



A-Level Chemistry

Group 2

Mark Scheme

Time available: 58 minutes

Marks available: 53 marks

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Mark schemes

1.

- (a) Mg^{2+} has a higher charge than Na^+ / Mg^{2+} ions are smaller / Mg^{2+} has a greater charge density / Mg atoms smaller than Na atoms / Mg has more delocalised electrons than Na

Allow

Mg has a higher nuclear charge

1

Stronger attraction to delocalised sea of electrons / stronger metallic bonding

Not attraction for outer electrons

1

- (b) $2\text{Mg} + \text{TiCl}_4 \rightarrow 2\text{MgCl}_2 + \text{Ti}$

Allow multiples

1

Mg changes oxidation state from 0 to +2 so electrons are lost / Ti changes oxidation state from +4 to 0, so gains electrons

Allow

Oxidation state of Mg increases so it is a reducing agent

1

- (c) Observation with MgCl_2 : (slight) white ppt

1

Observation with BaCl_2 : no (visible) change / colourless solution / no reaction

Do not allow nothing / no observation

1

[6]

2.

- (a) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$

Allow correct numbers that are not superscripted

1

- (b) $\text{Ca(s)} + 2\text{H}_2\text{O(l)} \longrightarrow \text{Ca}^{2+}(\text{aq}) + 2\text{OH}^{-}(\text{aq}) + \text{H}_2(\text{g})$

State symbols essential

1

- (c) Oxidising agent

1

- (d) $\text{Ca(g)} \longrightarrow \text{Ca}^{+}(\text{g}) + \text{e}^{-}$

State symbols essential

Allow 'e' without the negative sign

1

- (e) Decrease

If answer to 'trend' is not 'decrease', then chemical error = 0 / 3

1

Ions get bigger / more (energy) shells

Allow atoms instead of ions

1

3.

- (a) More (electron) shells / (outer) electrons further from the nucleus / larger atoms / more shielding

If 'molecules' mentioned CE = 0

It = Ba

Mark independently

ALLOW energy levels for shells

Both ideas must be comparative

1

So weaker attraction of nucleus/protons for (outer) electrons

NOT hold/pull/bonded for 'attraction'

Idea of nucleus or protons must be clear

ALLOW M2 if electrons implied from mention in M1

ALLOW converse if it is clear that answer refers to Ca

1

- (b) White solid / white ash

ALLOW 'white smoke/powder'

IGNORE 'product'

NOT ppt

IGNORE fumes

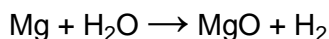
IGNORE tube/glass goes black

1

Bright light / white light

ALLOW glow/flame for light

1



IGNORE state symbols

1

- (c) BaSO_4 is insoluble but $\text{Ba}(\text{NO}_3)_2$ is soluble

OR

BaSO_4 precipitates but $\text{Ba}(\text{NO}_3)_2$ product(s) of second reaction is soluble/remains in solution

OR

BaSO_4 is insoluble but no reaction occurs in second case

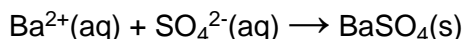
NOT just 'no observation' in second case

Comparison of solubilities must be implied

NOT Barium is soluble/insoluble

Correct state symbols required

1



1

[7]

4.

- (a) **M1** Increases / gets bigger

*If **M1** is incorrect **CE = 0** for the clip*

*If **M1** is blank, mark on and seek to **credit the correct information in the text***

M2 requires a correct **M1**

M2** requires correct **M1

More shells or sub-shells or (main) levels or sub-levels or orbitals (of electrons)

*If “molecules” penalise **M2***

Not simply “more electrons”

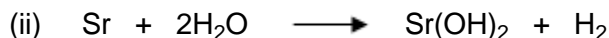
Not “more outer shells”

Ignore reference to nuclear charge and shielding

2

- (b) (i) Increases / gets more reactive / reacts more vigorously / violently (down the Group)

1



Credit multiples and correct ionic equations

Ignore state symbols

1

- (c) $\text{Ba}(\text{OH})_2$

*This **MUST** be a formula so ignore the name*

Credit $\text{Ba}^{2+} 2\text{OH}^-$

Ignore state symbols

1

[5]

5.

- (a) **M1** Used in a barium meal / barium swallow / barium enema

OR (used to absorb) X-rays

*Credit a correct reference to **M1** written in the explanation in **M2** unless contradictory.*

M2 BaSO_4 / barium sulfate / it is insoluble

*For **M2** penalise obvious reference to barium or to barium ions being insoluble.*

2



Or multiples.

Ignore state symbols.

1

- (c) It / magnesium hydroxide is insoluble / insufficiently soluble / sparingly soluble / less soluble than barium hydroxide / forms low concentration solutions

Weak alkali alone is insufficient.

Formation of a precipitate needs explanation.

1

- (d) $\text{TiCl}_4 + 2\text{Mg} \longrightarrow 2\text{MgCl}_2 + \text{Ti}$

Or multiples.

Ignore state symbols.

