AQA A-LEVEL CHEMISTRY · 7405

CHEMISTRY



MARK SCHEME

3.2.2 GROUP 2, THE ALKALINE EARTH METALS

SCORE	PERCENTAGE
/247	%

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Q1.

A

[1]

Q2.

B

[1]

Q3.

B

[1]

Q4.

(a) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ (4s^0)$

1

(b) **M1** In $Ca^{(+)}$ (outer) electron(s) is further from nucleus

Or $Ca^{(+)}$ loses electron from a higher (energy) orbital

Or $Ca^{(+)}$ loses electron from a 4(s) orbital or 4th energy level or 4th energy shell and $K^{(+)}$ loses electron from a 3(p) orbital or 3rd energy level or 3rd energy shell

Must be comparative

Allow converse arguments

1

M2 More shielding (in Ca^{+})

1

(c) Be /Beryllium

1

(d) $Mg(OH)_2$

1

(e) $Ba^{2+} + SO_4^{2-} \rightarrow BaSO_4$

Ignore state symbols

1

n $BaCl_2$ (6/1000 × 0.25) = 1.5×10^{-3} and n Na_2SO_4 = (8/1000 × 0.15) = 1.2×10^{-3} and $BaCl_2$ /barium chloride in excess

Working required or 3×10^{-4} of $BaCl_2$

1

10 cm^3 (of 0.15 mol dm^{-3} sodium sulfate)

or 0.01dm^3

1

(f) **M1** Same electronic configuration / same number of electrons (in outer shell) / all

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have 37 electrons (1)

Ignore protons and neutrons unless incorrect numbers

Not just electrons determine chemical properties

1

M2 $\frac{86x + 87x + 88(100-2x)}{100} = 87.7$ = 87.7

Alternative M2:

$\frac{86 + 87 + 88y}{1 + 1 + y} = 87.7$

1

M3 x = 10% (or × = 0.1)

M3 y = 8

1

M4 (% abundance of 88 isotope is 100 – 2x10) = 80(.0)%

M4 % of 88 isotope is 100 – 10y = 80(.0) %

Allow other alternative methods

1

(g) $^{138}Ba^{+}$

1

(h) **M1** $\text{mass} = \frac{137 \times 10^{-3}}{6.022 \times 10^{23}}$ = 2.275 × 10^{-25} (kg)

Calculation of m in kg

If not converted to kg, max 4

If not divided by L lose M1 and M5, max 3

1

M2 $v^2 = \frac{2KE}{m} = \frac{2 \times 3.65 \times 10^{-16}}{2.275 \times 10^{-25}}$ = 3.2088 × 10^{9}

For re-arrangement

1

M3 $v = \sqrt{2KE/m}$ (v = 5.6646 × 10^{4})

For expression with square root

1

M4 v = d/t or d = vt or with numbers

1

M5 d = (5.6646 × 10^{4} × 2.71 × 10^{-5}) = 1.53 - 1.54 (m)

M5 must be to 3sf

If not converted to kg, answer = 0.0485-0.0486 (3sf). This scores 4 marks

1

Alternative method

M1 $m = \frac{137 \times 10^{-3}}{6.022 \times 10^{23}}$ = 2.275 × 10^{-25}

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M1 Calculation of m in kg

1

M2 v = d/t

M2, M3 and M4 are for algebraic expressions or correct expressions with numbers

1

M3 $d^2 = \frac{KE \times 2t^2}{m}$

1

M4 $d = \sqrt{\frac{KE \times 2t^2}{m}}$ $(= \sqrt{(3.65 \times 10^{-16} \times 2 \times (2.71 \times 10^{-5})^2 / 2.275 \times 10^{-25})})$

1

M5 d = 1.53 – 1.54 (m)

M5 must be to 3sf

1

[18]

Q5.

C

[1]

Q6.

(a) Ba^{2+} OR Sr^{2+}

1

Award M1 if barium named in M1 then used Ba^{2+} in the equation

M2 SO_4^{2-} (aq) + Ba^{2+} (aq) ⟶ $BaSO_4$ (s)

1

(b) OH^-

Award M1 if hydroxide named in M1 then used OH^- in the equation

1

Mg^{2+} (aq) + $2OH^-$ (aq) ⟶ $Mg(OH)_2$ (s)

1

[4]

Q7.

(a) Ans = C

1

(b) $[H^+] = \sqrt{K_w} = \sqrt{2.93 \times 10^{-15}}$ $(= 5.41 \times 10^{-8})$

1

pH = $(-\log (5.41 \times 10^{-8}) =$ <u>7.27</u>

Must be 2dp

7.27 scores 2 marks

1

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(c) $[H^+] = [OH^-]$

allow description in words

equal moles / quantities / numbers / ratio of H^+ and OH^-

1

(d) $[OH^-] = 0.0131 \times 2 = 0.0262$

pH = 12.95 scores 3 marks

pH = 12.42 scores 2 marks ($K_w = 1 \times 10^{-14}$)

pH = 12.65 scores 1 mark (not multiplied by 2)

pH = 12.35 scores 1 mark (divided by 2)

pH = 12.12 scores 0 marks (no × 2 and wrong K_w)

1

$[H^+] = (K_w / [OH^-]) = 2.93 \times 10^{-15} / 0.0262 (= 1.118 \times 10^{-13})$

1

$pH = (- \log (1.118 \times 10^{-13}) = 12.9514 = 12.95$
Or
$[OH^-] = 0.0131 \times 2 = 0.0262$
$pOH = (-\log 0.0262) = 1.5817$
$pH = (-\log K_w - pOH = -\log 2.93 \times 10^{-15} - 1.58 = 14.53 - 1.58) = 12.95$

allow to 2dp or more

1

(e) smaller / lower pH / less alkaline / more acidic

If not smaller CE = 0/2

Allow pH number between 8 and 12

1

(magnesium hydroxide) is less soluble / sparingly soluble/ solubility of hydroxide increases down group II

M2 dependent on M1 but if blank mark on

Ignore concentration and dissociation

Ignore incorrect formula

Do not allow $Mg(OH)_2$ is insoluble

1

[9]

Q8.

