AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.2.2.8

Metals as conductors

Past-paper questions

Tier	**Higher**
Question groups	**12**
Available paper years	**2007–2024**

Using this booklet

1. Answer the questions in order and show your working.
2. Original question numbers and marks are retained.
3. Print at actual size (100%) for measuring questions.
4. Use the companion answer booklet to check your work.

Name: _____ **Date:** _____

Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

4.2.2.8 Metals as conductors

Question 01

March 2007 | CHY1A | Original Q5 | Legacy

QUESTION FIVE

Iron is about twice as strong as aluminium.

Some other properties of aluminium and iron are shown in the table.

	Electrical conductivity	Density in grams per cm^3	Resistance to corrosion
Aluminium	very good	2.7	good
Iron	good	7.8	poor

5A Iron is better than aluminium for making bridges.

This is because iron . . .

1 is a better insulator.

2 is more easily painted.

3 is stronger.

4 has a higher density.

5B Aluminium is better than iron for making cans for fizzy drinks.

The main reason is that . . .

1 aluminium conducts electricity better.

2 aluminium is harder.

3 iron cannot be recycled.

4 aluminium is more resistant to corrosion.

5C Aluminium has a low density and good electrical conductivity.

Which use for aluminium depends on **both** of these properties?

1 for cooking pans

2 for aeroplanes

3 for overhead power cables

4 for racing cars

4.2.2.8 Metals as conductors

Question 01 · continued

5D Most of the iron that is made is converted into steel.

Compared with low carbon steel, high carbon steel . . .

1 corrodes more quickly.

2 is a better electrical conductor.

3 is harder.

4 is more easily shaped.

Turn over for the next question

4.2.2.8 Metals as conductors

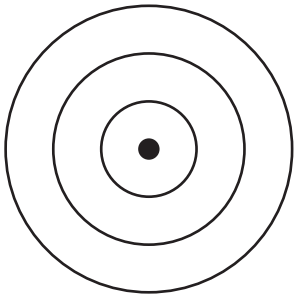
Question 02

June 2008 | CHY2H | Original Q7 | Legacy

7 Aluminium is a useful metal.

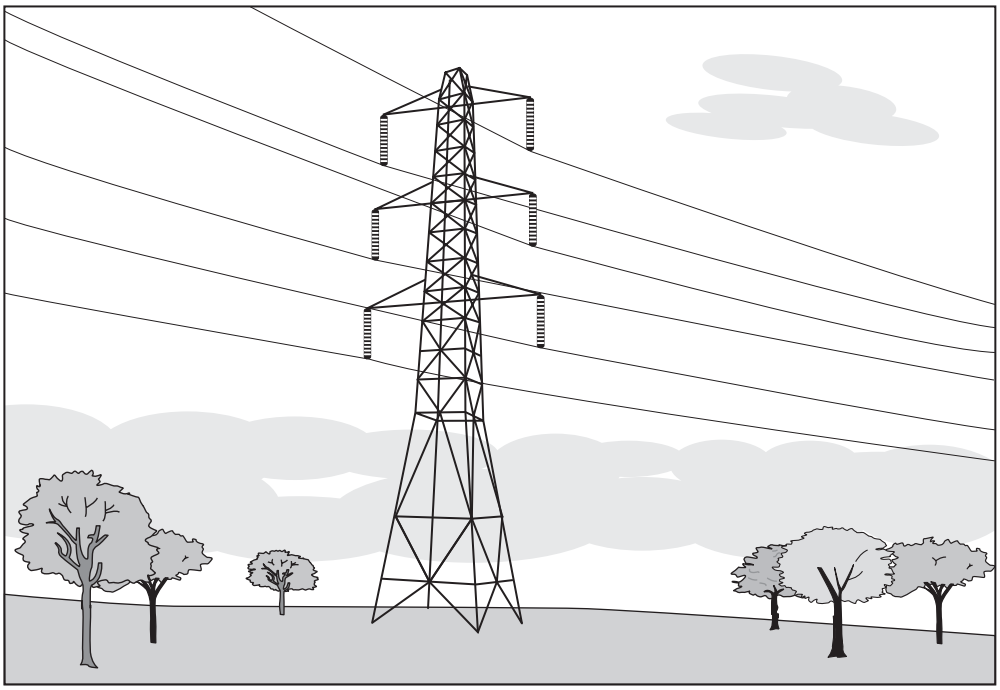
7 (a) The atomic number (proton number) of aluminium is 13.

