

GCSE Combined Science: Trilogy

Worksheet: Properties of small molecules

TIME 25 min	TOTAL 25 marks	CALCULATOR Allowed	DIFFICULTY Easy, Medium
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Topics: Properties of small molecules

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

Many covalent substances consist of small molecules.

0 1 . 1

Complete the sentence.

Tick (✓) **one** box.

Substances that consist of small molecules are usually

gases or liquids

☐

hard solids

☐

metals

☐

good conductors of electricity

☐

[1 mark]

0 1 . 2

What is overcome when water boils?

Tick (✓) **one** box.

Covalent bonds

☐

Intermolecular forces

☐

Ionic bonds

☐

Metallic bonds

☐

[1 mark]

0 1 . 3

Explain why substances that consist of small molecules do not conduct electricity.

.....

.....

[1 mark]

0 1 . 4

Methane boils at $-162\text{ }^{\circ}\text{C}$.

What is the state of methane at room temperature?

.....

.....

.....

.....

[1 mark]

0 2

Substances made of small molecules have typical properties.

0 2 . 1

Which property is typical of substances made of small molecules?

Tick (✓) **one** box.

High melting point

☐

Conducts electricity when solid

☐

Low melting and boiling points

☐

Giant lattice structure

☐

[1 mark]

0 3

To boil one mole of water needs 41 kJ of energy.

To break all of the O–H covalent bonds in one mole of water molecules needs 928 kJ of energy.

0 3 . 1

Calculate how many times more energy is needed to break the covalent bonds in one mole of water than to boil one mole of water.

.....

.....

.....

.....

.....

[2 marks]

0 3 . 2

A student said:

‘When water boils, the covalent bonds break and the molecules split up into hydrogen and oxygen.’

Use the data to explain why the student must be wrong.

.....

.....

[1 mark]

0 3 . 3

Describe what happens to the water molecules when water boils.

.....

.....

.....

.....

[2 marks]

0 4

Substances made of small molecules and giant covalent structures both contain covalent bonds, but they have very different melting points.

0 4 . 1

Explain why substances made of small molecules generally have much lower melting points than giant covalent structures, even though both contain covalent bonds.

[4 marks]

0 5

A student says:

‘Substances made of small molecules do not conduct electricity, because molecules do not contain any charged particles.’

0 5 . 1

Evaluate the student’s statement.

[2 marks]

0 6

A student tests glucose solution and sodium chloride solution for electrical conductivity. Each solution is tested using two carbon electrodes connected to a power supply and a bulb.

0 6 . 1

Predict whether the bulb lights with each solution.

.....

.....

.....

.....

[2 marks]

0 6 . 2

Explain the result for glucose solution.

.....

.....

[1 mark]

0 6 . 3

Give **one** variable the student should keep the same so that the test is fair.

.....

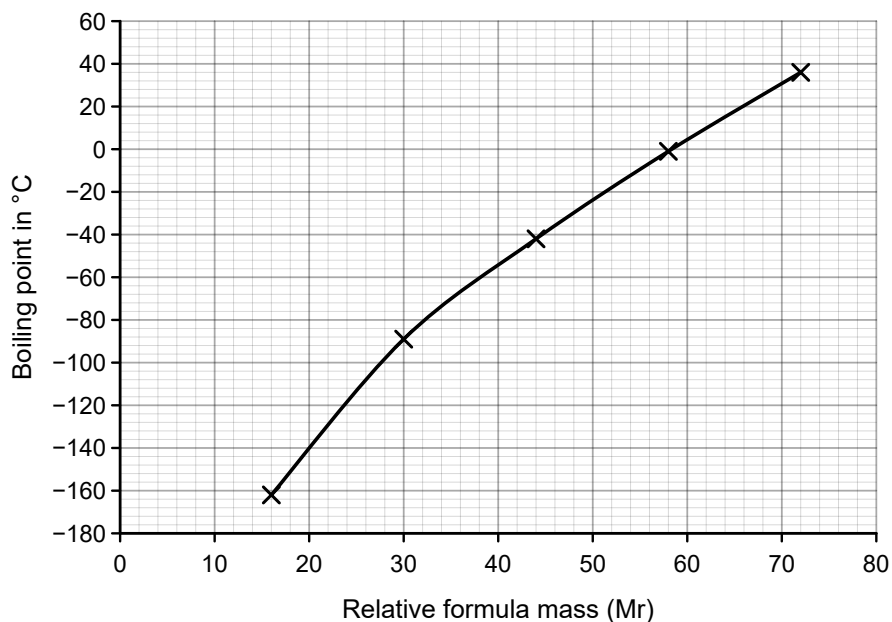
.....

