is important for the company to calculate the mass of

reactants in **Stage 3**.

.....

.....

(1)
(Total 8 marks)

Q4. 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 ☐

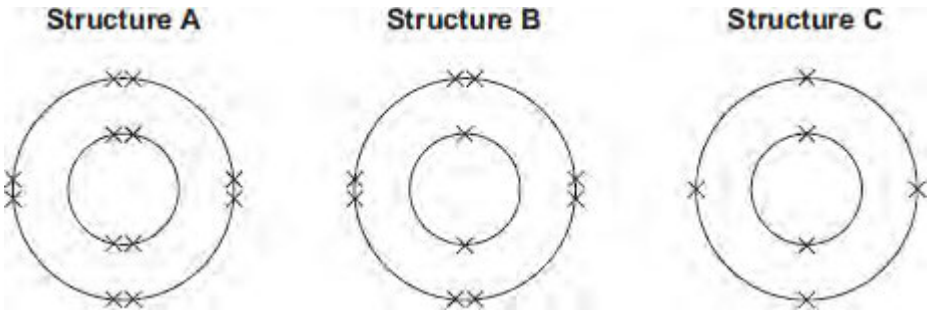
The mass number ☐

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?



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.

.....

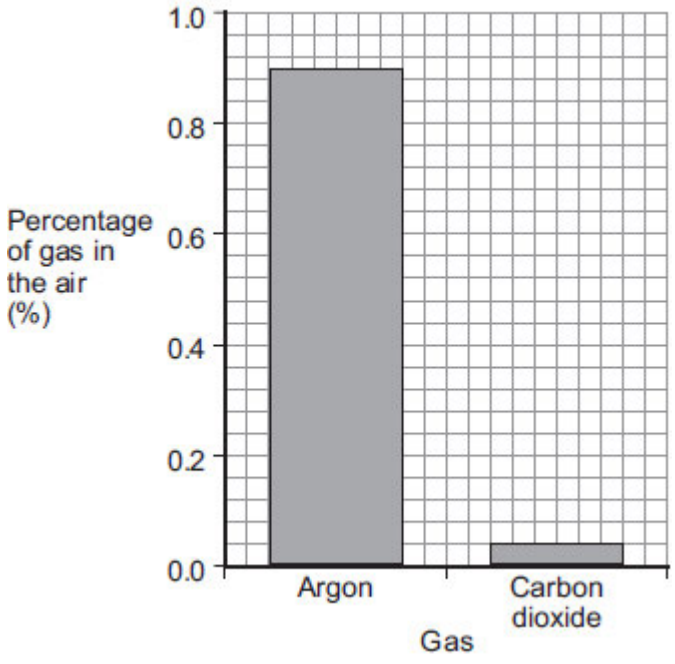
.....

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)

Q5. Printed pictures can be made using etchings.



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An etching can be made when a sheet of brass reacts with iron chloride solution.

(a) Brass is a mixture of two metals, copper and zinc.

(i) A mixture of two metals is called ..... .

(1)

(ii) Draw a ring around the correct answer to complete the sentence.

Copper and zinc atoms are different sizes.

This makes brass

harder
more flexible
softer

than the pure metals.

(1)

(b) Iron chloride has the formula $FeCl_3$

Relative atomic masses (A_r): Cl = 35.5; Fe = 56.

(i) Calculate the relative formula mass (M_r) of iron chloride ($FeCl_3$).

.....

.....

.....

Relative formula mass (M_r) of iron chloride = ...

(2)

(ii) Calculate the percentage of iron in iron chloride ($FeCl_3$).

.....

.....

.....

Percentage of iron in iron chloride = ...%

(2)
(Total 6 marks)