1. A student investigated the reactivity of three different metals.

This is the method used.

1. Place 1 g of metal powder in a test tube.
2. Add 10 cm^3 of metal sulfate.
3. Wait 1 minute and observe.
4. Repeat using the other metals and metal sulfates.

The student placed a tick in the table below if there was a reaction and a cross if there was no reaction.

	Zinc	**Copper**	**Magnesium**
Copper sulfate	✓	x	✓
Magnesium sulfate	x	x	x
Zinc sulfate	x	x	✓

(a) What is the dependent variable in the investigation?

Tick **one** box.

Time taken ☐

Type of metal ☐

Volume of metal sulfate ☐

Whether there was a reaction or not ☐

(1)

(b) Give **one** observation the student could make that shows there is a reaction between zinc and copper sulfate.

_____

_____

(1)

(c) The student used measuring instruments to measure some of the variables.

Draw **one** line from each variable to the measuring instrument used to measure the variable.

Variable	Measuring instrument
Mass of metal powder	Balance
	Measuring cylinder
	Ruler
Volume of metal sulfate	Burette
	Theromometer
	Test tube

(2)

(d) Use the results shown in table above to place zinc, copper and magnesium in order of reactivity.

Most reactive _____

↕

_____

Least reactive _____

(1)

(e) Suggest **one** reason why the student should **not** use sodium in this investigation.

_____

_____

(1)

(f) Which metal is found in the Earth as the metal itself?

Tick **one** box.

Calcium ☐

Gold ☐

Lithium ☐

Potassium ☐

(1)

(g) Iron is found in the Earth as iron oxide (Fe_2O_3).

Iron oxide is reduced to produce iron.

Balance the equation for the reaction.

___Fe_2O_3 + ___C → ___Fe + ___CO_2

(1)

(h) Name the element used to reduce iron oxide.

_____

(1)

(i) What is meant by reduction?

Tick **one** box.

Gain of iron ☐

Gain of oxide ☐

Loss of iron ☐

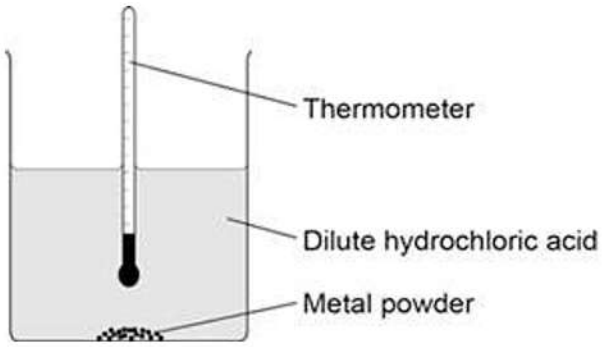
Loss of oxygen ☐

(1)

(Total 10 marks)

2. A student investigated the reactivity of different metals.

The student used the apparatus shown in the figure below.



The student used four different metals.

The student measured the temperature rise for each metal three times.

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

Metal	**Temperature rise in °C**			**Mean temperature rise in °C**
	Test 1	Test 2	Test 3	
Calcium	17.8	16.9	17.5	
Iron	6.2	6.0	6.1	6.1
Magnesium	12.5	4.2	12.3	12.4
Zinc	7.8	8.0	7.6	7.8

(a) Give **two** variables the student should control so that the investigation is a fair test.

1. _____

_____

2. _____

_____

(2)

(b) One of the results for magnesium is anomalous.

Which result is anomalous?

Suggest **one** reason why this anomalous result was obtained.

Result _____

_____

Reason _____

_____

(2)

(c) Calculate the mean temperature rise for calcium.

_____

Mean temperature rise = _____ °C

(1)

(d) The temperature rose when the metals were added to sulfuric acid.

Give **one** other observation that might be made when the metal was added to sulfuric acid. How would this observation be different for the different metals?

_____

_____

_____

_____

(2)

(e) Aluminium is more reactive than iron and zinc but less reactive than calcium and magnesium.

Predict the temperature rise when aluminium is reacted with dilute hydrochloric acid.

_____

Temperature rise = _____ °C

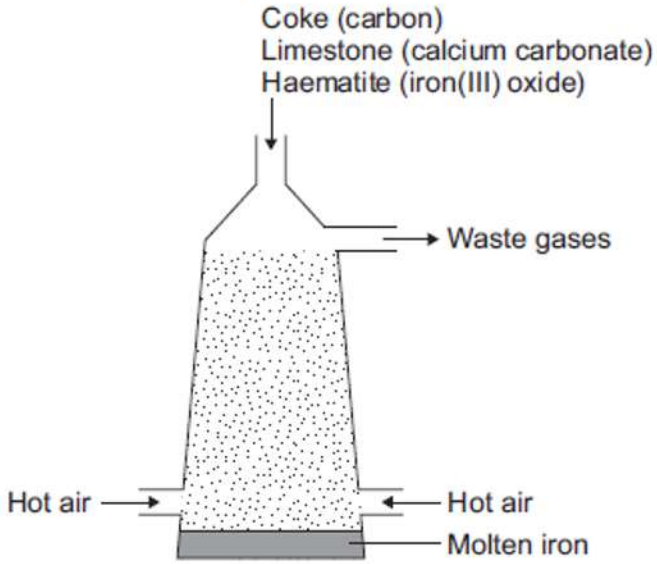
(1)

(Total 8 marks)

3. This question is about iron and aluminium.

(a) Iron is extracted in a blast furnace. **Figure 1** is a diagram of a blast furnace.