(a) $BaCl_2$ / $Ba(OH)_2$ / $Ba(NO_3)_2$ / BaX_2 or names

Ignore acidification but CE = 0/3 if H_2SO_4

If reagent incorrect or blank then CE =0/3

If Ba^{2+} or wrong formula, lose M1 and mark on

1

colourless solution / no (visible) change (nvc) / no ppt / no (visible) reaction

Ignore nothing happens and no observation

1

white precipitate / white solid

1

(b) NaOH / sodium hydroxide / other Group 1 hydroxides

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If reagent incorrect or blank then CE =0/3
If reagent incomplete, lose M1 and mark on

1

white precipitate / white solid

1

(white) ppt which dissolves in excess (NaOH)
If reagent is excess NaOH, allow colourless solution for M3

1

Alternative Method

Name or formula of Group 1 carbonate

1

white precipitate / white solid

1

(white) precipitate and effervescence

1

[6]

Q9.

(a) CO_2 gas escapes or is lost

1

(b) Mass CO_2 = 16.11 − 14.58 = 1.53 g

1

M_r CO_2 = 44.0

Mol CO_2 = 1.53 / 44.0 = 3.48×10^{-2}

1

Mol $SrCO_3$ = 3.48×10^{-2}

1

Mass $SrCO_3$ = mol × M_r = $3.48 \times 10^{-2} \times 147.6$

Mass $SrCO_3$ = 5.13 (g)
1 mark for the answer and 1 for 3 sf precision
Allow 5.14 g (as a result of rounding)

2

(c) Percentage error = $\frac{0.01}{6.26} \times 100$

= 0.160 (%)

1

(d) Original Mass SrO = 6.26 − 0.347 − 5.13

= 0.783 g (or 783 mg)
OR 6.26 − 0.347 − 4.85 = 1.063 g
*Allow 0.773 g or 773 mg (from rounding error in part **(b)***

1

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Justification: All $SrCO_3$ reacted because heated to constant mass.

1

(e) $3SrO + 2Al \longrightarrow Al_2O_3 + 3Sr$

1

Al acts as a reducing agent

1

Sr is collected as a vapour because

1

Al_2O_3 is an ionic lattice and so has strong ionic attractions

1

Than Sr which is a metallic structure with (relatively) weaker bonding

1

[14]

Q10.

(a) $Ca + 2H_2O \longrightarrow Ca(OH)_2 + H_2$

1

8 − 12

1

(b) Decrease

1

(c) $BaCl_2$

Allow $Ba(NO_3)_2$ or other soluble barium salt

1

$Ba^{2+} + SO_4^{2-} \longrightarrow BaSO_4$

Allow equation if state symbols missing but penalise if state symbols are incorrect

1

(d) Strong attraction

1

Between positive and negative ions

1

[7]

Q11.

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

Allow correct numbers that are not superscripted

1

(b) $Ca(s) + 2H_2O(l) \longrightarrow Ca^{2+}(aq) + 2OH^-(aq) + H_2(g)$

State symbols essential

1

(c) Oxidising agent

1

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

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

Weaker attraction of ion to lost electron

1

[7]

Q12.

(a) **Q** is calcium or magnesium

1

bromide

1

R is aluminium

1

chloride

1

S is iron(III)

1

sulfate

1

Mark this question independently

(b) $Ba^{2+} + SO_4^{2-} \longrightarrow BaSO_4$

1

$[Fe(H_2O)_6]^{3+} + 3OH^- \longrightarrow Fe(H_2O)_3(OH)_3 + 3H_2O$

1

$2[Fe(H_2O)_6]^{3+} + 3CO_3^{2-} \longrightarrow 2Fe(H_2O)_3(OH)_3 + 3H_2O + 3CO_2$

1

$[Fe(H_2O)_6]^{3+} + 4Cl^- \longrightarrow [FeCl_4]^- + 6H_2O$

1

[10]

Q13.

Identifies precipitate as being $BaSO_4$

1

Moles of Barium sulfate = mass/Mr

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(= 0.764 / 233.4)
= 0.003273 moles

Allow conseq if Mr $BaSO_4$ or $BaCl_2$ incorrect

1

Mass of Barium chloride = 208.3 × 0.003273 = 0.6818 g

1

Percentage of Magnesium chloride $= \frac{1.056 - 0.6818}{1.056} \times 100$

Do NOT penalise incorrect precision here

Allow range 33.7-35.5% (rounding errors penalised elsewhere in paper)

1

[4]

Q14.

(a) Sulfuric acid has 2 × the H^+ ion concentration

Larger concentration of H^+ is sufficient.

1

Calcium is more reactive (than magnesium)

Allow reference to a greater surface area for calcium.

Do not allow any references to temperature variations.

1

(b) Calcium sulfate

Accept $CaSO_4$

1

$Ca + H_2SO_4 \rightarrow CaSO_4 + H_2$

Accept $Ca^{2+} + SO_4^{2-} \rightarrow CaSO_4$

Allow multiples or fractions of these equations.

Ignore state symbols.

1

Calcium sulfate is <u>insoluble</u> or has <u>(very) low solubility</u>

Accept "an <u>insoluble</u> layer is formed".

Answer must refer to the low solubility.

1

[5]

Q15.

A

[1]

Q16.