Complete the diagram to show the electronic structure of an aluminium atom.
Use crosses (x) to represent the electrons.



(1 mark)

7 (b) Aluminium is used as the electrical conductor for overhead power cables.



Explain why metals are good conductors of electricity.

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(2 marks)

3

4.2.2.8 Metals as conductors

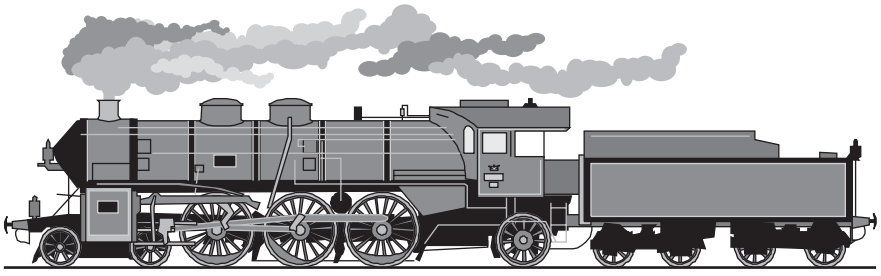
Question 03

June 2009 | CHY1AP | Original Q4 | Legacy

QUESTION FOUR

Read the following newspaper extract.

Copper shortage puts the brakes on Flying Scotsman renovation



A major overhaul of the steam locomotive Flying Scotsman has been delayed by more than a year because of the lack of copper for the engine's firebox.

Copper is at a record high price because of huge demand from China's rapidly growing economy. The price had been falling over the previous 30 years, which had discouraged exploration for new supplies.

Other users have been forced to switch to cheaper materials, with plumbers using plastic rather than copper pipes, and telecoms firms using fibre-optic cables rather than copper wire.

4A The firebox of a steam locomotive is where coal is burned to boil water.

Which of these properties is **not** important when using copper in the firebox of a steam locomotive?

1 Copper is a good conductor of heat.

2 Copper has a high melting point.

3 Copper is a good conductor of electricity.

4 Copper is easily hammered and bent into shape.

4.2.2.8 Metals as conductors

Question 03 · continued

4B Which row in the table explains why copper was important to plumbers and telecoms firms?

	Plumbers	Telecoms firms
1	High melting point	Good heat conductor
2	Good electrical conductor	High melting point
3	Resistant to corrosion	Good electrical conductor
4	High boiling point	Good electrical conductor

4C Which of the following would make the copper shortage in China and other countries worse?

1 recycling scrap copper rather than burying it in landfill sites

2 developing alternative materials to do the same job as copper

3 extraction of copper from low-grade ores

4 forcing suppliers to reduce the price of copper

4D Why is it environmentally important to recycle copper rather than mine fresh copper ore?

1 Copper ores are non-renewable, and a lot of energy is needed to extract copper from its ore.

2 There are enormous reserves of copper ore which are not expected to run out for hundreds of years.

3 Copper ores are cheap, and scrap copper is easy to dispose of in landfill sites.

4 Copper recycling is difficult and uses more energy when compared with processing new ores.

4.2.2.8 Metals as conductors

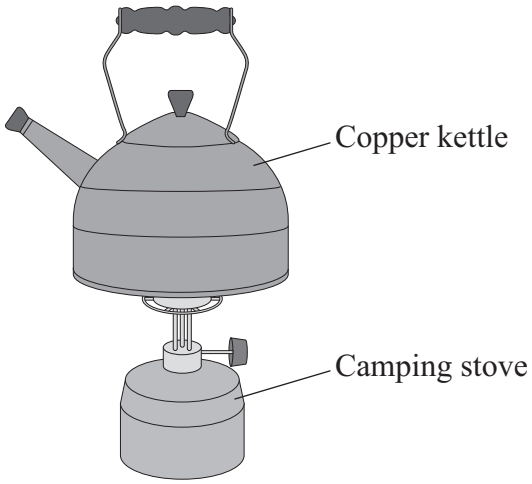
Question 04

January 2010 | CHY2H | Original Q4 | Legacy

4 The picture shows a copper kettle being heated on a camping stove.

Copper is a good material for making a kettle because:

- it has a high melting point
- it is a very good conductor of heat.



