Solutions

Marking: **M1** a correct method, **A1** the correct answer, **B1** an independent mark.

Each answer shows the steps, then the **result**.

2.1

a lattice of positive ions / cations and delocalized electrons; held by electrostatic attraction between them

2.2

Mg^{2+} has a higher charge than Na^{+} and gives two delocalized electrons per atom; Mg^{2+} is smaller; so the attraction between ions and delocalized electrons is stronger and more energy is needed to break it

2.3

the layers of cations can slide over each other; the delocalized electrons still hold the ions together, so the metal does not break; delocalized electrons are free to move through the structure and carry charge

2.4

a transition element has an incomplete d sublevel in at least one of its ions; Zn is $[Ar]3d^{10}4s^{2}$ and Zn^{2+} is $[Ar]3d^{10}$: the 3d sublevel is always full

3.1

(a) melting point rises from Na to Al; the cation charge rises (+1, +2, +3), so there are more delocalized electrons; and the cations get smaller, so the attraction is stronger

(b) K^{+} is larger than Na^{+} (an extra electron shell); the delocalized electrons are further from the nuclei, so the attraction is weaker

3.2

(a) good electrical conductor; low density / does not corrode / ductile

(b) it has delocalized electrons; which move through the lattice when a potential difference is applied

(c) aluminium has a much lower density, so the cables are lighter

(d) delocalized electrons gain kinetic energy and move quickly through the metal; they pass on energy by collisions with ions / the vibrating ions also pass it on

(e) calcium delocalizes only its two 4s electrons; chromium can also delocalize its 3d electrons, so there are more delocalized electrons per atom; the metallic bonding is much stronger

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