A

[1]

Q17.

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

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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

$Mg + H_2O \longrightarrow MgO + H_2$

***IGNORE** state symbols*

1

(c) $BaSO_4$ is insoluble but $Ba(NO_3)_2$ is soluble

OR

$BaSO_4$ precipitates but $Ba(NO_3)_2$ 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

$Ba^{2+}(aq) + SO_4^{2-}(aq) \longrightarrow BaSO_4(s)$

1

[7]

Q18.

(a) **M1** acidified potassium dichromate or $K_2Cr_2O_7$ / H_2SO_4

OR $K_2Cr_2O_7$ / H^+ ***OR*** acidified $K_2Cr_2O_7$

M2 (orange to) green solution ***OR*** goes green

M3 (solution) remains orange or no reaction or no (observed) change

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*If no reagent or incorrect reagent in **M1**, **CE = 0** and no marks for **M1**, **M2** or **M3***

*If incomplete / inaccurate attempt at reagent e.g. "dichromate" or "dichromate(IV)" or incorrect formula or no acid, **penalise M1 only and mark on***

*For **M2** ignore dichromate described as "yellow" or "red"*

*For **M3** ignore "nothing (happens)" or "no observation"*

Alternative using $KMnO_4$ / H_2SO_4

M1 acidified potassium manganate(VII) / potassium permanganate or $KMnO_4$ / H_2SO_4

OR $KMnO_4$ / H^+ ***OR*** acidified $KMnO_4$

M2 colourless solution ***OR*** goes colourless

M3 (solution) remains purple or no reaction or no (observed) change

*For **M1***

*If incomplete / inaccurate attempt at reagent e.g. "manganate" or "manganate(IV)" or incorrect formula or no acid, **penalise M1 only and mark on***

*Credit alkaline $KMnO_4$ for possible full marks but **M2** gives brown precipitate or solution goes green*

3

(b) **M1** (Shake with) Br_2 ***OR*** bromine (water) ***OR*** bromine (in CCl_4 / organic solvent)

M2 (stays) orange / red / yellow / brown / the same

OR no reaction ***OR*** no (observed) change

M3 decolourised / goes colourless / loses its colour / orange to colourless

*If no reagent or incorrect reagent in **M1**, **CE = 0** and no marks for **M1**, **M2** or **M3***

*If incomplete / inaccurate attempt at reagent (e.g. Br), **penalise M1 only and mark on***

*No credit for combustion observations; **CE = 0***

*For **M2 in every case***

Ignore "nothing (happens)"

Ignore "no observation"

Ignore "clear"

***OR* as alternatives**

Use $KMnO_4$ / H_2SO_4

M1 acidified potassium manganate(VII) / potassium permanganate ***OR*** $KMnO_4$ / H_2SO_4

OR $KMnO_4$ / H^+ ***OR*** acidified $KMnO_4$

M2 (stays) purple or no reaction or no (observed) change

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M3 decolourised / goes colourless / loses its colour

Use iodine

M1 iodine or I_2 / KI or iodine solution

M2 no change

M3 decolourised / goes colourless / loses its colour

Use concentrated sulfuric acid

M1 <u>concentrated</u> H_2SO_4

M2 no change

M3 brown

***For M1**, it must be a whole reagent and / or correct formula*

For M1** penalise incorrect attempt at correct formula, but mark **M2** and **M3

With potassium manganate(VII)

*If incomplete / inaccurate attempt at reagent e.g. "manganate" or "manganate(IV)" or incorrect formula or no acid, **penalise M1 only and mark on***

*Credit alkaline / neutral $KMnO_4$ for possible full marks but **M3** gives <u>brown precipitate</u> or solution goes <u>green</u>*

Apply similar guidance for errors in the formula of iodine or concentrated sulfuric acid reagent as those used for other reagents.

3

(c) **M1** Any <u>soluble</u> <u>chloride</u> including hydrochloric acid (ignore concentration)

M2 <u>white precipitate</u> or <u>white solid / white suspension</u>

M3 remains colourless or no reaction or no (observed) change or no precipitate or clear solution or it remains clear

***OR* as an alternative**

M1 Any <u>soluble</u> <u>iodide</u> including HI

M2 <u>yellow precipitate</u> or <u>yellow solid / yellow suspension</u>

M3 remains colourless or no reaction or no (observed) change or no precipitate or clear solution or it remains clear

***OR* as an alternative**

M1 Any <u>soluble</u> <u>bromide</u> including HBr

M2 <u>cream precipitate</u> or <u>cream solid / cream suspension</u>

M3 remains colourless or no reaction or no (observed) change or no precipitate or clear solution or it remains clear

***OR* as an alternative**

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M1 NaOH or KOH or any soluble carbonate

M2 brown precipitate or brown solid / brown suspension with NaOH / KOH (white precipitate / solid / suspension with carbonate)

M3 remains colourless or no reaction or no (observed) change or no precipitate or clear solution or it remains clear

*If no reagent or incorrect reagent or insoluble chloride in **M1**, **CE = 0** and no marks for **M1**, **M2** or **M3***

Allow chlorine water

*If incomplete reagent (e.g. chloride ions) or inaccurate attempt at formula of chosen chloride, or chlorine, **penalise M1 only and mark on***

*For **M2** require the word "white" and some reference to a solid. Ignore "cloudy solution" OR "suspension" (similarly for the alternatives)*

*For **M3***

Ignore "nothing (happens)"

Ignore "no observation"

Ignore "clear" on its own

Ignore "dissolves"

3

(d) **M1** Any soluble sulfate including (dilute or aqueous) sulfuric acid

M2 remains colourless or no reaction or no (observed) change or no precipitate or clear solution or it remains clear