4 (a) Explain why copper, like many other metals, has a high melting point.
You should describe the structure and bonding of a metal in your answer.

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(4 marks)

4.2.2.8 Metals as conductors

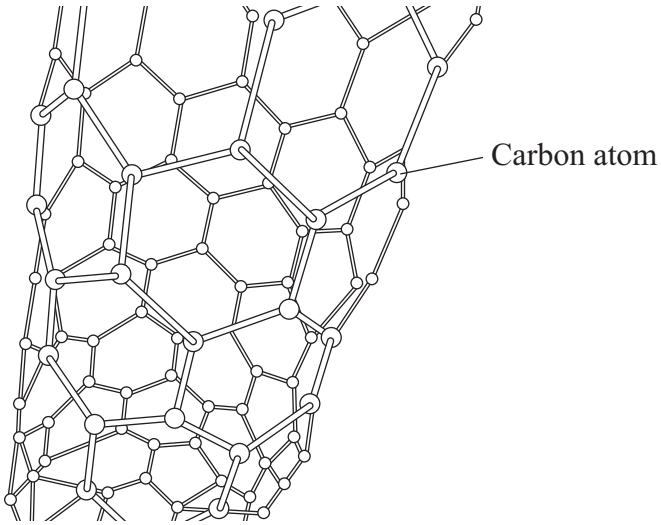
Question 04 · continued

for mark

4 (b) An aeroplane contains many miles of electrical wiring made from copper. This adds to the mass of the aeroplane.

It has been suggested that the electrical wiring made from copper could be replaced by lighter carbon nanotubes.

The diagram shows the structure of a carbon nanotube.



4 (b) (i) What does the term 'nano' tell you about the carbon nanotubes?

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(1 mark)

4 (b) (ii) Like graphite, each carbon atom is joined to three other carbon atoms.

Explain why the carbon nanotube can conduct electricity.

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(2 marks)

7

4.2.2.8 Metals as conductors

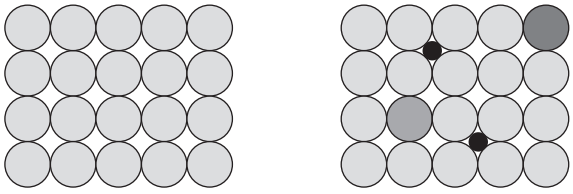
Question 05

June 2011 | CHY1AP | Original Q3 | Legacy

QUESTION THREE

This question is about iron and different types of steel.

3A The diagrams show the arrangement of atoms in pure iron and in stainless steel.



Pure iron Stainless steel

Pure iron is soft and easily shaped because the atoms . . .

1 are not arranged in a regular pattern.

2 are small and spherical.

3 are in layers that can slide over each other.

4 are of different sizes.

3B Stainless steel rather than pure iron is used for making cutlery.

Which row in the table gives two reasons why stainless steel is used?

Stainless steel . . .		
1	is harder.	is a better heat conductor.
2	is more resistant to corrosion.	is harder.
3	is a better heat conductor.	can be more easily shaped.
4	can be more easily shaped.	is more resistant to corrosion.

4.2.2.8 Metals as conductors

Question 05 · continued

3C Which type of iron or steel is used to make hammer heads and chisels?

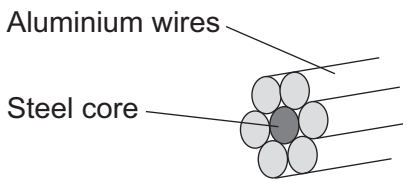
1 cast iron (iron from a blast furnace)

2 pure iron

3 low carbon steel

4 high carbon steel

3D The diagram shows the structure of an overhead power cable. The steel core gives strength to the cable.



Aluminium is used because it is a good conductor of electricity and . . .

1 it has a low density.

2 it is a good conductor of heat.

3 it can be hammered into shape.

4 it is a hard metal.

