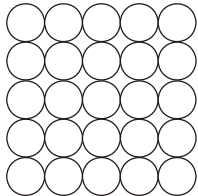


Metals and their uses

1. Iron is the main structural metal used in the world.

(a) The diagram represents the particles in iron, Fe.



Draw a ring around the correct word in the box to complete the sentence.

Iron is described as an element because all the

- | |
|-----------|
| atoms |
| compounds |
| metals |

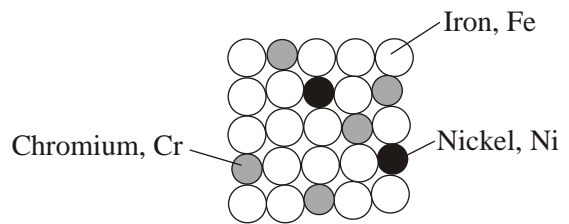
are the same.

(1)

(b) Stainless steel is mostly iron.

The diagram represents the particles in stainless steel.

Use the correct words from the box to complete the sentences about alloys.



- | | | | | | |
|-------|---------|----------|---------|-------|-----------|
| metal | mixture | molecule | polymer | smart | structure |
|-------|---------|----------|---------|-------|-----------|

Stainless steel is an alloy because it is a of iron, chromium and nickel.

An alloy is made up of more than one type of

Stainless steel alloys are harder than iron because the different sized atoms added change the

An alloy that can return to its original shape after being deformed is called a alloy.

(4)

- (c) In the UK, we use about 1.8 billion steel cans every year but only 25% are recycled. Used steel cans are worth about £100 per tonne.

Recycling saves raw materials and reduces waste that would end up in landfill. Producing steel by recycling used cans saves 75% of the energy that would be needed to produce steel from iron ore. This also reduces carbon dioxide emissions.

- (i) Give **two** reasons, from the information above, to explain why recycling used steel cans is a good idea.

1

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2

.....

(2)

- (ii) Suggest how the local council could increase the percentage of used steel cans that are recycled.

.....

.....

(1)

(Total 8 marks)

2. Niobium is a typical transition metal.

Put a tick (✓) next to each of the **four** properties in the table that you would expect for Niobium.

Property	
brittle	
conducts heat	
dull	
forms coloured compounds	
high melting point	
low boiling point	
strong	
very reactive	

(Total 4 marks)

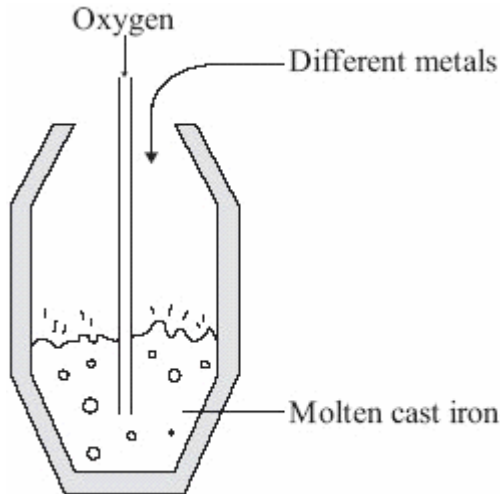
3. The demand for iron and steel is high.

(a) Iron that is extracted from its oxide by carbon reduction in a blast furnace is called cast iron. Cast iron contains about 4% carbon. This carbon makes cast iron very brittle.

Carbon steels can be made by the following processes.

- Blowing oxygen into molten cast iron to remove most of the carbon.
- Adding a calculated amount of carbon.

Sometimes different metals may also be added to the molten carbon steels.



(i) Suggest how blowing oxygen into molten cast iron removes most of the carbon.

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(2)

(ii) Why are different metals sometimes added to molten carbon steels?

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(1)

(b) The percentage of iron and steel recycled in the UK has been increasing.

Year	%iron and steel recycled
1998	25
2000	35
2002	42
2004	46
2006	57

The UK government has set targets for the percentage of iron and steel to be recycled. In 2006 the target was exceeded.

Suggest **two** reasons why the UK government wants to encourage recycling of iron and steel.

