

GCSE Combined Science: Trilogy

Worksheet: Properties of metals and alloys

TIME 30 min	TOTAL 29 marks	CALCULATOR Allowed	DIFFICULTY Easy, Medium
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Topics: Properties of metals and alloys

NAME	CLASS	DATE
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- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Answer all questions in the spaces provided.
- In all calculations, show clearly how you work out your answer.
- The marks for questions are shown in brackets.

0 1

Metals and alloys are used for many purposes.

0 1 . 1

Complete the sentence.

Tick (✓) **one** box.

In pure metals, the atoms are arranged in

layers

☐

pairs

☐

a random mixture

☐

small molecules

☐

[1 mark]

0 1 . 2

What is an alloy?

.....

.....

[1 mark]

0 1 . 3

Why are alloys used instead of pure metals for many purposes?

Tick (✓) **one** box.

Alloys are harder.

☐

Alloys are softer.

☐

Alloys are always cheaper.

☐

Alloys conduct electricity better.

☐

[1 mark]

0 1 . 4

Most metals have high melting points.

Explain why.

.....

.....

.....

.....

[2 marks]

0 2

Alloys are mixtures of a metal with one or more other elements.

0 2 . 1

Why are alloys usually harder than pure metals?

Tick (✓) **one** box.

Different-sized atoms distort the layers, so the layers cannot slide as easily

☐

Alloys contain ionic bonds instead of metallic bonds

☐

Alloys have fewer delocalised electrons

☐

Alloys always have lower melting points

☐

[1 mark]

0 3

A technician has a sample of a pure metal and a sample of an alloy of the same metal, and wants to compare their hardness.

0 3 . 1

Describe a simple test the technician could use to compare the hardness of the two samples.

.....

.....

.....

.....

[2 marks]

0 4

Duralumin is an alloy used to make aircraft. It contains 4.4% copper, 1.5% magnesium and 0.6% manganese by mass. The rest is aluminium.

0 4 . 1

Calculate the percentage of aluminium in duralumin.

.....

.....

.....

Percentage = %

[1 mark]

0 4 . 2

Calculate the mass of copper in 250 kg of duralumin.

.....

.....

.....

.....

Mass of copper = kg

[2 marks]

0 4 . 3

Explain why duralumin is harder than pure aluminium.

.....

.....

.....

.....

.....

.....

[3 marks]

0 4 . 4

Pure aluminium melts at 660 °C.
Explain why aluminium has a high melting point.

.....

.....

.....

.....

[2 marks]

.....

0 5

Solder is an alloy used to join electrical components. One type of solder contains 63% tin and 37% lead by mass.

Table 1 shows the melting points of tin, lead and this solder.

Table 1

Substance	Melting point in °C
Tin	232
Lead	327
Solder (63% tin, 37% lead)	183

0 5 . 1

Calculate the mass of tin and the mass of lead in 250 g of this solder.

.....

.....

.....

.....

[2 marks]

0 5 . 2

A student claimed:

‘Mixing metals to make an alloy always increases the melting point.’

Use Table 1 to evaluate this claim.

.....

.....

.....

.....

[2 marks]

0 5 . 3

Suggest why a low melting point is an advantage for solder.

.....

.....

[1 mark]

0 5 . 4

Solder is harder than pure tin.
Explain why.

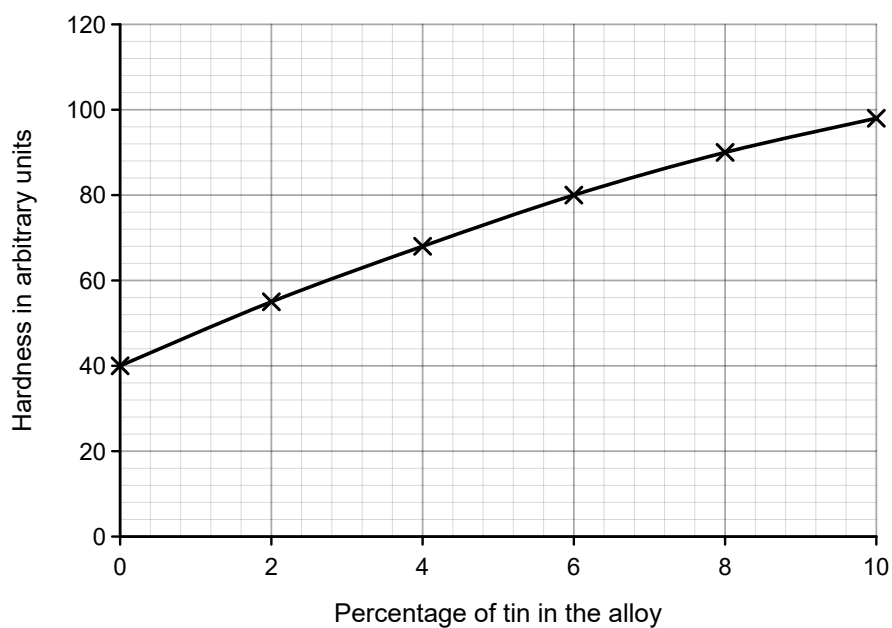
[2 marks]

0 6

Bronze is an alloy of copper and tin. A student measured the hardness of samples of bronze containing different percentages of tin.