4.2.2.8 Metals as conductors

Question 06

June 2015 | CH2HP | Original Q3 | Legacy

3 This question is about metals and alloys.

3 (a) Explain how electricity is conducted in a metal.

To gain full marks you must include a description of the structure and bonding of a metal.

[4 marks]

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3 (b) Describe how the structure of an alloy is different from the structure of a pure metal.

[2 marks]

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3 (c) Alloys are used to make dental braces and coins.

3 (c) (i) Nitinol is an alloy used in dental braces.

Why is Nitinol used in dental braces?

[1 mark]

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4.2.2.8 Metals as conductors

Question 06 · continued

3 (c) (ii) Suggest **one** reason why coins are not made of pure copper.

Do **not** give cost as a reason.

[1 mark]

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.....

3 (c) (iii) Some coins are made from an alloy of aluminium.

Complete the sentence.

[1 mark]

Aluminium is manufactured by the electrolysis of a molten mixture of

cryolite and ..... .

3 (c) (iv) Banks keep coins in poly(ethene) bags. These bags are made from low density poly(ethene).

High density poly(ethene) can also be made from the same monomer.

How can the same reaction produce two different products?

[1 mark]

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3 (d) Give **two** reasons why instrumental methods of analysis are used to detect impurities in metals.

[1 mark]

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11

4.2.2.8 Metals as conductors

Question 07

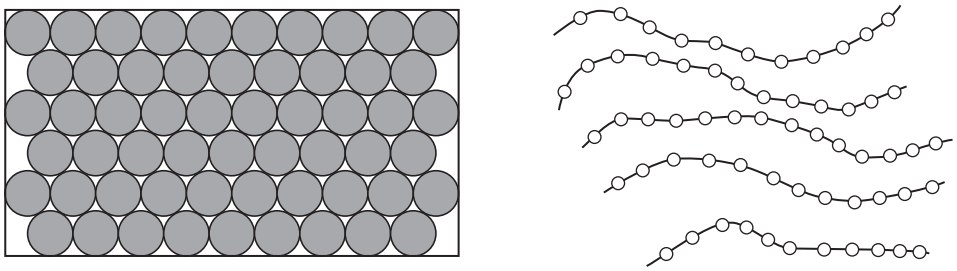
June 2017 | CH2HP | Original Q2 | Legacy

2 **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

Metals and thermosoftening polymers have different properties.

Figure 3 shows structures of a metal and a thermosoftening polymer.

Figure 3



Explain how the properties of a metal and a thermosoftening polymer relate to their structures.

In your answer you should describe the structures of a metal and a thermosoftening polymer.

[6 marks]

4.2.2.8 Metals as conductors

Question 08

November 2021 | 8462/1H | Original Q1

0 1 This question is about carbon and its compounds.

Fullerenes are molecules of carbon atoms.

The first fullerene to be discovered was Buckminsterfullerene (C_{60}).

0 1 . 1 What shape is a Buckminsterfullerene molecule?

[1 mark]

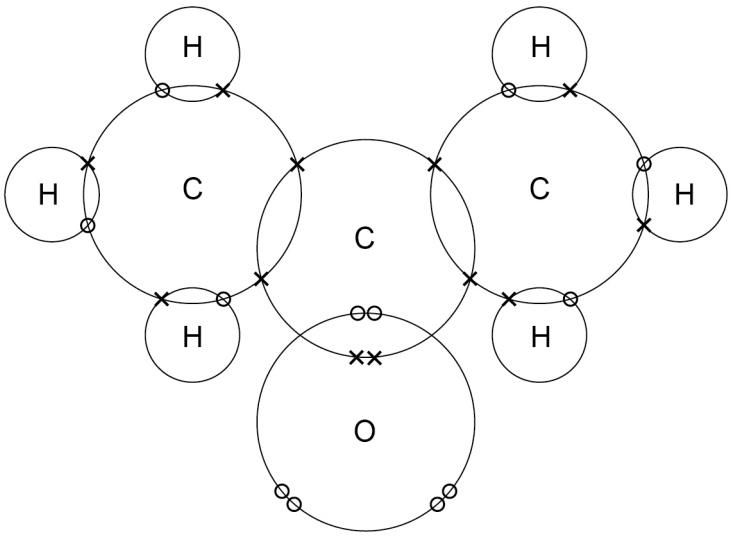
0 1 . 2 Give **one** use of a fullerene.

