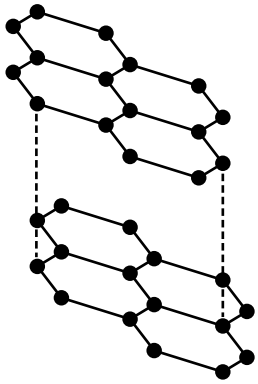
1 Graphite is a form of carbon.



(a) Graphite is used as a lubricant.

Write down **one** property of graphite that explains why it is used as a lubricant.

..... **[1]**

(b) Graphite conducts electricity.

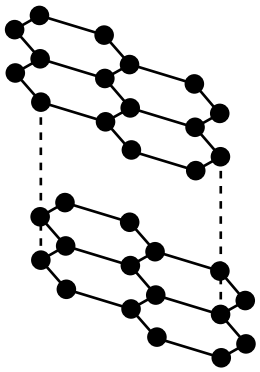
Explain how. Use ideas about structure and bonding.

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.....

..... **[1]**

2 Graphite is one of the allotropes of carbon.



(a) Graphite is used to make pencil leads.

Explain why the properties of graphite make it suitable for pencil leads.

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..... **[2]**

(b) Graphite is used as an electrode in electrolysis.

This is because it conducts electricity and has a high melting point.

(i) Explain why graphite can conduct electricity. Use the diagram to help you.

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..... **[1]**

(ii) Explain why graphite has a high melting point. Use the diagram to help you.

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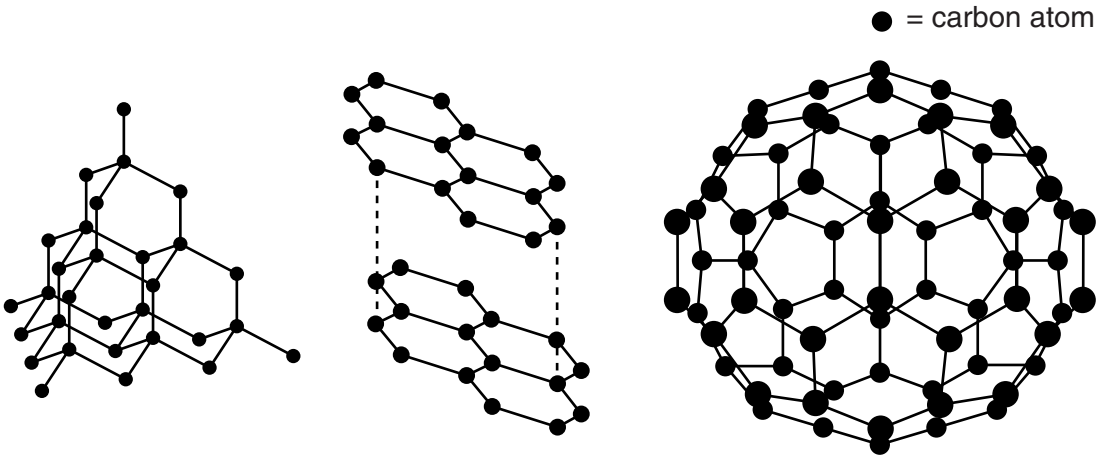
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..... **[2]**

[Total: 5]

3 Carbon can exist in different solid forms.

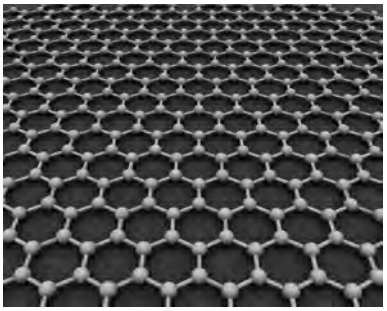


diamond **graphite** **buckminsterfullerene**

(a) What is the name given to these three forms?

..... **[1]**

(b) Look at the diagram.



It shows the structure of a new solid form of carbon called graphene.

Graphene contains **one layer** of carbon atoms.

Graphene is made from graphite.

Graphene is harder than graphite.

Explain, using ideas about structure and bonding, why **graphene** is **hard** and **graphite** is **slippery**.

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..... **[2]**

(c) Diamond and graphite have different properties and different uses.

Look at the table.

It shows some information about the properties of diamond and graphite.

Property	Diamond	Graphite
State at room temperature	solid	solid
Appearance at room temperature	transparent	black
Melting point	very high	very high
Hardness	very hard	soft
Electrical conductivity	does not conduct	good conductor

Diamond is used to make cutting tools.



The picture shows a drill bit with diamonds on its end.

This drill is used to cut through rock.

Explain why diamond is used to make cutting tools.

Use the table to help you.

