

1 (a) Two pieces of metal can be joined by welding them together.



(i) Complete the sentence by putting a cross (☒) in the box next to your answer.

The structure of a metal is a lattice of

(1)

- A anions
- B anions and cations
- C cations in a sea of electrons
- D molecules in a sea of electrons

(ii) To join two pieces of metal by welding, they must be melted together.

State why a high temperature has to be used.

(1)

(iii) The pieces of metal are welded together in an atmosphere of argon.

Explain why an atmosphere of argon is used.

(2)

(b) Some metals react with halogens.

Iron reacts with bromine, Br_2 , to form iron(III) bromide, FeBr_3 .

Write the balanced equation for this reaction.

(2)

(c) Complete the sentence by putting a cross (☒) in the box next to your answer.

At room temperature, iodine is a

(1)

- A** brown gas
- B** brown liquid
- C** grey solid
- D** purple gas

(d) When a halogen is added to a solution containing halide ions a displacement reaction may occur.

In the table

✓ shows a displacement reaction occurs

✗ shows a displacement reaction does not occur

halogen added	halide ion in solution		
	chloride ion	bromide ion	iodide ion
chlorine		✓	✓
bromine	✗		✓
iodine	✗	✗	

Use the information in the table to explain the order of reactivity of the three halogens.

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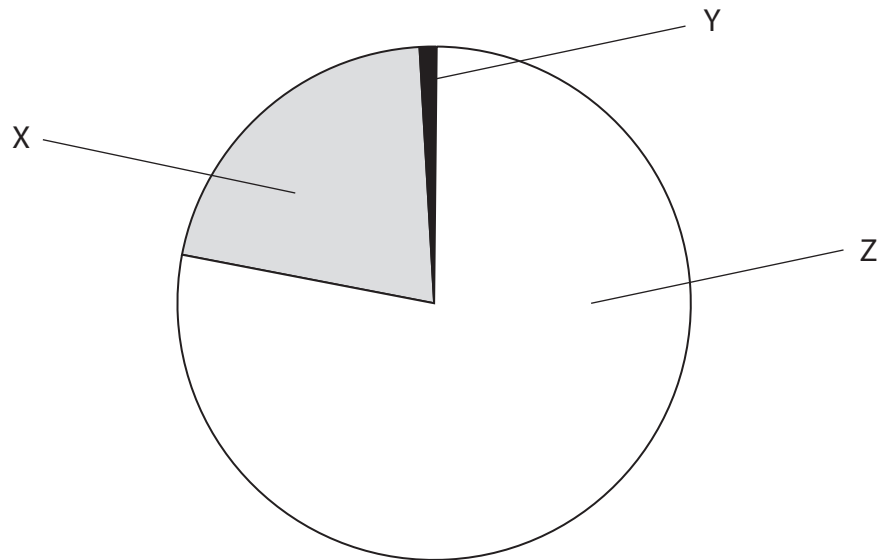
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(Total for Question 1 = 9 marks)

2 The Earth's atmosphere today contains a mixture of different gases.

(a) The pie chart shows the percentages of nitrogen, oxygen and other gases in the atmosphere.



Which row of the table identifies X, Y and Z correctly?

Put a cross (☒) in the box next to your answer.

(1)

	X	Y	Z
<input type="checkbox"/> A	oxygen	nitrogen	ot gases
<input type="checkbox"/> B	other gases	oxygen	nitrogen
<input type="checkbox"/> C	oxygen	other gases	nitrogen
<input type="checkbox"/> D	nitrogen	other gases	oxygen

- (b) (i) The percentage of oxygen in the atmosphere has increased since the Earth's earliest atmosphere.

Describe the process that has caused this change.

(2)

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- (ii) Describe a test to show a gas is oxygen.

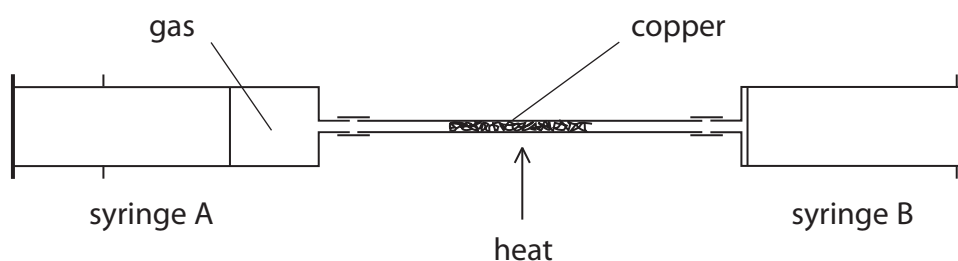
(2)

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- (c) This apparatus is used to find the volume of oxygen in 100 cm³ of air.



When heated, copper reacts with oxygen in the air to form copper oxide.

Syringe A contains 100 cm³ of air, syringe B contains no air.

The hard glass tube contains excess copper.

The copper is heated strongly and the air is passed backwards and forwards over the copper until no more copper reacts.

The apparatus is then left to cool.

- (i) State why an excess of copper must be used.

(1)

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(ii) Explain how this experiment can be used to find the volume of oxygen in 100 cm^3 of air.

(2)

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(Total for Question 2 = 8 marks)

3 The list shows some metals in order of reactivity.

most reactive	sodium
	aluminium
	zinc
	iron
	copper
least reactive	gold

(a) Aluminium and iron are extracted by reduction of their oxides.