[1 mark]

Propanone is a compound of carbon, hydrogen and oxygen.

Figure 1 shows the dot and cross diagram for a propanone molecule.

Figure 1



4.2.2.8 Metals as conductors

Question 08 · continued

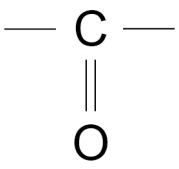
0 1 . 3 Complete **Figure 2** to show a propanone molecule.

Use a line to represent each single bond.

Use **Figure 1**.

[1 mark]

Figure 2



0 1 . 4 Determine the molecular formula of propanone.

Use **Figure 1**.

[1 mark]

Molecular formula = _____

0 1 . 5 Propanone is a liquid with a low boiling point.

Why does propanone have a low boiling point?

[1 mark]

Tick (✓) **one** box.

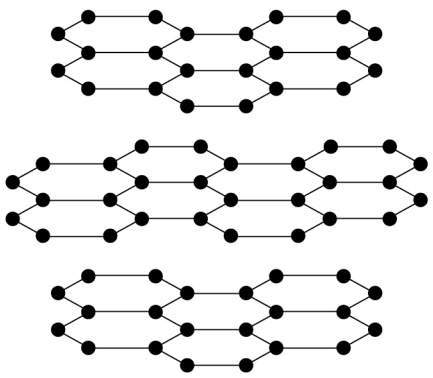
- The covalent bonds are strong. ☐
- The covalent bonds are weak. ☐
- The intermolecular forces are strong. ☐
- The intermolecular forces are weak. ☐

4.2.2.8 Metals as conductors

Question 08 · continued

0 1 . 6 **Figure 3** represents the structure of graphite.

Figure 3



Explain why graphite is:

- a good electrical conductor
- soft and slippery.

You should answer in terms of structure and bonding.

[6 marks]

11

4.2.2.8 Metals as conductors

Question 09

November 2021 | 8462/1H | Original Q6

0 6 This question is about metals.

0 6 . 1 **Table 3** shows information about four substances.

Table 3

Substance	Melting point in °C	Boiling point in °C	Does it conduct electricity in the solid state?	Does it conduct electricity in the liquid state?
A	–117	79	No	No
B	801	1413	No	Yes
C	1535	2750	Yes	Yes
D	1610	2230	No	No

Which substance could be a metal?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

0 6 . 2 Explain why alloys are harder than pure metals.

[3 marks]

4.2.2.8 Metals as conductors

Question 09 · continued

0 6 . 3 A student wants to compare the reactivity of an unknown metal, **Q**, with that of zinc.

Both metals are more reactive than silver.

The student is provided with:

- silver nitrate solution
- metal **Q** powder
- zinc powder
- a thermometer
- normal laboratory equipment.

No other chemicals are available.

Describe a method the student could use to compare the reactivity of metal **Q** with that of zinc.

Your method should give valid results.

[4 marks]

8

4.2.2.8 Metals as conductors

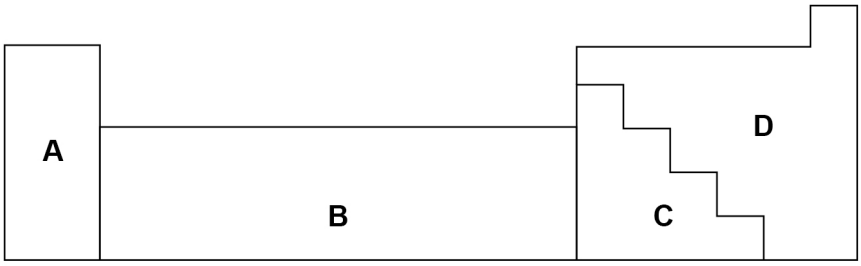
Question 10

June 2022 | 8462/1H | Original Q1

0 1 This question is about metals and non-metals.

Figure 1 shows an outline of part of the periodic table.

Figure 1



0 1 . 1 Element **Q** is a dull solid with a melting point of 44 °C.