M3 white precipitate or white solid / white suspension

*If no reagent or incorrect reagent or insoluble sulfate in **M1**, **CE = 0** and no marks for **M1**, **M2** or **M3***

Accept $MgSO_4$ and $CaSO_4$ but not barium, lead or silver sulfates

*If concentrated sulfuric acid or incomplete reagent (e.g. sulfate ions) or inaccurate attempt at formula of chosen sulfate, **penalise M1 only and mark on***

*For **M3 (or M2 in the alternative)** require the word "white" and some reference to a solid.*

Ignore "cloudy solution" OR "suspension"

*For **M2 (or M3 in the alternative)***

Ignore "nothing (happens)"

Ignore "no observation"

Ignore "clear" on its own

Ignore "dissolves"

***OR* as an alternative**

M1 NaOH or KOH

M2 white precipitate or white solid / white suspension

M3 remains colourless or no reaction or no (observed) change or no precipitate or clear solution or it remains clear

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If incomplete reagent (e.g. hydroxide ions) or inaccurate attempt at formula of chosen hydroxide, ***penalise M1 only and mark on***

If ***M1*** *uses* NH_3 *(dilute or concentrated)* ***penalise M1 only and mark on***

3

[12]

Q19.

(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 <u>vigorously / violently</u> (down the Group)

1

(ii) $Sr + 2H_2O \longrightarrow Sr(OH)_2 + H_2$

Credit multiples and correct ionic equations

Ignore state symbols

1

(c) $Ba(OH)_2$

This MUST be a formula so ignore the name

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

Ignore state symbols

1

[5]

Q20.

$ZnCO_3 \rightarrow ZnO + CO_2$

Ignore state symbols.

If equation incorrect, allow one mark only for correct atom economy method.

1

Percentage atom economy =

Mark consequentially for incorrect formula mass(es)

1

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$\frac{81.4}{125.4}$ × 100 = 64.9

Accept answer to at least 2 significant figures

1

[3]

Q21.

(a) Compound 1

If M1 incorrect, CE = 0

M1

1

No visible change with H_2SO_4

M2

1

Gives white ppt with NaOH

M3

1

(b) $BaCO_3$

1

The carbonate ion releases CO_2

1

but the $BaSO_4$ formed is highly insoluble.

1

(c) Compound 4

1

$Sr(OH)_2 + H_2SO_4 \rightarrow SrSO_4 + 2H_2O$

Allow ionic equation; ignore state symbols

1

[8]

Q22.

(a) 0.155 g per 100 cm^3

M1

Allow 0.153 − 0.157

1

(0.155 / 74.1) × 10 = 0.0209 mol dm^{-3}

M2

Allow 0.0206 − 0.0212

1

Answer to 3 significant figures

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M3

The correct answer only loses M1

1

(b) Take a known volume of the saturated solution

1

Evaporate the filtrate to dryness

Allow titrate with dilute HCl or HNO_3 .....

1

Weigh the residue

.....of known / specified concentration

Ignore any references to indicators

1

[6]

Q23.

(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 <u>$BaSO_4$ / barium sulfate / it is insoluble</u>

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

2

(b) $Mg(OH)_2 + \mathbf{2}HCl \longrightarrow MgCl_2 + 2H_2O$

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) $TiCl_4 + \mathbf{2}Mg \longrightarrow \mathbf{2}MgCl_2 + Ti$

Or multiples.

Ignore state symbols.

1

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

OR an equation to produce <u>hydrogen / H_2</u>

(eg $Mg + \mathbf{2}H_2O \longrightarrow Mg(OH)_2 + H_2$)

(eg $Mg + H_2O \longrightarrow MgO + H_2$)

*For **M1***

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

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hydrogen.

*Award one mark only for '<u>exothermic reaction</u> 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]

Q24.

(a) (i) $SrCl_2(aq) + Na_2SO_4(aq) \rightarrow SrSO_4(s) + 2NaCl(aq)$

Allow multiples, including fractions.

Allow ionic equations.

Lose this mark if any of the state symbols are missing or incorrect.

1

(ii) Add nitric acid to the mixture (until in excess)

Do not allow any suggestion that the solution is an emetic.

1

Filter (to isolate strontium sulfate)

1

(b) <u>Insoluble barium sulfate</u> is formed

Allow '<u>removes barium ions as a precipitate</u>'.

1

(c) Add silver nitrate, <u>then dilute ammonia</u> (solution) **M1**

Do not allow answers which imply silver nitrate and ammonia are added at the same time.

Allow 'add silver nitrate, then concentrated ammonia (solution)'.

*Can score **M1** in the answer for **M3***

1

Cream precipitate **M2**

Allow 'off white precipitate'.

1

No visible change or precipitate dissolves slightly in dilute ammonia **M3**

Allow 'soluble / colourless solution / precipitate dissolves in concentrated ammonia'.

Allow 3 marks for:

*Add dilute ammonia (solution), then silver nitrate **M1***

*No visible change **M2***

*Cream / off white precipitate with silver nitrate **M3***

1

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[7]

Q25.

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

Allow (ii) × (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 <u>incorrect / too large mass</u> (of silver chloride)

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

1

2 <u>To remove</u> <u>soluble impurities</u> / <u>excess silver nitrate</u> (solution) / <u>strontium nitrate</u> (solution)

Do not allow 'to remove impurities'.

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

1

(b) (i) $Mg^{2+}(aq) + 2OH^-(aq) \rightarrow Mg(OH)_2(s)$

Allow $Mg^{2+}(aq) + 2OH^-(aq) \rightarrow Mg^{2+}(OH^-)_2(s)$

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) $(CH_3COO)_2Ca \rightarrow CH_3COCH_3 + CaCO_3$

Allow multiples.

