

Ions in a sea of electrons

Chemistry grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · Lab answers

The answers use the sample data above. Your own numbers will differ a little, but the pattern should match: pure metals usually survive more bends than alloys. Show how you find each mean, state which result is anomalous, and explain results with the layer model.

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

Question 1 Calculating the means

The brass result of 11 is much higher than 5 and 6, so it is anomalous. Copper: $(11 + 13 + 12) \div 3 = 12$. Aluminium: $(8 + 7 + 9) \div 3 = 8$. Brass: $(5 + 6) \div 2 = 5.5$. Steel: $(3 + 2 + 4) \div 3 = 3$.

Copper 12, aluminium 8, brass 5.5, steel 3 bends.

Question 2 The pattern

The pure metals copper and aluminium survived 12 and 8 bends, but the alloys brass and steel survived only 5.5 and 3. The order from most to fewest bends is copper, aluminium, brass, steel.

Pure metals took more bends than alloys.

Question 3 Explain with particles

Copper has identical ions in neat layers that slide easily and keep bonded to the electron sea, so the wire deforms without breaking. Brass contains zinc atoms of a different size, which disturb the layers and stop them sliding, so cracks form sooner.

Different-sized atoms stop the layers sliding.

Question 4 Anomalous result

The piece might have been a softer sample or bent more slowly or by a smaller angle. I would repeat the brass test with new pieces and reject the anomaly if it does not occur again.

Repeat the test and exclude the anomaly.

Question 5 Fair test

Wire diameter, wire length above the clamp, bend angle and the speed of bending. Using the same person to bend each wire also helps.

Diameter, length, angle and speed.

Question 6 Making it more reliable

Fit a small guide that forces every bend to exactly 90° and run five wires of each metal rather than three. A narrow range within each set, such as 11 to 13 for copper, then shows the method is consistent.

A fixed guide and more repeats.

Question 7 Uses

Copper is ductile, conducts electricity very well and survives repeated bending. Steel is much stronger and harder, so it can hold enormous loads, although it conducts less well.

Copper for conduction, steel for strength.