State what is meant by reduction.

(1)

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(b) Electrolysis and heating with carbon are two methods of reduction.

Explain why aluminium needs to be extracted from its ore by electrolysis, rather than by heating with carbon.

(2)

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(c) Iron is extracted from iron oxide, Fe_2O_3 .

In the extraction process the iron oxide is heated with carbon to form iron and carbon dioxide.

Write the balanced equation for this reaction.

(3)

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*(d) Pure metal can be converted into alloys.

In many cases alloys are more useful than pure metals, for example they are stronger. Gold alloys, stainless steel and nitinol are examples of useful alloys.

Describe how alloying improves the usefulness of metals and how strength is increased in terms of structure.

You may use diagrams to help your answer.

(6)

Handwriting practice area consisting of 25 horizontal dotted lines.

(Total for Question 3 = 12 marks)

4 This is part of the reactivity series of metals.

most reactive	magnesium
	aluminium
	zinc
	iron
	copper
	silver
least reactive	gold

(a) Iron is extracted by the reduction of iron oxide.

In the extraction process, iron oxide is reduced by heating it with carbon.

(i) The extraction process involves both reduction and oxidation reactions.

State what is oxidised in this process.

(1)

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(ii) Aluminium is extracted from its oxide by electrolysis.

Explain why iron can be extracted from iron oxide by heating it with carbon but electrolysis has to be used to extract aluminium from its oxide.

(2)

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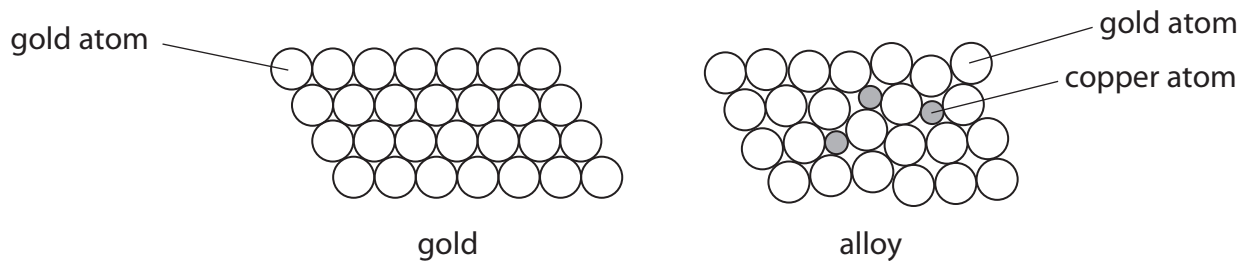
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(b) The photograph shows a mask discovered in Colombia.

It is made from a gold and copper alloy.



The diagrams show the structure of pure gold and of the alloy containing a few atoms of copper.



Explain how the presence of copper atoms results in an alloy with a higher strength than pure gold.

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*(c) Metals have specific uses based on their properties.

The table shows some properties of four metals.

metal	cost of 1 kg / £	density / g cm ⁻³	relative strength	resistance to corrosion	electrical conductivity
aluminium	1	2.70	high	good	good
copper	5	8.92	high	good	very good
gold	33000	19.3	low	excellent	excellent
silver	620	10.5	low	very good	excellent

Use the data in the table to explain some uses of each of these metals in relation to their individual properties.

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(Total for Question 4 = 12 marks)

5 (a) Copper(II) chloride contains copper ions, Cu^{2+} , and chloride ions, Cl^- .

(i) What is the formula of this copper chloride?

Put a cross (☒) in the box next to your answer.

(1)

- A CuCl
- B Cu_2Cl
- C CuCl_2
- D Cu_2Cl_2

(ii) In a reaction 0.64 g copper are reacted to produce copper chloride.
The theoretical yield of this reaction is 1.35 g copper chloride.

Explain what is meant by **theoretical yield**.

(2)

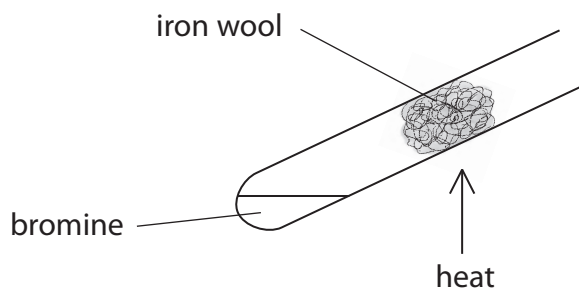
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(b) Bromine reacts with hot iron wool to produce solid iron(III) bromide, FeBr_3 .



(i) Write the balanced equation for the reaction between iron and bromine gas. Include state symbols.

(3)

(ii) Calculate the relative formula mass of iron(III) bromide, FeBr_3 .
(Relative atomic masses: Fe = 56, Br = 80)

(1)

relative formula mass =

(iii) Iron also reacts with iodine to form iron(II) iodide, FeI_2 .

Calculate the percentage by mass of iron in iron(II) iodide.

(Relative formula mass $\text{FeI}_2 = 310$)

(2)

percentage by mass of iron =%

(iv) Hydrogen peroxide reacts with some iron compounds.

The molecular formula of hydrogen peroxide is H_2O_2 .

Give the empirical formula of hydrogen peroxide.

(1)

(Total for Question 5 = 10 marks)