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Allow propanone as C_3H_6O

Allow $(CH_3COO^-)_2Ca^{2+} \rightarrow CH_3COCH_3 + Ca^{2+}CO_3^{2-}$

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) <u>precipitate</u> 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 CE = 0 / 2

1

$C_{12}H_{10}N_2O_8S$

Correct answer with no working scores 1 mark only.

1

[15]

Q26.

(a) (Measure the) <u>volume of gas</u> / <u>mass of the container + contents</u>

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

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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]

Q27.

(a) **M1 (could be scored by a correct mathematical expression**

*Correct answer to the calculation gains all of **M1**, **M2** and **M3***

M1 $\underline{\Delta H = \Sigma \Delta H_f \text{ (}\textbf{products}\text{)} - \Sigma \Delta H_f \text{ (}\textbf{reactants}\text{)}}$

Credit 1 mark for − 101 (kJ mol^{-1})

OR a correct cycle of balanced equations

M2 = − 1669 − 3(− 590)
= − 1669 + 1770
(This also scores M1)

M3 = **+ 101** (kJ mol^{-1})

Award 1 mark ONLY for − 101

For other incorrect or incomplete answers, proceed as follows

- *check for an arithmetic error (AE), which is either a transposition error or an incorrect multiplication; this would score 2 marks (**M1** and **M2**)*
- *If no AE, check for a correct method; this requires either a correct cycle with 3Sr and 2Al OR a clear statement of **M1** which could be in words and scores **only M1***

M4 - Using powders
Any **one** from

- To increase collision frequency / collisions in a given time / rate of collisions
- To increase the surface contact / contact between the solids / contact between (exposed) particles

Ignore dividing final answer by 3

*Penalise **M4** for reference to molecules.*

5

M5 Major reason for expense of extraction
Any **one** from

- Aluminium is extracted by electrolysis ***OR*** aluminium extraction uses (large amounts of) electricity
- Reaction / process / It / the mixture requires heat

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- It is endothermic

(b) Calcium has a higher melting point than strontium, because

Ignore general Group 2 statements.

Correct reference to size of cations / proximity of electrons

M1 (For Ca) delocalised electrons closer to cations / positive ions / atoms / nucleus

OR cations / positive ions / atoms are smaller

OR cation / positive ion / atom or it has fewer (electron) shells / levels

*Penalise **M1** if either of Ca or Sr is said to have more or less delocalised electrons OR the same nuclear charge.*

Ignore reference to shielding.

Relative strength of metallic bonding

M2 (Ca) has stronger attraction between the cations / positive ions / atoms / nucleus and the delocalised electrons

OR

stronger metallic bonding

(assume argument refers to Ca but credit converse argument for Sr)

***CE= 0** for reference to molecules or Van der Waals forces or intermolecular forces or covalent bonds.*

2

(c) **M1** $\mathbf{2}Mg + O_2 \longrightarrow \mathbf{2}MgO$

M2 $Mg + \mathbf{2}H_2O \longrightarrow Mg(OH)_2 + H_2$

Credit multiples of the equations.

M3 Magnesium hydroxide is used as an antacid / relieve indigestion (heartburn) / neutralise (stomach) acidity / laxative

*Not simply "milk of magnesia" in **M3***

3

[10]

Q28.

(a) As concentration increases the amount of heat given out increases / temperature increases **(M1)**

Any order.

Ignore references to an exothermic reaction.

1

More successful collisions or reactions in a given time **OR** more particles have the activation energy **(M2)**

Allow could be a second / n^{th} order reaction.

1

(An increase in temperature or more heat given out) increases the rate of a reaction **(M3)**

1

(b) The magnesium is coated with an oxide / MgO **(M1)**

Allow magnesium hydroxide.

1

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MgO / the coating / the corrosion product has to be removed before Mg will react
OR Mg and MgO / the coating / the corrosion product react at different rates
OR Initially MgO / the coating / the corrosion product reacts not Mg **(M2)**

Ignore inert coating.

1

(c) Any **two** from:

Any order.

Slower with hot water or faster with steam

The hot water produces $Mg(OH)_2$ / the hydroxide **OR** steam produces MgO / the oxide

(Slow) bubbling with hot water **OR** bright white light / flame / white solid with steam

2 max

(d) Magnesium sulfate is soluble and calcium sulfate is insoluble / slightly soluble / magnesium sulfate is more soluble / calcium sulfate is less soluble / correct trend in solubility **(M1)**

Any order.

***M1** requires a comparison of the two solubilities.*

Calcium sulfate coats the surface of the calcium **(M2)**

Coating prevents further contact with / reaction by the acid **(M3)**

*'Calcium sulfate forms a protective coating' scores **M2** only.*

3

[10]

Q29.

Mg^{2+} and Cl^-

Do not allow names.

[1]

Q30.

(a) (i) Change in concentration (of a substance / reactant / product) in unit time / given time / per (specified) unit of time

*This may be written mathematically **OR** may refer to the gradient of a graph of concentration / volume against time*

OR

Amount of substance formed / used up in unit time / given time / per (specified) unit of time

Ignore additional information including reference to collisions

1

(ii) At **W**

M1 (QoL)

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The rate / it is zero

M2

The magnesium has all reacted / has been used up
Ignore reference to the acid being used up

OR

No more collisions possible between acid and Mg

OR

Reaction is complete / it has stopped

OR

No more hydrogen / product is produced

2

(iii) M1

Twice / double as many particles / hydrogen ions (in a given volume)
*Penalise reference to (hydrochloric acid) molecules in **M1***
*Penalise reference to "HCl particles" in **M1***

OR

Twice / double as much hydrochloric acid

M2

Twice / double as many effective / successful collisions (in a given time)