Element **Q** does not conduct electricity.

Which section of the periodic table in **Figure 1** is most likely to contain element **Q**?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

0 1 . 2 Element **R** forms ions of formula R^{2+} and R^{3+}

Which section of the periodic table in **Figure 1** is most likely to contain element **R**?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

0 1 . 3 Give **two** differences between the physical properties of the elements in Group 1 and those of the transition elements.

[2 marks]

1 _____

_____

2 _____

_____

4.2.2.8 Metals as conductors

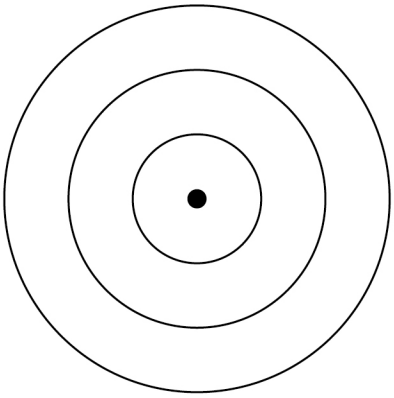
Question 10 · continued

0 1 . 4 Complete **Figure 2** to show the electronic structure of an aluminium atom.

Use the periodic table.

[1 mark]

Figure 2



0 1 . 5 Aluminium is a metal.

Describe how metals conduct electricity.

Answer in terms of electrons.

[3 marks]

0 1 . 6 Name the type of bonding in compounds formed between metals and non-metals.

[1 mark]

4.2.2.8 Metals as conductors

Question 10 · continued

0 1 . 7 Magnesium oxide is a compound formed from the metal magnesium and the non-metal oxygen.

Describe what happens when a magnesium atom reacts with an oxygen atom.

You should refer to electrons in your answer.

[4 marks]

13

4.2.2.8 Metals as conductors

Question 11

June 2023 | 8462/1H | Original Q6

0 6 This question is about uses of metals in electrical wires.

Electrical wires can be made from:

- aluminium
- copper
- silver.

Figure 6 shows three uses of electrical wires.