1

- (e) **M1** Hydrogen / H_2 produced

OR an equation to produce hydrogen / H_2

(eg $\text{Mg} + 2\text{H}_2\text{O} \longrightarrow \text{Mg}(\text{OH})_2 + \text{H}_2$)

(eg $\text{Mg} + \text{H}_2\text{O} \longrightarrow \text{MgO} + \text{H}_2$)

*For **M1***

Do not penalise an incorrect equation; the mark is for H_2 or hydrogen.

*Award one mark only for 'exothermic reaction with steam / H_2O ' for a student who has not scored **M1***

M2 requires correct **M1**

risk of explosion

OR forms explosive mixture (with air)

OR (highly) flammable

Ignore 'violent' reaction.

2

[7]

6.

- (a) (Measure the) volume of gas / mass of the container + contents

1

Suitable named piece of equipment

Gas syringe (or inverted burette or measuring cylinder, as long as student has referred to the cylinder being filled with water) / balance.

Equipment must be correct for the measurement stated.

1

- (b) Any **one** of:

- Mass of magnesium

Allow amount of magnesium.

- Surface area of magnesium

1

- (c) (i) Gravity: Conical flask or beaker and funnel /

Vacuum: Sealed container with a side arm and Buchner or Hirsch funnel

Must be either gravity filtration (with a V-shaped funnel) or vacuum filtration (with a side-arm conical flask) appropriately drawn.

1

Filter paper

Must show filter paper as at least two sides of a triangle (V-shaped) for gravity filtration or horizontal filter paper for vacuum filtration.

1

- (ii) Wash with / add (a small amount of cold) water

Ignore filtering.

1

[6]

7.

- (a) (i) 1.08×10^{-2}

Do not penalise precision but must be to at least 2 significant figures.

Do not accept 1×10^{-2}

1

- (ii) $5.4(0) \times 10^{-3}$

Allow (i) / 2

Do not penalise precision but must be to at least 2 significant figures.

1

- (iii) 266.6

Lose this mark if answer not given to 1 decimal place.

1

- (iv) mass = $5.4(0) \times 10^{-3} \times 266.6 = 1.44 \text{ g}$ **M1**

Allow (ii) \times (iii).

1

percentage = $1.44 \times 100 / 2.25 = 64.0$ **M2**

*Allow consequential answer from **M1***

Lose this mark if answer not given to 3 significant figures.

*Correct answer with no working scores **M2** only.*

1

- (v) 1 Would give an incorrect / too large mass (of silver chloride)

Do not allow 'to get an accurate result' without qualification.

1

- 2 To remove soluble impurities / excess silver nitrate (solution) / strontium nitrate (solution)

Do not allow 'to remove impurities'.

Do not allow 'to remove excess strontium chloride solution'.

1

- (b) (i) $\text{Mg}^{2+}(\text{aq}) + 2\text{OH}^{-}(\text{aq}) \rightarrow \text{Mg}(\text{OH})_2(\text{s})$
 Allow $\text{Mg}^{2+}(\text{aq}) + 2\text{OH}^{-}(\text{aq}) \rightarrow \text{Mg}^{2+}(\text{OH})_2(\text{s})$
 Allow multiples, including fractions.
 Lose mark if state symbols are missing or incorrect.
 Lose mark if incorrect charge on an ion.

1

- (ii) Does not produce CO_2 / gas which distends stomach / does not produce wind / does not increase pressure in stomach
 Allow 'prevents flatulence' and 'prevents burping'.
 Do not allow 'gas' without qualification.

1

- (c) $(\text{CH}_3\text{COO})_2\text{Ca} \rightarrow \text{CH}_3\text{COCH}_3 + \text{CaCO}_3$
 Allow multiples.
 Allow propanone as $\text{C}_3\text{H}_6\text{O}$
 Allow $(\text{CH}_3\text{COO}^{-})_2\text{Ca}^{2+} \rightarrow \text{CH}_3\text{COCH}_3 + \text{Ca}^{2+}\text{CO}_3^{2-}$

1

- (d) Ca (salt) - no visible change with sodium chromate(VI) **M1**
 Allow 'yellow solution formed' or 'no ppt. forms'.
 Allow **M1** and **M2** in any order.

1

Sr and Ba (salts) give (yellow) precipitate with sodium chromate(VI) **M2**
 Lose this mark if precipitate has an incorrect colour.

1

Sr precipitate (chromate(VI)) dissolves in ethanoic acid / Ba precipitate (chromate(VI)) does not dissolve in ethanoic acid **M3**
 If ethanoic acid is added first, allow access to **M1** and **M3**.

1

- (e) C 42.09 / 12, H 2.92 / 1, N 8.18 / 14, O 37.42 / 16 and S 9.39 / 32.1
 Accept any other correct method of working.
 If relative atomic mass has been divided by the percentage composition is used then $\text{CE} = 0 / 2$

1

$\text{C}_{12}\text{H}_{10}\text{N}_2\text{O}_8\text{S}$
 Correct answer with no working scores 1 mark only.

1

[15]