Figure 1



(i) Calcium carbonate decomposes at high temperatures.

Complete the word equation for the decomposition of calcium carbonate.

calcium carbonate ⟶ _____ +

_____

(2)

(ii) Carbon burns to produce carbon dioxide.

The carbon dioxide produced reacts with more carbon to produce carbon monoxide.

Balance the equation.

$$C(s) + CO_2(g) \longrightarrow \_\_\_\_\_\ CO(g)$$

(1)

(iii) Carbon monoxide reduces iron(III) oxide:

$$Fe_2O_3(s) + 3\ CO(g) \longrightarrow 2\ Fe(s) + 3\ CO_2(g)$$

Calculate the maximum mass of iron that can be produced from 300 tonnes of iron(III) oxide.

Relative atomic masses (A_r): O = 16; Fe = 56

_____

_____

_____

_____

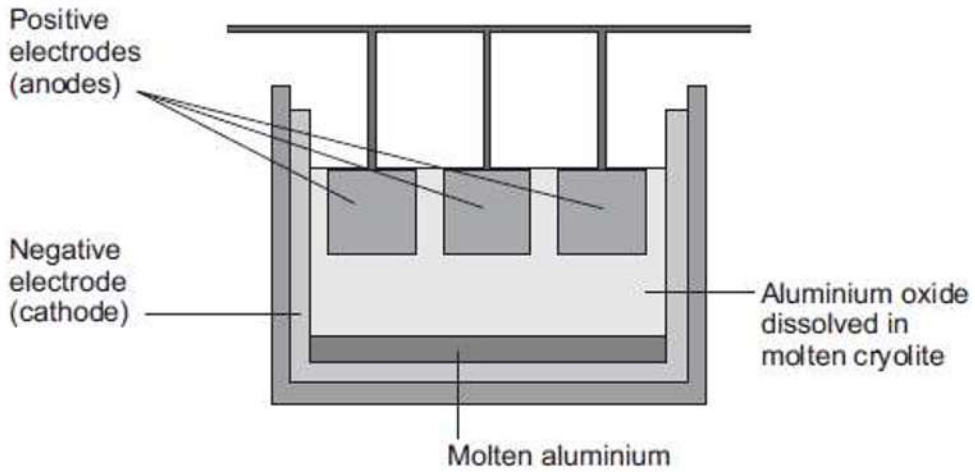
_____

Maximum mass = _____ tonnes

(3)

(b) Aluminium is extracted by electrolysis, as shown in **Figure 2**.

Figure 2



(i) Why can aluminium **not** be extracted by heating aluminium oxide with carbon?

_____

_____

(1)

(ii) Explain why aluminium forms at the negative electrode during electrolysis.

_____

_____

_____

_____

_____

_____

_____

(3)

(iii) Explain how carbon dioxide forms at the positive electrodes during electrolysis.

_____

_____

_____

_____

_____

_____

(3)

(Total 13 marks)

4. This question is about metals.

(a) Which unreactive metal is found in the Earth as the metal itself?

Tick (✓) **one** box.

aluminium ☐

gold ☐

magnesium ☐

(1)

(b) Complete the sentence.

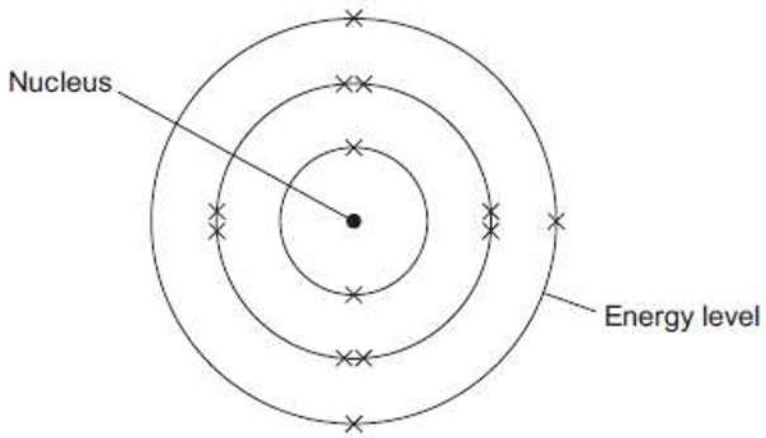
Aluminium is an element because aluminium is made of

only one type of _____ .

(1)

(c) **Figure 1** shows the electronic structure of an aluminium atom.

Figure 1



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

electrons	**ions**	**protons**	**neutrons**	**shells**

The nucleus of an aluminium atom contains _____ and

_____ .

(2)

(ii) Complete the sentence.

