

- M1.** (a) (i) Average/mean mass of 1 atom (of an element);
Average mass of 1 atom × 12. 1
- Mass 1/12 atom of ^{12}C ;
Mass 1 atom of ^{12}C .
QWC. 1
- (ii) Other isotope = 46.0%; 1
- $$107.9 = \frac{(54 \times 107.1) + (46 \times ?)}{100};$$
- M2 whole expression.* 1
- 108.8;
Answer 108.8 (3 marks).
Answer min 1 d.p.. 1
- Same electronic configuration/ same number of electrons (in outer shell)/ both have 47 electrons;
Ignore protons and neutrons unless incorrect.
Not just electrons determine chemical properties. 1
- (b) Ionisation; 1
- high energy electrons fired at sample;
Allow electron gun /blasted with electrons. 1
- Acceleration; 1
- With electric field/accelerating potential/potential difference;
Allow by negative plate. 1
- Deflection; 1
- With electromagnet/ magnet/ magnetic field;
M2 dependent on M1.

M4 dependent on M3.

M6 dependent on M5.

1

(c) (Silver) metallic (bonding);

Vdw/molecules CE=0.

1

Regular arrangement of same sized particles;

1

+ charge in each ion;

Ignore multiple positive charges.

Candidates do not need to show delocalised electrons.

1

(d) Ionic (bonds);

1

Minimum 4 ions shown in 2D square arrangement placed Correctly;

Do not allow multiple charges on ions.

1

Further 3 ions shown correctly in a cubic lattice;

1

Strong (electrostatic) forces/bonds;

If vdw/molecules/covalent mentioned CE = 0 for M4 and M5.

1

Between + and - ions;

Accept between oppositely charged ions.

1

[20]

M2. (a) $2\text{Al} + 3\text{CuCl}_2 \rightarrow 2\text{AlCl}_3 + 3\text{Cu}$;

(accept multiples/fractions)

OR

$2\text{Al} + 3\text{Cu}^{2+} \rightarrow 2\text{Al}^{3+} + 3\text{Cu}$;

1

- (b) (i) increases; 1
- (ii) lower than expected / lower than Mg / 1
 less energy needed to ionise; e⁻ removed from (3)p sub-level; 1
(‘e⁻ removed’ may be implied)
 of higher energy / further away from nucleus / shielded by 3s e⁻; 1
- (c) Al(g) → Al²⁺(g) + e⁻; 1
- (d) trend: increases; 1
 more protons / higher charge on cation / more delocalised e⁻ / smaller atomic/ionic radius; 1
 stronger attraction between (cat)ions and delocalised/free/mobile e⁻ 1
 OR
 stronger metallic bonding; 1

[9]

- M3.** (a) (i) positive ions **(1)**
 (attract) delocalised electrons **(1)** *(or sea of or free or mobile) (1)*
Confusion with - ve ions
or ionic lattice C.E. = 0
- (ii) more protons **(1)** (or Mg²⁺ more charge than Na⁺)
 attracts delocalised (or bonding) electrons more strongly **(1)**

Delocalised: can be brought forward from (a) (i)

OR more delocalised electrons (1)

Attacks positive ions more (1)

*Metallic bonding is stronger scores one mark, only given if
no other marks awarded*

4

(b) macromolecular **(1)** *(or giant molecule etc)*

covalent **(1)**

strong covalent bonds **(1)**

or bonds require much energy to break

3

(c) delocalised *(OR free or sea of or mobile)* electrons **(1)**

1

(d) Planes **(1)**

weak (bonds) forces between planes **(1)**

2

or v.dw forces between planes

[10]

M4.A

[1]