

Mark schemes

1

- (a) (i) Increases 1
- (ii) Decreases 1
- (iii) Increases 1
- (b) Calcium has a higher melting point than strontium, because
CE = 0 for reference to molecules or intermolecular forces or covalent bonds

Correct reference to size of cations/proximity of electrons

M1 (For Ca) delocalised electron(s) closer to cations / positive ions / nucleus
Ignore “Van der Waals forces (between atoms)” but penalise if between “molecules”

OR cations / positive ions / atoms are smaller

OR cation / positive ion / atom or it has fewer (electron) shells / levels
Ignore general Group 2 statements
Answers must be specific

Relative strength of metallic bonding

M2 (For Ca) has stronger attraction between the cations / positive ions / nucleus and the delocalised electron(s)
Penalise M1 if Ca or Sr is said to have more or less delocalised electrons

OR

stronger metallic bonding

(assume argument refers to Ca but accept converse argument for Sr)
Ignore reference to shielding

2

- (c) (i) Sulfuric acid / it contains sulfate ions / SO_4^{2-}

OR

Do not penalise an additional but incorrect formula for sulfate ion.

Sulfuric acid would form a (white) precipitate

If only the formula of the sulfate ion is given, it must be correct

1



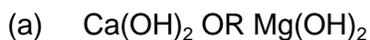
Ignore state symbols

No multiples

1

[7]

2



Ignore name

Could be ionic

1



OR



Either formula or name can score

Do not penalise the spelling “fluoride”

When both formula and name are written,

- *penalise contradictions*
- *if the attempt at the correct **formula** is incorrect, ignore it and credit **correct name** for the mark unless contradictory*
- *if the attempt at the correct name is incorrect, ignore it and credit **correct formula** for the mark unless contradictory*

1



Ignore name (even when incorrect)

The correct formula must be clearly identified if an equation is written

1



Only the correct formula scores;

penalise lower case “b”, penalise upper case “R”, penalise superscript

Ignore name

The correct formula must be clearly identified if an equation is written

1

(e) **M1** S OR S₈ OR S₂

M2 I₂ (ONLY)

Ignore names

penalise lower case "i" for iodine,

penalise superscripted numbers

Mark independently

The correct formula must be clearly identified in each case if an equation is written

2

(f) (i) CH₃CH₂CH=CH₂

Structure of but-1-ene. Ignore name

Credit "sticks" for C-H bonds

1

(ii) CH₃CH₂CH₂CH₂OH

Structure of butan-1-ol. Ignore name

Credit "sticks" for C-H bonds

1

(iii) CH₃CH₂CH₃

Structure of propane. Ignore name

Ignore calculations and molecular formula

Credit "sticks" for C-H bonds

Ignore the molecular ion

1

(iv) CH₃CH₂Br OR C₂H₅Br

Structure of bromoethane.

Ignore name and structure of nitrile

Credit "sticks" for C-H bonds

1

[10]

3

- (a) (i) **M1** (yellow precipitate is) silver iodide OR AgI (which may be awarded from the equation)

M2 $\text{Ag}^+ + \text{I}^- \rightarrow \text{AgI}$ (Also scores M1 unless contradicted)

M3 sodium chloride OR NaCl

For M2

Accept multiples

Ignore state symbols

Allow crossed out nitrate ions, but penalise if not crossed out

3

- (ii) The silver nitrate is acidified to

- react with / remove ions that would interfere with the test
- prevent the formation of other silver precipitates / insoluble silver compounds that would interfere with the test
- remove (other) ions that react with the silver nitrate
- react with / remove carbonate / hydroxide / sulfite (ions)
Ignore reference to “false positive”

1

- (iii) **M1 and M2 in either order**

M1 Fluoride (ion) OR F

- M2**
- Silver fluoride / AgF is soluble / dissolves (in water)
 - no precipitate would form / no visible / observable change
*Do not penalise the spelling “fluoride”,
Penalise “fluride” once only
Mark M1 and M2 independently*

2



(or the ions together)

M2 white precipitate / white solid / white suspension

M3 Barium meal or (internal) X-ray or to block X-rays

M4 BaSO₄ / barium sulfate is insoluble (and therefore not toxic)

For M1, ignore state symbols

Allow crossed out sodium ions, but penalise if not crossed out

For M2, ignore “milky”

If BaSO₃ OR BaS used in M1 and M4, penalise once only

For M3 Ignore radio-tracing

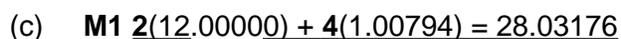
For M4 NOT barium ions

NOT barium

NOT barium meal

NOT “It” unless clearly BaSO₄

4



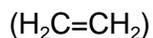
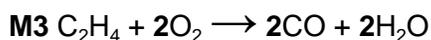
M2 Ethene and CO or “they” have an imprecise **M_r** of 28.0 / 28

OR

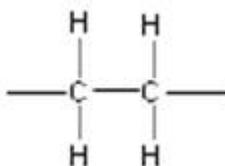
Ethene and CO or “they” have the same M_r to one d.p.