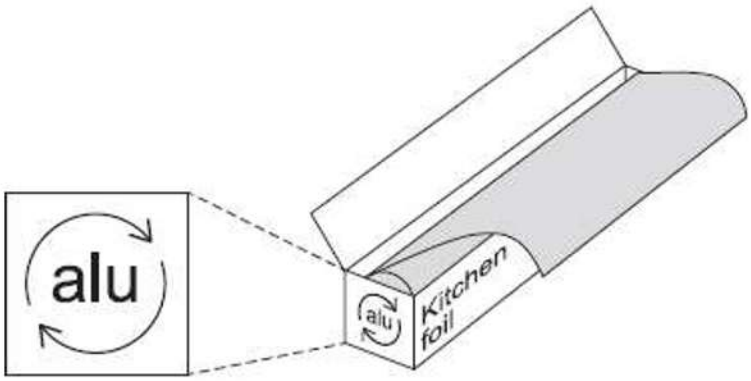
In the periodic table, aluminium is in Group _____ .

(1)

(d) Aluminium is used for kitchen foil.

Figure 2 shows a symbol on a box of kitchen foil.

Figure 2



The symbol means that aluminium can be recycled. It does not show the correct chemical symbol for aluminium.

(i) What is the correct chemical symbol for aluminium?

_____ .

(1)

(ii) Give **two** reasons why aluminium should be recycled.

_____

_____

_____

_____

(2)

(e) Aluminium has a low density, conducts electricity and is resistant to corrosion.

Which **one** of these properties makes aluminium suitable to use as kitchen foil?
Give a reason for your answer.

_____

_____

_____

_____

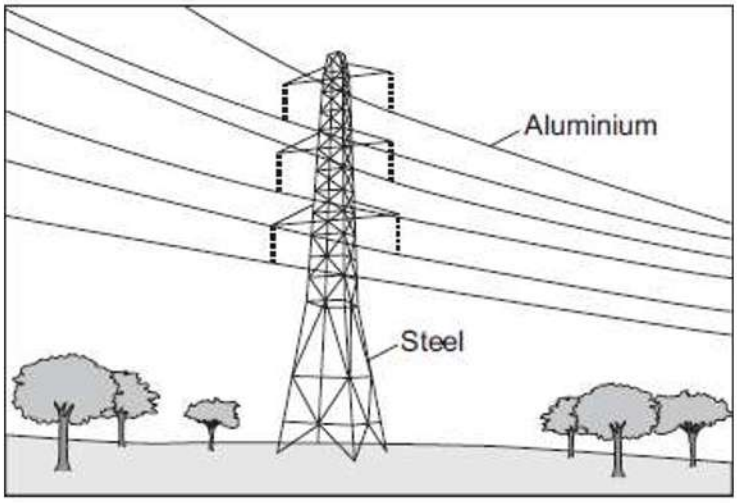
(2)

(Total 10 marks)

5. This question is about metals.

Figure 1 shows the metals used to make pylons and the wires of overhead cables.

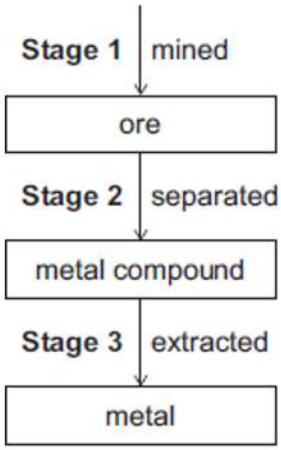
Figure 1



(a) An ore contains a metal compound.

A metal is extracted from its ore in three main stages, as shown in **Figure 2**.

Figure 2



Explain why **Stage 2** needs to be done.

_____

_____

_____

_____

(2)

(b) Cast iron from a blast furnace contains 96% iron and 4% carbon.

(i) Cast iron is not suitable for the manufacture of pylons.

Give **one** reason why.

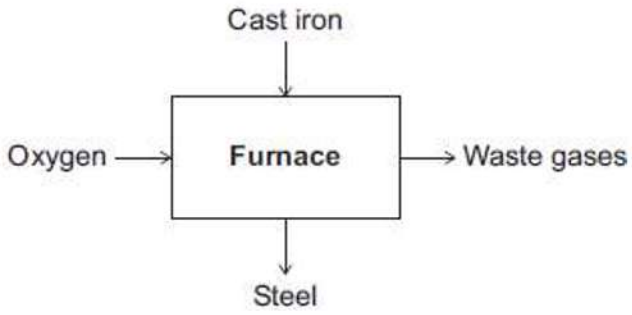
_____

_____

(1)

(ii) Most cast iron is converted into steel, as shown in **Figure 3**.

Figure 3



Describe how cast iron is converted into steel.

Use **Figure 3** to help you to answer this question.

_____

_____

_____

_____

(2)

(c) Aluminium and copper are good conductors of electricity.

(i) State **one** property that makes aluminium more suitable than copper for overhead cables.

_____

_____

(1)

(ii) How can you tell that copper is a transition metal and aluminium is **not** a transition metal from the position of each metal in the periodic table?

_____

_____

_____

_____

(2)

(iii) Copper can be extracted from solutions of copper salts by adding iron.

Explain why.

_____

_____

_____

_____

(2)

(Total 10 marks)