1(a). A student sets up three test tubes to investigate the rusting of iron as shown in **Fig. 18.1**.

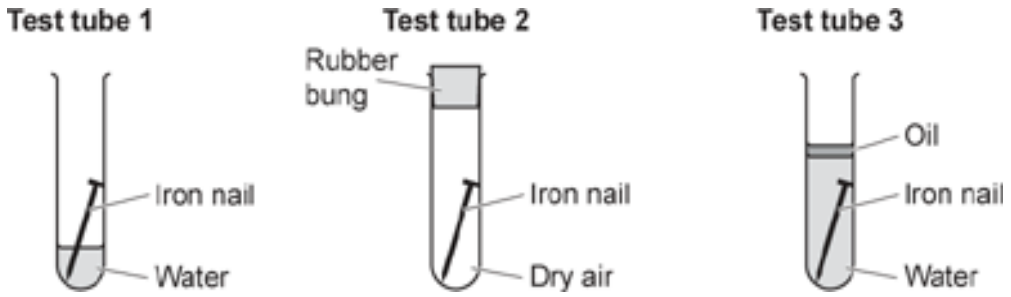


Fig. 18.1

- The student measures the mass of each nail at the start of the experiment.
- They measure the mass of each nail again after a week.

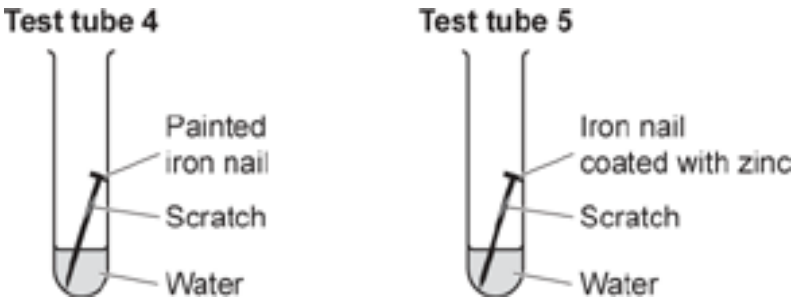
The table shows the results.

Test tube	Mass of nail at start (g)	Mass of nail after a week (g)
1	4.42	.....
2	4.46	.....
3	4.51	4.51

Complete the table to estimate the mass of the nails in test tubes 1 and 2 after a week.

[2]

(b). The student sets up another two test tubes as shown in **Fig. 18.2. Fig. 18.2**



The iron nail in test tube 4 rusted. The iron nail in test tube 5 did **not** rust.

Explain why.

Test tube 4 _____

_____

Test tube 5 _____

_____

_____ **[3]**

(c). Copper is extracted by heating copper oxide with carbon.

$2CuO + C \rightarrow 2Cu + CO_2$

i. Explain why this is an example of a **redox** reaction.

_____

_____

_____ **[2]**

ii. Calculate the mass of copper that can be made from 15 tonnes of copper oxide.

$2CuO + C \rightarrow 2Cu + CO_2$

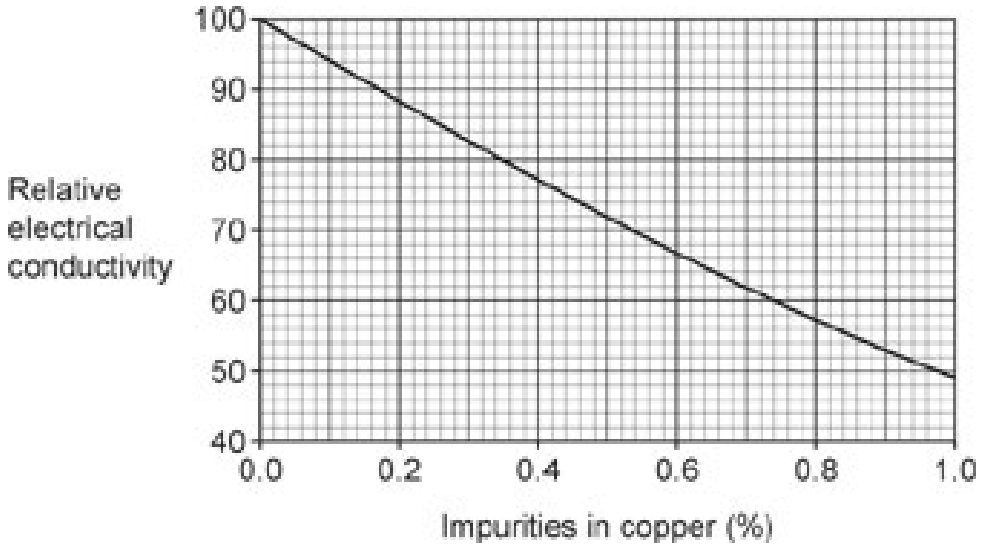
Give your answer to **2** significant figures.

Relative atomic mass (A_r): Cu = 63.5
Relative molecular mass (M_r): CuO = 79.5

Mass of copper = ...tonnes **[3]**

iii. Copper is used in electrical wires.

The graph shows how impurities in copper affect the relative electrical conductivity of copper.



Copper extracted from copper oxide is about 99% pure.

Explain why copper extracted from copper oxide is purified to almost 100% pure using electrolysis.

Use data from the graph in your answer.

[2]

2. What is an **advantage** of extracting metals by phytoextraction?

A It can extract metals from contaminated soils.
B It is dependent on weather conditions.
C It is slow.
D It produces carbon dioxide gas when the plants are burnt.

Your answer ☐ **[1]**

3. What is a life-cycle assessment?

A Analysis of the cost of making, using, and disposing of a product.
B Analysis of the energy needed to use a product throughout its lifetime.
C Analysis of the potential environmental impact of manufacturing a product.
D Analysis of the potential environmental impact that a product may have throughout its lifetime.

Your answer ☐ **[1]**

4. A life-cycle assessment looks at the potential environmental impact at each stage of the life of a product.

A car manufacturer does a life-cycle assessment for cars made from

- steel
- aluminium.

The table gives information about the life-cycle impact of cars made from steel and aluminium.

	Steel	**Aluminium**
Production CO_2 emissions from mining the ore, extracting the metal, to manufacturing the car	6444 kg	9794 kg
Driving CO_2 emissions from the use of petrol or diesel	37 054 kg	36 248 kg
End of life CO_2 emissions saved by recycling metals rather than extracting new metals	 –1546 kg	 –3634 kg

Evaluate which type of metal has the smallest environmental impact over its lifetime.
Use the information in the table, and your own knowledge of how metals are extracted.

[6]

5. Why are alloys stronger than the pure metals which they are made from?

A Alloys combine the properties of the metals they are made from.
B Alloys contain atoms of different sizes.
C Alloys contain different atoms bonded together.
D Alloys have strong bonds between their molecules.

Your answer ☐ **[1]**

6. Copper can be extracted from copper ore by heating the copper ore with carbon.

Copper can also be extracted by bioleaching.

What is an **advantage** of bioleaching?

A It can produce sulfuric acid.
B It extracts copper, which is then purified by electrolysis.
C It is done at low temperatures.
D It is slow.

Your answer ☐ **[1]**

7. This is the balanced symbol equation for the reaction of copper oxide with carbon.

$2CuO + C \rightarrow 2Cu + CO_2$

What happens to the copper oxide in this reaction?

A It is neutralised.
B It is oxidised.
C It is reduced.
D It is thermally decomposed.

Your answer ☐ **[1]**

END OF QUESTION PAPER