[1 mark]

0 7

Figure 1 shows the boiling points of five compounds that consist of small molecules. The compounds are methane, ethane, propane, butane and pentane.

Figure 1



0 7 . 1

Describe the relationship between relative formula mass and boiling point.

[1 mark]

0 7 . 2

Explain this relationship.

[2 marks]

0 7 . 3

Hexane has a relative formula mass of 86.
Predict the boiling point of hexane.

.....

.....

.....

Boiling point = °C

[1 mark]

0 7 . 4

The melting points of all five compounds are below –100 °C.
Which of the five compounds is a liquid at 20 °C?

.....

.....

.....

.....

[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: Properties of small molecules · 25 marks

Question 1 (4 marks)

01.1 [1 mark]

Correct: gases or liquids

01.2 [1 mark]

Correct: Intermolecular forces

01.3 [1 mark]

Answer: The molecules do not have an overall electric charge.

- the molecules have no overall (electric) charge (1)
-

01.4 [1 mark]

Answer: gas

- gas (1)
-
-

Question 2 (1 mark)

02.1 [1 mark]

Correct: Low melting and boiling points

Question 3 (5 marks)

03.1 [2 marks]

Answer: 23 (22.6)

- $928 \div 41$ (1)
 - $22.6 / 23$ (1)
-

03.2 [1 mark]

Answer: If the covalent bonds broke, about 928 kJ would be needed to boil one mole of water, but only 41 kJ is needed.

- breaking the covalent bonds would need 928 kJ per mole, but boiling needs only 41 kJ per mole / boiling needs far less energy than breaking the bonds (1)
-

03.3 [2 marks]

Answer: The weak intermolecular forces between the water molecules are overcome, and the molecules move far apart and move randomly as a gas (steam).

- the (weak) intermolecular forces / forces between the molecules are overcome (1)
- the molecules move far apart / move randomly and quickly as a gas (1)

Notes: Simply stating that the covalent bonds do not break does not score. Do not accept 'the molecules split up'.

Question 4 (4 marks)

04.1 [4 marks]

Answer: Melting a substance made of small molecules only overcomes weak intermolecular forces; the covalent bonds do not break. In a giant covalent structure there are no separate molecules, so many strong covalent bonds must be broken, which needs far more energy.

Levels of response

- **Level 2 (3–4)** A clear, logically linked answer covering the key points accurately.
- **Level 1 (1–2)** One or two relevant points with little linking.
- **No marks (0)** Nothing relevant or worthy of credit.

Indicative content

- in substances made of small molecules, melting only overcomes the weak intermolecular forces between the molecules
 - the (strong) covalent bonds within the molecules are not broken when the substance melts
 - in giant covalent structures there are no separate molecules: all the atoms are joined by strong covalent bonds
 - melting a giant covalent structure means breaking many strong covalent bonds, which needs far more energy
-

Question 5 (2 marks)

05.1 [2 marks]

Answer: The conclusion is correct, but the reason is wrong: molecules do contain charged particles (protons and electrons). They do not conduct because the molecules have no overall charge and there are no ions or delocalised electrons that are free to move.

- the conclusion is correct: substances made of small molecules do not conduct electricity (1)
- but the reason is wrong: molecules contain charged particles (protons and electrons); they do not conduct because the molecules have no overall charge / there are no free ions or electrons to carry charge (1)

Notes: Allow a comment that some small molecules, such as hydrogen chloride, react with water to form ions, so their solutions conduct.

Question 6 (4 marks)

06.1 [2 marks]

Answer: glucose solution: the bulb does not light; sodium chloride solution: the bulb lights

- glucose solution: bulb does not light (1)
- sodium chloride solution: bulb lights (1)

06.2 [1 mark]

Answer: Glucose is made of molecules with no overall charge, so there are no ions to carry charge.

- glucose consists of (small) molecules with no overall charge / there are no ions (or delocalised electrons) to carry charge (1)

06.3 [1 mark]

Answer: the potential difference of the power supply

- e.g. the potential difference / power supply setting, the distance between the electrodes, the depth of the electrodes in the solution, the concentration of the solutions (1)

Question 7 (5 marks)

07.1 [1 mark]

Answer: The boiling point increases as the relative formula mass increases.

- boiling point increases as relative formula mass increases (1)

07.2 [2 marks]

Answer: Larger molecules have stronger intermolecular forces, so more energy is needed to overcome them.

- intermolecular forces increase with the size of the molecules (1)
- so more energy is needed to overcome the intermolecular forces (1)

Notes: Do not accept 'covalent bonds are broken'.

07.3 [1 mark]

Answer: any value from 60 °C to 80 °C (actual 69 °C)

- any value from 60 to 80 (°C) (1)

07.4 [1 mark]

Answer: pentane

- pentane (1)
-