Questions are for both separate science and combined science students unless indicated in the question

Q1.

This question is about iron.

(a) Iron is a metal.

Describe how iron conducts thermal energy.

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(2)

(b) Pure iron is too soft for many uses.

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

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(3)

(c) 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? **(HT only)**

Tick (✓) **one** box.

$Fe + Cl_2 \rightarrow FeCl_2$ ☐

$Fe + 3\ Cl_2 \rightarrow FeCl_6$ ☐

$2\ Fe + Cl_2 \rightarrow 2\ FeCl$ ☐

$2\ Fe + 3\ Cl_2 \rightarrow 2\ FeCl_3$ ☐

(1)

The most common oxides of iron are Fe_2O_3 and Fe_3O_4

(d) What is the ratio of the numbers of ions in Fe_3O_4?

Tick (✓) **one** box.

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

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

$3\ Fe^{2+} : 4\ O^{2-}$ ☐

$3\ Fe^{3+} : 4\ O^{2-}$ ☐

(1)

(e) Calculate the percentage (%) by mass of iron in Fe_3O_4

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

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Percentage by mass of iron = _____ %

(3)

(f) 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. **(chemistry only) (HT only)**

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.

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Volume of carbon dioxide = _____ dm^3

(5)

(Total 15 marks)

Q2.

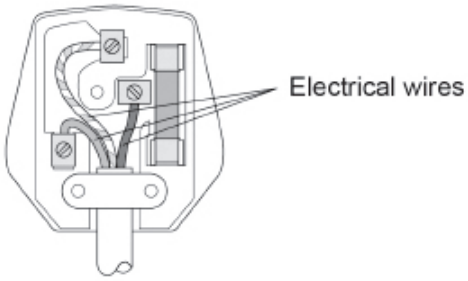
This question is about uses of metals in electrical wires.

Electrical wires can be made from:

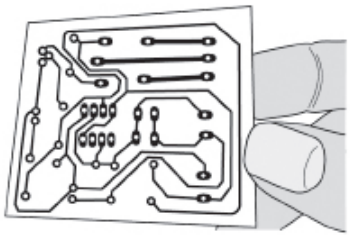
- aluminium
- copper
- silver.

The figure below shows three uses of electrical wires.

Overhead power cables



Wiring in homes



Printed circuit boards

The table below shows information about the metals.

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

	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

(a) Evaluate the use of aluminium, copper and silver for the types of electrical wires shown in the figure above.

Use the table.

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(4)

(b) Describe how metals conduct electricity.

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(3)

(c) 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.

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(2)

(Total 9 marks)