1

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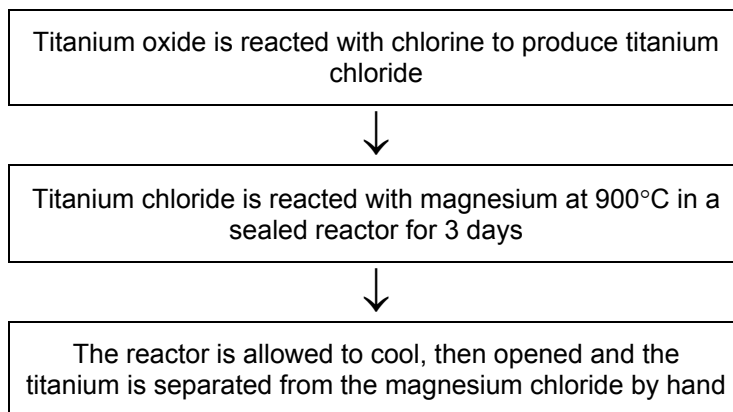
2

.....

(2)
(Total 5 marks)

4. Titanium is used in aircraft, ships and hip replacement joints. Titanium is as strong as steel but 45% lighter, and is more resistant to acids and alkalis.

Most titanium is produced from its ore, rutile (titanium oxide), by a batch process that takes up to 17 days.



Titanium reactors produce about 1 tonne of the metal per day.

Iron blast furnaces produce about 20 000 tonnes of the metal per hour.

- (a) Give **one** property of titanium that makes it more useful than steel for hip replacement joints.

.....

(1)

- (b) In the reactor magnesium is used to produce titanium. If carbon were used instead of magnesium, no titanium would be produced.

What does this tell you about the relative reactivities of carbon, magnesium and titanium?

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(2)

(c) The use of titanium is limited because it is expensive.

Explain why titanium costs more than steel.

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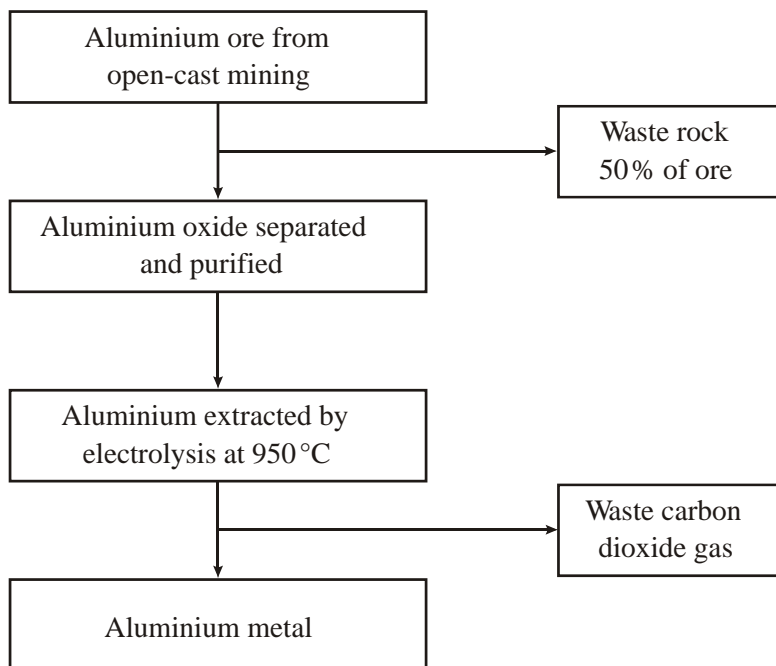
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(3)
(Total 6 marks)

5. Aluminium has many uses because of its low density, good electrical conductivity, flexibility and resistance to corrosion.

The main steps in the extraction of aluminium are shown in the flow chart.



(a) Use the information in the flow chart to suggest the benefits of recycling aluminium.

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(3)

- (b) Pure aluminium is rarely used for the construction of large objects. Small amounts of other metals are usually mixed with aluminium.

Explain why.

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(2)
(Total 5 marks)

6. Use the Reactivity Series of Metals on the Data Sheet to help you to answer this question.
The table gives information about the extraction of some metals.