OR

Twice / double as many collisions with either sufficient energy to react
OR with $E \geq E_a$

OR

double the successful / effective collision frequency

2

(b) (i) The activation energy is the minimum energy for a reaction to go / start

OR

Minimum energy for a successful/ effective collision

1

(ii) M1 Products lower than reactants on the profile
Mark independently

M2 Activation energy (E_a) shown and labelled correctly from reactants to peak of curve
Mark independently

2

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(c) (i) $Ba + 2H_2O \longrightarrow Ba(OH)_2 + H_2$

$Ba + 2H_2O \longrightarrow Ba^{2+} + 2OH^- + H_2$

Allow multiples

Ignore state symbols

1

(ii) M1 $Ba^{2+} + SO_4^{2-} \longrightarrow BaSO_4$

*Ignore state symbols in **M1***

*Not multiples in **M1***

M2 White precipitate / solid

Extra ions must be cancelled

*Penalise contradictory observations in **M2***

2

(iii) M1 Barium meal / barium swallow / barium enema

*Accept a correct reference to **M1** written in the explanation in **M2**, unless contradictory*

OR used in X-rays ***OR*** to block X-rays ***OR*** X-ray contrast medium ***OR*** CT scans

M2 $BaSO_4$ / barium sulfate is insoluble (and therefore not toxic)

*For **M2** NOT barium ions*

NOT barium

NOT barium meal and NOT "It"

Ignore radio-tracing

2

[13]

Q31.

(a) (i) $Ba + 2H_2O \longrightarrow Ba(OH)_2 + H_2$

Ignore state symbols

Credit multiples and correct ionic equations

1

(ii) (Reactivity with water) increase(s) / increasing / increased (down the Group / from Mg to Ba)

Accept "greater" or "gets more" or similar words to that effect.

Ignore reference to "increase in solubility / gets more soluble"

1

(b) $Mg(OH)_2$

Accept $Mg^{2+}(OH^-)_2$ / $Mg(HO)_2$

Insist on brackets and correct case

1

(c) **M1** Barium meal / barium swallow / barium enema or (internal) X-ray or to block X-rays

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M2 $BaSO_4$ / barium sulfate is insoluble (and therefore not toxic)

*Accept a correct reference to **M1** written in the explanation in **M2**, unless contradictory*

*For **M2** NOT barium ions*

NOT barium

NOT barium meal and NOT "It"

Ignore radio-tracing

2

[5]

Q32.

(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

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Do not penalise an <u>additional</u> but incorrect formula for sulfate ion.

<u>Sulfuric acid</u> would form a (white) <u>precipitate</u>

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

1

(ii) $Ba^{2+} + SO_4^{2-} \longrightarrow BaSO_4$ ONLY

Ignore state symbols

No multiples

1

[7]

Q33.

(a) $Ca(OH)_2$ OR $Mg(OH)_2$

Ignore name

Could be ionic

1

(b) NaF or sodium fluoride

OR

NaCl or sodium chloride

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

(c) NaClO OR NaOCl

Ignore name (even when incorrect)

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

1

(d) **Br_2** (ONLY)

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 S_8 OR S_2

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M2 I_2 (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) $CH_3CH_2CH=CH_2$

Structure of but-1-ene. Ignore name
Credit "sticks" for C-H bonds

1

(ii) $CH_3CH_2CH_2CH_2OH$

Structure of butan-1-ol. Ignore name
Credit "sticks" for C-H bonds

1

(iii) $CH_3CH_2CH_3$

Structure of propane. Ignore name
Ignore calculations and molecular formula
Credit "sticks" for C-H bonds
Ignore the molecular ion

1

(iv) CH_3CH_2Br OR $C_2H_5B_r$

Structure of bromoethane.
Ignore name and structure of nitrile
Credit "sticks" for C-H bonds

1

[10]

Q34.

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

M2 $Ag^+ + I^- \longrightarrow AgI$ (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 <u>ions that would interfere</u> with the test
- prevent the formation of other <u>silver precipitates / insoluble</u> <u>silver compounds</u> that would interfere with the test

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- 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

(b) **M1** $Ba^{2+} + SO_4^{2-} \longrightarrow BaSO_4$

(or the ions together)

M2 white precipitate / white solid / white suspension

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

M4 $BaSO_4$ / 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 $BaSO_3$ 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 $BaSO_4$

4

(c) **M1** **2**(12.00000) + **4**(1.00794) = 28.03176

M2 Ethene and CO or "they" have an imprecise $\mathbf{M}_r$ of 28.0 / 28

OR

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

OR

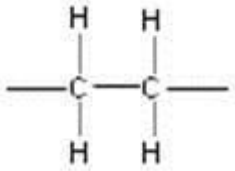
These may be shown by two clear, simple sums identifying both compounds

M3 $C_2H_4 + \mathbf{2}O_2 \longrightarrow \mathbf{2}CO + \mathbf{2}H_2O$

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($H_2C=CH_2$)

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 $CH_2=CH_2$ 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

[15]

Q35.

(a) Hydrochloric acid = **C**

1

Barium chloride = **A**

1

(b) Barium sulfate is insoluble

1

$CuSO_4 + BaCl_2 \rightarrow BaSO_4 + CuCl_2$

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.*

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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]

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Q1.

The majority of students (74%) were able to recall correctly the reducing agent in this process.

Q2.

Many students (81.2%) got this correct and appreciated the use of barium sulfate in medicine.

Q3.

Most students (69.2%) got this question correct but many confused the uses of magnesium hydroxide and calcium hydroxide.

Q4.

(a) The electron configuration was well known (88.9% correct).