OR

These may be shown by two clear, simple sums identifying both compounds



M4 Displayed formula



M5 Type of polymer = Addition (polymer)

M1 must show working using 5 d.p. for hydrogen

Penalise “similar” or “close to”, if this refers to the imprecise value in M2, since this does not mean “the same”

For M3, accept $\text{CH}_2=\text{CH}_2$ OR CH_2CH_2

For M4, all bonds must be drawn out including those on either side of the unit.

Penalise “sticks”

*Ignore brackets around **correct** repeating unit but penalise “n”*

Penalise “additional”

5

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4

(a) Hydrochloric acid = **C**

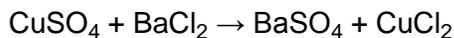
1

Barium chloride = **A**

1

(b) Barium sulfate is insoluble

1



Accept multiples.

Accept ionic equation.

Do not penalise lack of state symbols, but if used they must be correct.

1

(c) CO_2 / Carbon dioxide

1

(d) Reagent 1 silver nitrate (solution)

Ignore lack of reference to acidifying prior to addition of silver nitrate solution.

1

Observation 1 White precipitate

1

Reagent 2 (dilute) ammonia solution / aqueous ammonia

*Do not accept addition of **ammonia** only.*

1

Observation 2 (Colourless) solution

Allow ppt dissolves.

Do not allow 'goes colourless' or 'goes clear'.

Chlorine and no visible change or solution does not become orange scores M3 and M4.

1

(e) Gloves / wash hands after use

Ignore 'eye protection'.

Do not accept 'do not ingest the chemicals', 'wipe up spillages', 'use a fume cupboard', 'wear a lab coat' (list principle).

1

[10]

5

(a) (i) Blue to green

Accept blue to yellow.

1

(ii) Decrease / less acid needed

Ignore references to rate

1

(iii) Gloves **or** avoid skin contact

Allow 'if reagent contacts skin wash off (immediately)' or answers to that effect.

Do not accept 'wash' only.

Ignore 'eye protection' or 'lab coat' or 'use of fume cupboard' or 'don't ingest'.

1

(iv) Less chance of losing liquid on swirling / liquid doesn't splash on swirling

Do not accept 'easier to swirl' on its own.

Do not accept 'easier to stir'.

1

(v) Idea that a single titration could be flawed / anomalous

Allow an indication that the first titration is a rough titration.

Do not allow 'to improve accuracy' without qualification.

Do not allow vague references to 'outliers'.

1

(b) (i) $2.3(3) \times 10^{-2}$

Do not penalise additional significant figures, but do not allow 0.02

1

- (ii) Dilution of acid needed / may react with carbon dioxide in air
Accept 'poor end-point' or 'no suitable indicator' or 'a large volume (of calcium hydroxide) will be needed'.
Ignore references to low solubility or concentration too low.

1

[7]

6

- (a) Remove undissolved barium hydroxide / excess solid
Do not accept 'remove impurities'.

1

- (b) Filtration
Do not accept 'decanting' or 'sieving'.
Ignore references to heating or drying.

1

- (c) Remove (excess) sulfuric acid

1

- (d) $\text{Ba}(\text{OH})_2 + \text{H}_2\text{SO}_4 \rightarrow \text{BaSO}_4 + 2\text{H}_2\text{O}$
Accept multiples.
Accept $\text{Ba}^{2+} + \text{SO}_4^{2-} \rightarrow \text{BaSO}_4$
Ignore state symbols.

1

- (e) (i) 233.4
Accept 233

1

- (ii) 0.018(2)
Do not penalise additional significant figures, but do not allow 0.02
Allow consequential answer from (i).