Metal	Date of discovery	Main source	Main extraction method
Gold	Known to ancient civilisations	In the Earth as the metal itself	Physically separating it from the rocks it is mixed with
Zinc	1500	Zinc carbonate	Reduction by carbon
Sodium	1807	Sodium chloride	Electrolysis

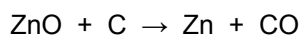
- (a) Explain why gold is found mainly as the metal itself in the Earth.

.....

.....

(1)

- (b) One of the reactions involved in producing zinc is represented by this equation.



Explain why carbon can be used to extract zinc.

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(1)

- (c) Sodium is one of the most abundant metals on Earth.

Explain, as fully as you can, why sodium was not extracted until 1807.

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(2)
(Total 4 marks)

7. Copper is found in the Earth's crust as an ore containing copper sulfide. Large areas of land, where this ore was once quarried, are contaminated with low percentages of copper sulfide. Copper would be too expensive to extract from this contaminated land using the traditional method of quarrying and then heating in a furnace.

(a) The percentage of copper ore in the contaminated land is low.

(i) It would be too expensive to extract from this land by the traditional method.

Explain why.

.....
.....

(1)

(ii) Extracting copper from this land by the traditional method would have a major environmental impact.

Give **one** reason why.

(1)

(b) One way to extract the copper from land that contains low percentages of copper sulfide is by bioleaching. Bioleaching uses bacteria. The bacteria produce a solution of copper sulfate.

It is possible to get copper from a solution of copper sulfate using scrap iron.

(i) It is economical to use scrap iron to get copper.

Give **one** reason why.

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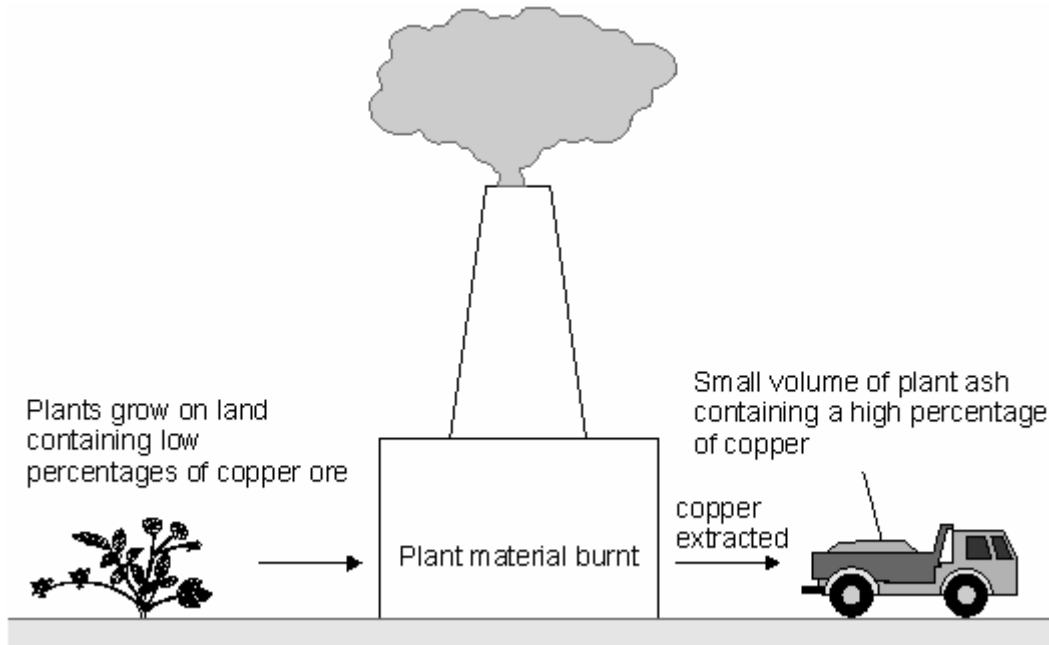
(1)

(ii) Why can iron be used to get copper from copper sulfate solution?

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(1)

- (c) A new way to extract the copper from land that contains low percentages of copper sulfide is phytomining. Phytomining uses plants. Plants are grown on this land and absorb copper compounds through their roots.



- (i) Use this information to give **two** advantages of phytomining compared to the traditional method.
- 1
- 2
- (2)
- (ii) Use this information to suggest **one** disadvantage of phytomining compared to the traditional method.
-
-

(1)
(Total 7 marks)