(b) Only the best students gained both marks here (19%); many students focused on whether the electron was being removed from a full or partially full orbital instead of considering why the attraction between the nucleus and the electron might be different.

(c) Less than half of the students (39.5%) could give the correct answer here; lithium was a common error.

(d) The majority of students (76.3%) answered this correctly, although there were quite a number who gave the incorrect formula.

(e) The ionic equation was generally correct and many students could also calculate that barium chloride was in excess. Just under a third of students managed to score all three marks.

(f) Most students could state why isotopes have the same chemical properties. In the calculation, many students gave an algebraic equation with two unknowns and could not proceed any further. The students who gave a correct algebraic expression with one unknown could work through the calculation and generally gained full marks. Some students answered the question by trial and error and this was also given full credit. Pleasingly, 43.7% of students gained all four marks available.

(g) Most students deduced that the mass number of the ion would be 138 but less than 30% of students could give the correct formula for the ion including its charge.

(h) Some students answered this part very well (with 36.6% scoring full marks), but most students scored partial marks or no marks; common errors included failure to use the Avogadro constant, not converting mass to kg, and incorrect rearrangement of expressions.

Q5.

Although 73.5% of students chose the correct response, A was a significant distractor, suggesting confusion with the reaction between magnesium and cold water.

Q6.

(a) The correct ion was identified quite often but the equation was much less well answered.

(b) Even good students struggled with this question. The context of the ion test was the reverse of the common way of asking the question and, as such, poorly understood.

Q7.

(a) This question was answered well (89.5% correct).

(b) Many students scored both marks here, although some did not give the answer to two decimal places and thereby lost a mark; some students failed to take the square root of K_w.

(c) The answer to this question was generally well known, although some students appeared to believe that a pH of 7.27 was not sufficiently alkaline.

(d) This question differentiated well. Many students failed to appreciate that calcium hydroxide is dibasic and an answer of 12.65 was common. Some students used $K_w = 1.00 \times 10^{-14}$ and a few students failed to give the answer to two decimal places.

(e) The idea that magnesium hydroxide is less soluble than calcium hydroxide was appreciated by only a few students. Many thought the pH value should be the same. Some who gave a lower pH followed this with a discussion about the magnesium ion's greater polarising power.

Q8.

(a) Many students gave incomplete reagents or the wrong formula. Barium itself was an occasional wrong answer. Most students gained the observation mark for potassium sulfate, but not for potassium nitrate.

(b) Good answers to this question were rarely seen. Sodium hydroxide was the most common correct reagent, but students then failed to realise that an excess of sodium hydroxide was needed to distinguish between the two metal ions. A few students suggested sodium carbonate as the reagent but then failed to give full observations.

Q13.

This question was very poorly answered with few getting to the correct overall answer. The unstructured nature of this calculation proved too difficult for most especially following the requirement to identify correctly $BaSO_4$ as the precipitate formed. Only the very best students scored well here.

Q14.

A common mistake in **(a)** was to allow the answer that sulfuric was a stronger acid than hydrochloric without reference to the correct answer relating to concentration of acid ions. In **(b)** there was good discrimination but many markers ignored the underlined terms in the Marking Guidelines that had to be present in a correct answer.

Q15.

Usually well answered.

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Q17.

Two-thirds of the marks in this enthalpy-based question involved students being able to carry out calculations based on Hess' Law and, as always, there was a divide between those who could cope with such questions and those who couldn't.

In part (a) the importance of learning definitions was illustrated. Many students failed to make clear that all reactants and products need to be in their standard states.

In questions such as part (b) students are strongly advised to start with a clear and complete indication of the expression relating the enthalpy change of the reaction to the data given or to draw out a clearly labelled cycle. Students who relied on the use of a learned expression often got this wrong way round, possibly due to confusion with the use of enthalpies of formation whereas, in this case, the data provided were enthalpies of combustion.

In a question like part (c) students are strongly advised to sketch out the displayed formulae of all reactants and products when working with bond energies. Failing to do so in many cases meant that bonds were omitted or miscounted (3 x C-C in propan-1-ol was often seen) by students.

Q18.

This was a high demand question, since it requires application of chemistry from the specification and a failure to provide a suitable test reagent leads to the loss of three marks in each part. The number of possible answers to distinguish silver nitrate in part (c) was considerable and partial credit was awarded for test reagents that were unsuitable for test-tube tests, but which led to correct chemical observations. Less than one third of students scored all three marks on part (c) and part (d), whereas three quarters scored full marks on part (b).

Q19.

This covered aspects of Group 2 chemistry and in part (a), the trend in atomic radius down the Group was usually correct, but the simple reason that one more main level of electrons was being added for each element in the Group was seen less than might have been expected. As has happened in the past, the failure to be able to work out the formula of Group 2 compounds resulted in the loss of marks for some students.

Q20.

This question was well done with a few of the weaker students having problems with correct formulae.

Q21.

All parts of this question were good discriminators with, poor expression of the chemical ideas the major problem. Over-generous marking was particularly evident in parts (a) and (b).

Q22.

In part (a) Centres often ignored the requirement for 3 s.f. in the answers and were lenient in marking part (b). It is the sequence of steps here that is important and the omission of a 'known volume' the usual error. Centres must not give credit for 'evaporate' as part of a method that is clearly unworkable.

Q23.

Incorrect formulae of Group 2 compounds and that of titanium(IV) chloride were common and it was problems with these that contributed to only about two-thirds of students scoring the mark in parts (b) and (d), respectively. Just over half of students scored both marks in part (e).

Q24.

(a) (i) In this part, it was disappointing to note that there were many instances of missing or incorrect state symbols that were missed or ignored by the marker.

(ii) The logic required in this part again required a careful and sequenced expression of ideas that some found challenging.

