

Chemical Bonds; Ionic; Covalent; Metal

Mark Scheme 1

| | |
|------------------|--|
| Level | GCSE (9-1) |
| Subject | Combined Science: Trilogy - Chemistry |
| Exam Board | AQA |
| Topic | 5.2 Bonding Structure + Props Matter |
| Sub-Topic | Chemical Bonds; Ionic; Covalent; Metal |
| Difficulty Level | Silver Level |
| Booklet | Mark Scheme 1 |

Time Allowed: 56 minutes

Score: /55

Percentage: /100

Grade Boundaries:

| | | |
|---------------|---|-----|
| M1.(a) | A base | 1 |
| | (b) forces | 1 |
| | (c) calcium loses electrons and oxygen gains electrons <i>max 3 for incorrect reference to atom / ion or to oxygen / oxide</i> | 1 |
| | two electrons are transferred | 1 |
| | calcium has a 2^+ charge | 1 |
| | oxide has a 2^- charge | 1 |
| | | [6] |
| M2.(a) | 408 kg | 1 |
| | (b) all points correct <i>$\pm \frac{1}{2}$ small square</i> | 2 |
| | <i>allow 1 mark if 5 points correct</i> | |

best fit line

1

(c)
$$\frac{1989 \times 100}{36}$$

1

5525 dm³

1

(d) relative formula mass of TiCl₄ is 190

1

25.26 %

1

Answer given to 3 significant figures = 25.3 %

1

25.23% with or without working gains 3 marks

(e) argon is unreactive

1

water (vapour) would react with sodium

allow water (vapour) would react with titanium(IV) chloride

1

and air contains oxygen that would react with reactants

allow and air contains oxygen that would react with products

1

(f) (titanium conducts electricity) because electrons in the outer shell of the metal atoms are delocalised

1

and so electrons are free to move

allow the delocalised electrons in the metal carry electrical charge through the metal

1

through the whole structure

1

[15]

M3.(a) (i) neutrons

this order only

1

electrons

1

protons

1

(ii) box on the left ticked

1

(b) (i) effervescence / bubbling / fizzing / bubbles of gas

*do **not** accept just gas alone*

1

magnesium gets smaller / disappears

allow magnesium dissolves

*allow gets hotter **or** steam produced*

ignore references to magnesium moving and floating / sinking and incorrectly named gases.

1

(ii) Marks awarded for this answer will be determined by the Quality of Communication (QC) as well as the standard of the scientific response. Examiners should also refer to the information in the Marking Guidance and apply a 'best-fit' approach to the marking.

0 marks

No relevant content

Level 1 (1–2 marks)

There are simple statements of some of the steps in a procedure for obtaining magnesium chloride.

Level 2 (3–4 marks)

There is a description of a laboratory procedure for obtaining magnesium chloride from dilute hydrochloric acid and magnesium.

The answer must include a way of ensuring the hydrochloric acid is fully reacted **or** a method of obtaining magnesium chloride crystals.

Level 3 (5–6 marks)

There is a well organised description of a laboratory procedure for obtaining magnesium chloride that can be followed by another person.

The answer must include a way of ensuring the hydrochloric acid is fully reacted **and** a method of obtaining magnesium chloride crystals.

examples of the points made in the response:

- hydrochloric acid in beaker (or similar)
- add small pieces of magnesium ribbon
- until magnesium is in excess or until no more effervescence occurs *
- filter using filter paper and funnel
- filter excess magnesium
- pour solution into evaporating basin / dish
- heat using Bunsen burner
- leave to crystallise / leave for water to evaporate / boil off water
- decant solution
- pat dry (using filter paper).

*Student may choose to use a named indicator until it turns a neutral colour, record the number of pieces of magnesium added then repeat without the indicator.

6

[12]

M4.(a) magnesium loses electrons

there are four ideas here that need to be linked in two pairs.

1

two electrons

1

chlorine gains electrons

*magnesium loses electrons and chlorine gains electrons
scores **2** marks.*

1

two atoms of chlorine

*magnesium loses two electrons and two chlorines each gain
one electron will score full marks.*

1

(b) 95

*correct answer with or without working gains **2** marks
if answer incorrect, allow $24 + 35.5 + 35.5$ for **1** mark*

2

[6]

M5.(a) (i) points correctly plotted ($\pm \frac{1}{2}$ small square)

*four points = **2** marks*

*three points = **1** mark*

Max 2

straight line of best fit using full range of points from 0,0

1

(ii) any **one** from:

must explain why the point is below the line

- the solution may not have been properly stirred
- the electrodes may have been a larger distance apart
- the drop of sodium chloride may have been a smaller volume / smaller

allow not enough sodium chloride added

allow smaller amount of sodium chloride

*do **not** allow too few drops added*

ignore the student may have misread the conductivity meter

1

(iii) any **one** from:

- the volume of pure water
allow amount
- the concentration (of the solutions added)
- the volume (of the drops) of solution added
ignore number of drops
- the distance between the electrodes
- the same electrodes **or** electrodes made of the same material
- same depth **or** surface area of electrodes in the water
- constant power supply
ignore current
- stirred

1

(b) (i) because (pure) water is covalent / molecular (simple) **or** contains molecules

1

therefore (pure) water has no free / mobile electrons **or** ions
molecules do not have a charge or molecules do not contain ions gains 2 marks

1

(ii) because there are ions in sodium chloride
allow Na⁺ and / or Cl⁻(ions) or ionic bonding.
Ignore particles other than ions for MP1.

1

which can move **or** carry the current / charge
MP2 must be linked to ions only.

1

(iii) Hydrogen
allow H₂ / H

1

[10]

M6. Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response.

0 marks

No relevant content

Level 1 (1–2 marks)

*There is a statement about the bonding and / or structure **or** melting / boiling point of chlorine **or** sodium chloride.*

Level 2 (3–4 marks)

*There are statements about the bonding and / or structure of chlorine **or** sodium chloride.*

Level 3 (5–6 marks)

*There are statements about the bonding and / or structure of chlorine **and** sodium chloride.*

*There is an explanation of why chlorine is a gas **or** sodium chloride is a solid.*

Examples of chemistry points made in response:

Chlorine:

covalent bonds between atoms

forming (simple) molecules

no / weak attraction / bonds between molecules

low boiling point

Sodium chloride:

*ionic bonds **or** electrostatic attraction*

strong bonds

in all directions

between oppositely charged ions

forming giant lattice

large amounts of energy needed to break bonds

high melting point