Figure 6

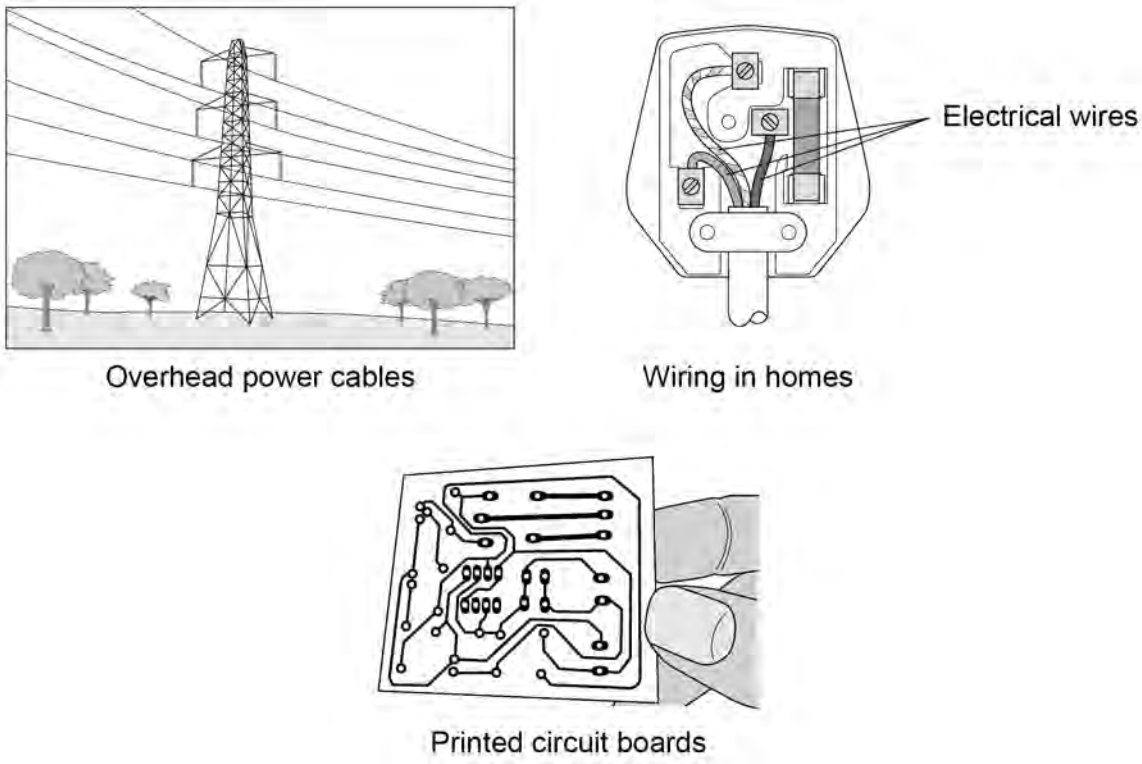


Table 5 shows information about the metals.

The higher the value for electrical conductivity, the better the metal is at conducting electricity.

Table 5

	Aluminium	Copper	Silver
Electrical conductivity in arbitrary units	37.7	59.6	63.0
Density in g/cm^3	2.7	9.0	10.5
Cost of metal per kg in £	1.50	7.00	640.00

4.2.2.8 Metals as conductors

Question 11 · continued

0 6 . 1 Evaluate the use of aluminium, copper and silver for the types of electrical wires shown in **Figure 6**.

Use **Table 5**.

[4 marks]

0 6 . 2 Describe how metals conduct electricity.

[3 marks]

Question 6 continues on the next page

4.2.2.8 Metals as conductors

Question 11 · continued

0 6 . 3 Electrical wires are usually made of pure metals and **not** alloys. This is because pure metals are better electrical conductors.

Suggest why alloys do **not** conduct electricity as well as pure metals.

Answer in terms of structure and bonding.

[2 marks]

9

4.2.2.8 Metals as conductors

Question 12

June 2024 | 8462/1H | Original Q7

0 7 This question is about iron.

0 7 . 1 Iron is a metal.

Describe how iron conducts thermal energy.

[2 marks]

0 7 . 2 Pure iron is too soft for many uses.

Explain why mixing iron with other metals makes alloys which are harder than pure iron.

[3 marks]

Question 7 continues on the next page

4.2.2.8 Metals as conductors

Question 12 · continued

0 7 . 3 When iron reacts with chlorine, 0.12 mol of iron reacts with 0.18 mol of chlorine (Cl_2).

Which is the correct equation for the reaction?

[1 mark]

Tick (✓) **one** box.

$Fe + Cl_2 \rightarrow FeCl_2$ ☐

$Fe + 3Cl_2 \rightarrow FeCl_6$ ☐

$2Fe + Cl_2 \rightarrow 2FeCl$ ☐

$2Fe + 3Cl_2 \rightarrow 2FeCl_3$ ☐

The most common oxides of iron are Fe_2O_3 and Fe_3O_4

0 7 . 4 What is the ratio of the numbers of ions in Fe_3O_4?

[1 mark]

Tick (✓) **one** box.

$2\ Fe^{2+} : 1\ Fe^{3+} : 4\ O^{2-}$ ☐

$1\ Fe^{2+} : 2\ Fe^{3+} : 4\ O^{2-}$ ☐

$3\ Fe^{2+} : 4\ O^{2-}$ ☐

$3\ Fe^{3+} : 4\ O^{2-}$ ☐

4.2.2.8 Metals as conductors

Question 12 · continued

0 7 . 5 Calculate the percentage (%) by mass of iron in Fe_3O_4

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

[3 marks]

Percentage by mass of iron = _____ %

0 7 . 6 Fe_2O_3 reacts with carbon to produce carbon dioxide.

The equation for the reaction is:

$$2\,Fe_2O_3(s) + 3\,C(s) \rightarrow 4\,Fe(s) + 3\,CO_2(g)$$

Calculate the volume of carbon dioxide gas at room temperature and pressure that is produced from 40.0 kg of Fe_2O_3 using excess carbon.

Relative formula mass (M_r): Fe_2O_3 = 160

The volume of 1 mole of any gas at room temperature and pressure is 24 dm^3.

[5 marks]

Volume of carbon dioxide = _____ dm^3

15