

Ions in a sea of electrons

Chemistry grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · Test answers (mark scheme)

Use these model answers and marking points to score your paper out of 20. Award marks for the ideas rather than the exact words, and note the questions where you forgot to mention the electrons or the layers, since these are the usual missing points.

Level: Chemistry grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · **Curriculum:** GCSE C2

Question 1 Metallic bond (2 marks)

A metallic bond is the electrostatic attraction between positive metal ions and delocalised electrons.

Marking: 1 mark for positive ions and delocalised electrons, 1 mark for electrostatic attraction.

Question 2 Electrons in a wire (3 marks)

- a. Delocalised electrons.
- b. From left to right, towards the positive terminal.
- c. The ions are fixed in their layers.

Marking: 1 mark for each part.

Question 3 Why metals bend (3 marks)

Copper has layers of positive ions in a sea of delocalised electrons. When a force is applied, the layers slide over each other. The electrons still attract the ions in the new positions, so the bonding is maintained and the bar does not break.

Marking: 1 mark for layers sliding, 1 mark for electrons holding the ions together, 1 mark for the bond being maintained.

Question 4 Bronze statue (3 marks)

- a. $88 \div 100 \times 12.0 = \mathbf{10.56 \text{ kg.}}$
- b. $12.0 - 10.56 = \mathbf{1.44 \text{ kg.}}$

Marking: 1 mark for the method, 1 mark for 10.56 kg, 1 mark for 1.44 kg.

Question 5 Steel and iron (3 marks)

Steel is an alloy of iron with a small amount of carbon. Carbon atoms are different in size from iron atoms and disturb the regular layers. The layers cannot slide as easily, so steel is harder.

Marking: 1 mark for an alloy containing carbon, 1 mark for the different-sized atoms, 1 mark for layers sliding less easily.

Question 6 Sodium and magnesium (2 marks)

Magnesium forms Mg^{2+} ions and gives two electrons per atom, while sodium forms Na^+ and gives one. The attraction is stronger in magnesium, so more energy is needed to melt it.

Marking: 1 mark for the higher charge or more electrons, 1 mark for stronger attraction or more energy.

Question 7 Conducting heat (2 marks)

Free electrons take up energy and move quickly through the metal, and vibrating ions pass the energy on, so the energy spreads quickly through the pan.

Marking: 1 mark for free electrons moving, 1 mark for transfer of energy.

Question 8 Alloy or pure (2 marks)

Brass is harder because zinc atoms disturb the copper layers and stop them sliding. In brass the zinc atoms also hinder the movement of the electrons, so brass is a worse conductor.

Marking: 1 mark for hardness explained, 1 mark for the conductivity explanation.