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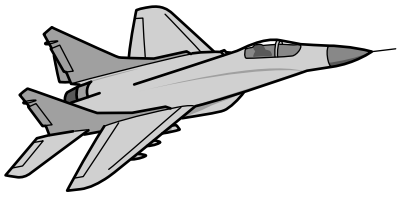
..... **[2]**

[Total: 5]

4 Look at the table. It gives information about the properties of some metals.

Metal	Melting point in °C	Density in g/cm^3	Relative strength (1 = weak, 10 = strong)	Relative heat conductivity (1 = low, 10 = high)	Cost per tonne in £
A	1660	4.5	6.4	8.6	5000
B	420	7.1	4.3	9.0	870
C	1535	7.9	8.2	7.3	400

Look at the picture of a military aircraft. Only small numbers of these aircraft are made.



Evaluate the advantages and disadvantages of each metal for making the **body** and **wings** of this military aircraft. Which metal, **A**, **B** or **C**, would you choose and why?

The quality of written communication will be assessed in your answer to this question.

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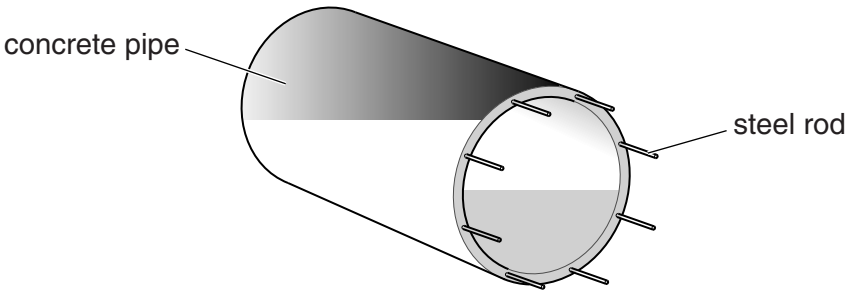
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..... **[6]**

[Total: 6]

5 Concrete is a building material made from cement.

Look at the picture. It shows a pipe made of reinforced concrete.



Look at the table. It shows some properties of concrete and steel.

	concrete	**steel**
density in g/cm^3	2.3	7.9
relative strength	40	210
flexibility	not flexible	has some flexibility
relative hardness	very hard	very hard

Explain, using information in the table, why reinforced concrete is a composite material and a better construction material than non-reinforced concrete.

The quality of written communication will be assessed in your answer to this question.

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..... **[6]**

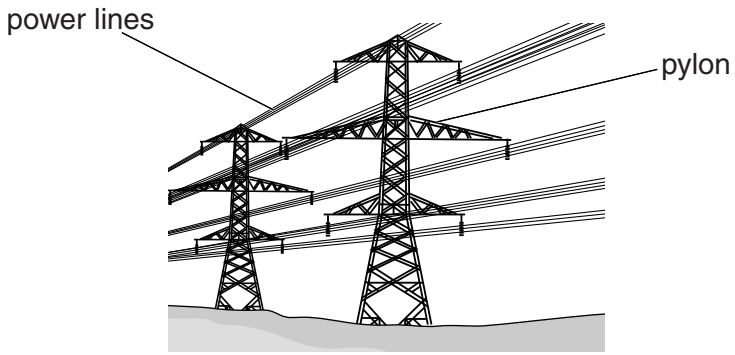
[Total: 6]

6 This question is about metals.

Look at the table. It shows the properties of two metals.

	aluminium	**iron**
density in g/cm^3	2.7	7.9
relative electrical conductivity	40	11
relative strength	70	210
cost per tonne in £	1350	400

Look at the picture of some power lines.



The power company makes the power lines from iron surrounded by aluminium.

Explain why the power company makes power lines from iron **and** aluminium.

Use information in the table.

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..... **[2]**

[Total: 2]

7 George is researching information about construction materials on the internet.

Look at his results.

material	formula	density in g/cm^3	relative hardness (1=soft, 10=very hard)	relative strength (1=weak, 500=very strong)
brick	no information	2.0	6	3
steel	mainly Fe	7.7	6	400
limestone	$CaCO_3$	2.4	3	7
granite	mainly SiO_2	2.9	7	23
lead	Pb	11.4	1	12
marble	$CaCO_3$	2.7	5	15
copper	Cu	8.9	3	200
wood	no information	0.9	0.8	1

(a) Which material would be the **most** scratch resistant?

Choose from the table.

Explain your answer.

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..... **[2]**

(b) Look at the picture of a girder bridge.



Which material would be best to use to make the girders of this bridge?

Choose from the table.

Explain your answer.

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..... **[2]**

(c) Marble, granite and wood are materials that can be used to make a kitchen worktop.