Figure 1 shows the results.

Figure 1



0 6 . 1

Describe how the hardness changes as the percentage of tin increases.

[2 marks]

0 6 . 2

Use Figure 1 to find the percentage of tin needed to make bronze with a hardness of 75 units.

.....

.....

.....

Percentage of tin = %

[1 mark]

0 6 . 3

Explain why adding tin makes copper harder.

.....

.....

.....

.....

.....

.....

[3 marks]

END OF QUESTIONS

Original practice questions written to match the specification. Not produced by, affiliated with or endorsed by AQA.

Mark scheme

GCSE Combined Science: Trilogy · Worksheet: Properties of metals and alloys · 29 marks

Question 1 (5 marks)

01.1 [1 mark]

Correct: layers

01.2 [1 mark]

Answer: A mixture of a metal with at least one other element (usually another metal).

- a mixture of a metal with (at least) one other element / other metals (1)
-

01.3 [1 mark]

Correct: Alloys are harder.

01.4 [2 marks]

Answer: Metals have giant structures with strong metallic bonding, which needs a lot of energy to overcome.

- giant structure with strong metallic bonding / strong attraction between positive ions and delocalised electrons (1)
 - a lot of energy is needed to overcome the metallic bonding (1)
-

Question 2 (1 mark)

02.1 [1 mark]

Correct: Different-sized atoms distort the layers, so the layers cannot slide as easily

Question 3 (2 marks)

03.1 [2 marks]

Answer: Try to scratch each sample with the same hard object, using the same force, and compare the scratches; the sample that is scratched less easily is harder.

- try to scratch each sample with the same object (e.g. a steel nail), using the same force (1)
- compare the depth / visibility of the scratches: the sample that is scratched less is the harder one (1)

Notes: Allow: drop the same mass from the same height onto each sample and compare the size of the dents.

Question 4 (8 marks)

04.1 [1 mark]

Answer: 93.5%

- $(100 - 4.4 - 1.5 - 0.6 =) 93.5 \text{ (\%)} (1)$
-

04.2 [2 marks]

Answer: 11 kg

- $250 \times 4.4 \div 100 (1)$
 - 11 (kg) (1)
-

04.3 [3 marks]

Answer: The copper, magnesium and manganese atoms are different sizes from aluminium atoms; they distort the layers so the layers cannot slide easily.

- atoms of copper / magnesium / manganese are a different size from aluminium atoms (1)
 - (so) the layers of aluminium atoms are distorted (1)
 - (so) the layers cannot slide over each other easily (1)
-

04.4 [2 marks]

Answer: It has a giant structure with strong metallic bonding (attraction between positive ions and delocalised electrons), which needs a lot of energy to overcome.

- strong electrostatic attraction between the positive ions and the delocalised electrons / strong metallic bonding (in a giant structure) (1)
 - a lot of energy is needed to overcome it (1)
-

Question 5 (7 marks)

05.1 [2 marks]

Answer: tin 157.5 g; lead 92.5 g

- tin: $250 \times 0.63 = 157.5$ (g) (1)
 - lead: $250 - 157.5 = 92.5$ (g) (1)
-

05.2 [2 marks]

Answer: The solder melts at 183 °C, lower than both tin (232 °C) and lead (327 °C), so the claim is not true for this alloy.

- the solder melts at a lower temperature (183 °C) than both tin (232 °C) and lead (327 °C) (1)
 - so the claim is wrong / not always true (1)
-

05.3 [1 mark]

Answer: It can be melted without damaging the electrical components.

- it can be melted without damaging the components / less energy is needed to melt it (1)
-

05.4 [2 marks]

Answer: The lead atoms are a different size from tin atoms and distort the layers, so the layers cannot slide over each other easily.

- lead atoms are a different size from tin atoms and distort the layers (1)
 - so the layers cannot slide over each other easily (1)
-

Question 6 (6 marks)

06.1 [2 marks]

Answer: The hardness increases, but the increase gets smaller at higher percentages of tin.

- hardness increases (as the percentage of tin increases) (1)
 - the rate of increase gets smaller / the curve levels off at higher percentages (1)
-

06.2 [1 mark]

Answer: 5.1% (allow 5.0–5.3%)

- any value from 5.0 to 5.3 (%) (1)
-

06.3 [3 marks]

Answer: Tin atoms are a different size from copper atoms, so they distort the layers and the layers cannot slide over each other as easily.

- tin atoms are a different size from copper atoms (1)
 - (so) the layers of atoms are distorted (1)
 - (so) the layers cannot slide over each other as easily (1)
-