

GCSE Combined Science: Trilogy

Worksheet: Metallic bonding

TIME 20 min	TOTAL 21 marks	CALCULATOR Allowed	DIFFICULTY Easy, Medium
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Topics: Metallic bonding

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 have metallic bonding.

0 1 . 1

Complete the sentence.

Tick (✓) **one** box.

Metals consist of giant structures of atoms arranged in a

random pattern

☐

regular pattern

☐

single layer

☐

small molecule

☐

[1 mark]

0 1 . 2

What are delocalised electrons?

.....

.....

[1 mark]

0 1 . 3

Which electrons become delocalised in a metal?

Tick (✓) **one** box.

All of the electrons

☐

Electrons in the inner shells

☐

Electrons in the outer shell

☐

One electron from every ten atoms

☐

[1 mark]

0 1 . 4

Are metallic bonds strong or weak?

.....

.....

.....

[1 mark]

0 2

Metals have giant structures held together by metallic bonding.

0 2 . 1

What is metallic bonding?

Tick (✓) **one** box.

Shared pairs of electrons between two atoms

☐

Transfer of electrons from one atom to another

☐

Electrostatic attraction between positive ions and delocalised electrons

☐

Weak forces between separate molecules

☐

[1 mark]

0 3

The electronic structure of magnesium is 2,8,2. In magnesium metal, the outer electrons of each atom are delocalised.

0 3 . 1

What is the charge on the positive ions in magnesium metal?

.....

.....

[1 mark]

0 3 . 2

How many delocalised electrons are there in a piece of magnesium that contains 5000 atoms?

.....

.....

.....

.....

[1 mark]

0 3 . 3

The positive ions in a metal repel each other.
Explain why the structure does not fall apart.

.....

.....

.....

.....

[2 marks]

0 3 . 4

Magnalium is an alloy of magnesium and aluminium.
What type of bonding is present in magnalium?

.....

.....

.....

.....

[1 mark]

0 4

Potassium melts at 63 °C. Calcium melts at 842 °C.

In solid potassium, each atom contributes 1 delocalised electron. In solid calcium, each atom contributes 2 delocalised electrons.

0 4 . 1

Use the information to explain why calcium has a much higher melting point than potassium.

.....

.....

.....

.....

.....

.....

[3 marks]

0 5

A student says:

‘Metallic bonds must be weak, because metals can be bent and hammered into shape.’

0 5 . 1

Evaluate the student’s statement.

.....

.....

.....

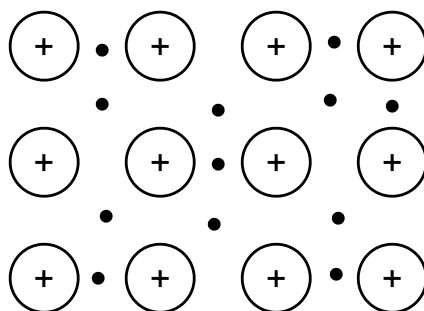
.....

[2 marks]

0 6

Figure 1 represents the structure of sodium metal. The small dots represent electrons.

Figure 1



0 6 . 1

What do the circles labelled + represent?

.....

.....

.....

.....

[1 mark]

0 6 . 2

What name is given to the electrons shown by the small dots?

.....

.....

.....

.....

[1 mark]

0 6 . 3

Explain how the particles in Figure 1 are held together.

.....

.....

.....

.....

[2 marks]

0 6 . 4

Figure 1 shows 12 circles labelled + and 12 small dots.
Explain why the numbers are the same.

[1 mark]

0 6 . 5

Give **one** limitation of Figure 1.

[1 mark]

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: Metallic bonding · 21 marks

Question 1 (4 marks)

01.1 [1 mark]

Correct: regular pattern

01.2 [1 mark]

Answer: Electrons that are free to move through the whole structure.

- electrons that are free to move (through the whole structure) (1)
-

01.3 [1 mark]

Correct: Electrons in the outer shell

01.4 [1 mark]

Answer: strong

- strong (1)
-
-

Question 2 (1 mark)

02.1 [1 mark]

Correct: Electrostatic attraction between positive ions and delocalised electrons

Question 3 (5 marks)

03.1 [1 mark]

Answer: 2+

- 2+ (1)

Notes: Allow +2. The sign must be shown.

03.2 [1 mark]

Answer: 10 000

- 10 000 (1)
-

03.3 [2 marks]

Answer: The delocalised electrons are attracted to all the positive ions; this strong electrostatic attraction holds the ions together.

- the (negative) delocalised electrons attract the positive ions (1)
 - this (strong) electrostatic attraction holds the structure together / is stronger than the repulsion (1)
-

03.4 [1 mark]

Answer: metallic

- metallic (1)
-

Question 4 (3 marks)

04.1 [3 marks]

Answer: Calcium has more delocalised electrons per atom and its ions have a greater charge (2+), so there is stronger electrostatic attraction between the ions and the delocalised electrons, which needs more energy to overcome.

- calcium has more delocalised electrons per atom / calcium ions have a higher charge (2+ compared with 1+) (1)
 - so the electrostatic attraction between the positive ions and the delocalised electrons is stronger (stronger metallic bonding) (1)
 - so more energy is needed to overcome the metallic bonding (1)
-

Question 5 (2 marks)

05.1 [2 marks]

Answer: The student is wrong: metallic bonds are strong (metals have high melting points). When a metal is bent, layers of ions slide over each other but stay held together by the delocalised electrons.

- the student is wrong: metallic bonds are strong (e.g. metals have high melting points) (1)
 - when a metal is bent, layers of ions slide over each other, but the delocalised electrons still hold the ions together (1)
-

Question 6 (6 marks)

06.1 [1 mark]

Answer: positive (sodium) ions

- positive (sodium / metal) ions (1)
-

06.2 [1 mark]

Answer: delocalised electrons

- delocalised (electrons) (1)
-

06.3 [2 marks]

Answer: Strong electrostatic attraction between the positive ions and the negative delocalised electrons.

- (strong) electrostatic attraction (1)
 - between the positive ions and the (negative) delocalised electrons (1)
-

06.4 [1 mark]

Answer: Each sodium atom has one outer electron, which becomes delocalised.

- each sodium atom has one outer electron which becomes delocalised (1)
-

06.5 [1 mark]

Answer: It is two-dimensional and shows the electrons in fixed positions, although they move.

- it is 2D / electrons are shown in fixed positions (but they move) / only a small part of the structure is shown / not to scale (1)
-