Describe the **advantages** and **disadvantages** of marble, granite and wood for making a kitchen worktop.

Use information from the table.

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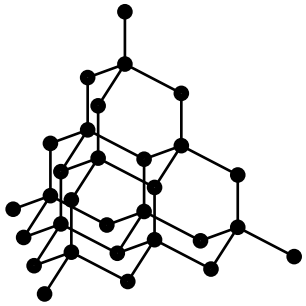
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..... **[3]**

[Total: 7]

8 Diamond is a form of carbon.

Look at the structure of diamond.



Scientists use the structure **and** bonding of a substance to explain its properties.

(a) Diamond has a very high melting point.

Explain why.

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..... **[2]**

(b) Diamond does not conduct electricity.

Explain why.

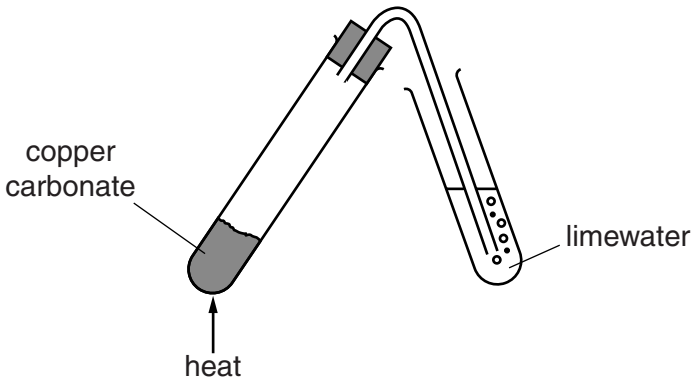
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..... **[1]**

[Total: 3]

9 (a (i) Sam investigates the action of heat on copper carbonate.

Look at the diagram. It shows the apparatus he uses.



Look at the word equation for the reaction

copper carbonate → copper oxide + xide

This is a **thermal decomposition** reaction.

Explain why.

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..... **[1]**

(ii) Sam makes some copper.

Sam heats copper oxide, CuO, with carbon, C.

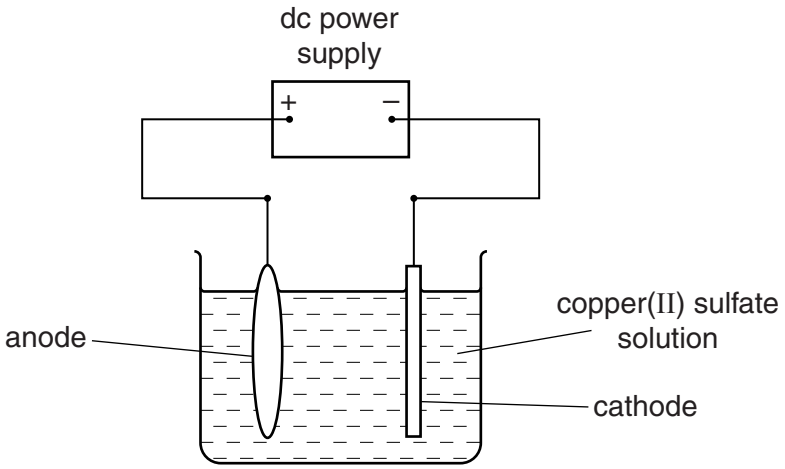
Copper, Cu, and carbon dioxide, CO_2, are made.

Write a **balanced symbol** equation for this reaction.

..... **[2]**

(b) The copper Sam makes is impure.

Look at the diagram. It shows the apparatus he uses to purify copper.



Look at the equations below for the electrode reactions.

The anode: $Cu - 2e^- \longrightarrow Cu^{2+}$

The cathode: $Cu^{2+} + 2e^- \longrightarrow Cu$

(i) Which reaction is oxidation and which is reduction?

Explain why.

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..... **[2]**

(ii) Use the electrode reactions to explain why the anode **loses** mass and the cathode **gains** mass.

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..... **[2]**

(c) Explain one **advantage** and one **problem** of recycling copper.

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..... **[2]**

(d) Look at the table. It shows some properties of three metals.

	Density in g/cm^3	**Relative electrical conductivity (0 = low, 100 = high)**	**Relative strength (0 = weak, 1000 = very strong)**	**Corrosion in moist air**	**Cost per tonne in £**
Aluminium	2.7	40	300	does not corrode	770
Copper	8.9	64	400	corrodes slowly	5900
Iron	7.9	11	600	corrodes	200

Look at the picture. It shows overhead power cables used by electric trains.



Which metal would you choose to make the overhead power cables?

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Justify your answer.

Use the data in the table.

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..... **[2]**

[Total: 11]