1

- (iii) $0.018(2) \times 171.3 = 3.12$
Do not penalise precision.
If 0.018 used, answer = 3.08

1

- $\times 10 = 31.2$
Do not penalise precision.
Allow this mark if 0.18(2) used directly.
Correct answer without working scores one mark only.
Allow consequential answer on (ii)

1

- (f) Barium sulfate / it is insoluble
Do not accept answers based on small amount ingested.
Do not accept barium.

1

[9]

7

(a) Cross between the Na cross and the Mg cross

1

(b) $\text{Al(g)} \rightarrow \text{Al}^+(\text{g}) + \text{e}^-$

$\text{Al(g)} - \text{e}^- \rightarrow \text{Al}^+(\text{g})$

$\text{Al(g)} + \text{e}^- \rightarrow \text{Al}^+(\text{g}) + 2\text{e}^-$

One mark for state symbols consequential on getting equation correct.

Electron does not have to have the – sign on it

Ignore (g) if put as state symbol with e^- but penalise state symbol mark if other state symbols on e^-

2

(c) 2nd/second/2/II

Only

1

(d) Paired electrons in (3)p orbital

Penalise wrong number

If paired electrons repel allow M2

1

repel

1

(e) Neon/Ne

No consequential marking from wrong element

1

$1\text{s}^22\text{s}^22\text{p}^6/[\text{He}]2\text{s}^22\text{p}^6$

Allow capital s and p

Allow subscript numbers

1

(f) Decreases

CE if wrong

1

Atomic radius increases/electron removed further from nucleus
or nuclear charge/electron in higher energy level/Atoms
get larger/more shells

Accept more repulsion between more electrons for M2

Mark is for distance from nucleus

Must be comparative answers from M2 and M3

CE M2 and M3 if mention molecules

Not more sub-shells

1

As group is descended more shielding

1

[11]

8

(a) **M1** The yield of zinc oxide increases/greater

If M1 is given as "decrease" OR "no effect" then CE= 0

M2 Removal of the carbon dioxide results in the equilibrium

Either

Shifting/moving/goes to the right

shifting/moving/goes L to R

favours the forward reaction/towards the products

M3 (By Le Chatelier's principle) the reaction/equilibrium will

respond so as to replace the CO₂/lost product

OR to make more CO₂

OR to increase concentration of CO₂

*For M3, not simply "to oppose the change/to oppose the loss of
CO₂/to oppose the removal of carbon dioxide."*

3

(b) **M1** Process 2 produces/releases SO₂

OR Process 2 produces/releases CO

M2 It/Process 3 avoids the release of SO₂ OR CO

OR It/Process 3 (captures and) converts SO₂ to H₂SO₄

M3 SO₂ causes acid rain OR is toxic/poisonous

OR CO is toxic/poisonous

3

*Ignore "global warming" and "greenhouse gases" and "the ozone
layer"*

If both CO and SO₂ claimed to form acid rain, treat as contradiction

(c) **M1** Process 3 (is expensive because it) uses electrolysis
OR due to high electricity/electrical consumption

M2 this is justified because the product/zinc is pure

Ignore "energy"

Penalise "pure"

2

(d) **M1** $\text{Zn}^{2+} + 2\text{e}^{-} \longrightarrow \text{Zn}$

Ignore state symbols

M2 the negative electrode OR the cathode

Ignore absence of negative charge on electron

Accept electrons subtracted from RHS

2

(e) **M1** The reaction of ZnO with sulfuric acid
OR the second reaction in Extraction process 3

M2 neutralisation or acid-base

OR alternatively

M1 The reaction of zinc carbonate in Extraction process 1

M1 could be the equation written out in both cases

M2 (thermal) decomposition

M2 depends on correct M1

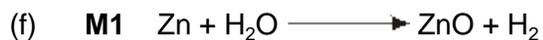
M3 It/carbon is oxidised/gains oxygen/changes oxidation state/number
from 0 to +2/increase in oxidation state/number in Process 2

Do not forget to award this mark

Ignore reference to electron loss but penalise electron gain

Ignore "carbon is a reducing agent"

3



M2 Zinc oxide and hydrogen

OR as an alternative



M2 Zinc hydroxide and hydrogen

Mark independently

If ZnO_2 is given for zinc oxide in the equation, penalise M1 and mark on

If ZnOH is given for zinc hydroxide in the equation, penalise M1 and mark on

Ignore state symbols

Credit multiples of the equation

If M1 is blank, either of the M2 answers could score

To gain both marks, the names must match the correct equation given.

2

[15]