The information and test in part (b) and (c) were well known and usually well expressed with occasional confusion regarding the concentration of the ammonia solution used.

Q25.

(a) The calculations in parts (i) to (iv) of this part were generally well done although there was some confusion regarding the number of significant figures (both in answers and the marking) and with some lower-scoring students experiencing difficulties in part (iv). However, the ideas underlying part (v) gave a greater challenge and many partial answers were seen (and sometimes incorrectly credited).

(b) In part (b) and (c) were well answered in the main with the usual caveat about state symbols. The formula of propanone was generally well known either as the molecular or structural formula.

(c) In part (b) and (c) were well answered in the main with the usual caveat about state symbols. The formula of propanone was generally well known either as the molecular or structural formula.

(d) The ideas in this part were found to be quite challenging to all but the highest-scoring students and a great deal of confusion was seen regarding colours, solutions and precipitates. In the marking, it is important to appreciate that to gain partial marks the procedure described must be chemically correct; M3 could not be awarded unless there is some correct work up to this point. Answers were often jumbled and contradictory. Many students failed to add sodium chromate solution at the start and so could not gain any marks. Where this addition was done, some students mentioned the formation of a precipitate with the calcium ion solution that then dissolved on addition of water. Many students did not appreciate that the substances were already in solution at the start of the procedure.

(e) As usual, the empirical formula in this part was well done with a few arithmetic errors only.

Q26.

(a) In this part, 'amount' was not sufficient. Many students simply referred to measuring the mass of the reagents but, since this is not practically possible without including the container too, it was not credited. Surprisingly, many students incorrectly wanted to measure the temperature.

(b) In this part, 'reagents' was insufficient since it is the magnesium that is critical.

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Although the quality of the diagram was not part of the assessment, poor diagrams often failed to show a clear filter funnel and a visible filter paper; this was penalised. For some reason, a large number of students decided incorrectly that distillation was the required process. The final question simply needed 'wash with water' and yet attracted some very complicated answers.

Q27.

The whole of this question was relatively straightforward and it was pleasing to see the majority of students gain at least 3 marks in part (a) and over 40% gain both marks in part (b).

In part (c), too many students failed to balance their equations or could not write the correct formula for magnesium hydroxide. Fewer than half of all students gained all three marks.

Q28.

(a) This part was found demanding. Few students were able to relate correctly an increase in concentration to an increase in temperature. Many answers contained no reference to temperature at all. In addition, some teachers tended to mark this question generously. Many students should have not been awarded the second mark as they did not state that there would be more successful collisions in a given time. Some students were incorrectly given full credit without making any reference to the extra heat generated by the reaction affecting the rate of this reaction.

(b) In this part, a surprising number of students did not realise that the surface coating was magnesium oxide, and an even larger number thought that magnesium oxide would not react with hydrochloric acid. This chemical error often went unpunished.

(c) This part was answered well, although many students gave only one difference, spreading the explanation across all four answer lines.

(b) In this part, a large number of students referred to solubility of the metals themselves rather than the sulfates. A solubility comparison was often lacking and few students appreciated that the insoluble calcium sulfate would prevent further contact between the acid and the metal.

Given the increasing pressure on schools and colleges to deliver the teaching programme, this was, overall, a very positive session. Teachers are once again thanked for the trouble taken with the coursework. Their efforts continue to be much appreciated by the moderator team.

Q29.

The final question, proved too difficult for most students. It is clear that many did not understand the term 'filtrate' and quoted the ions in barium sulfate. A considerable number of students gave a selection from a variety of correct and incorrect species to answer this deceptively simple question.

Q30.

In part (a)(i), many students were unable to state that the rate is zero at point W. There were many qualitative answers to part (a)(iii) even though the word "double" is used twice in the question. In part (b), students often failed to label their reaction profile with sufficient clarity and only 45% scored both marks.

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Q31.

Much of Group 2 chemistry requires learning and this question was no exception. The usual errors were seen although there were many very good answers.

Q32.

Part (a) involved a simple format but the chemical demand did not diminish and only 70% of the students wrote the correct response in part (a)(i). The correct use of chemical names and terminology was required in part (b). Part (c) was generally well answered.

Q33.

This question covered a wide range of the specification content. Halogen chemistry is not well-known by students and even when they may know some chemistry they can miss the mark by being unable to write the correct formula. Indicative of this was part (e) with only 18% scoring both marks and 56% scoring zero. The organic structures in part (f) were answered better, although part (f)(i) proved demanding and only 26% obtained this mark.

Q34.

Inorganic chemistry is a weakness for many candidates and this question proved challenging for some. Not surprisingly sodium bromide was a common incorrect response in part (a)(i).

Only the better candidates knew the reason for acidifying the silver nitrate solution in part (a)(ii) but the inability of this reagent to detect fluoride ions in part (a)(iii) was reasonably well known. Part (b) was a good discriminator; the relatively easy equation and observation marks eluded some. In part (c) most candidates could use the data to arrive at the correct precise Mr value but were less effective in explaining that the Mr values are the same when using one decimal place. The equation for complete combustion of ethene was done well but neither the displayed formula for the repeating unit nor the type of polymer scored highly.

Q35.

In part (a) only the highest-scoring candidates scored both marks. Weaker candidates seemed to be guessing.

In this part (b) was, perhaps, the most demanding question of all. Many candidates could not equate the appearance of a precipitate with insolubility, and even the better candidates could not write a correct equation for a very familiar reaction.

The better candidates scored full marks in this part (d). A few lost a mark because they were vague about the concentration of the ammonia solution to be used. A surprising number got the tests the wrong way around, losing two marks. Centres are reminded that if a candidate chooses an incorrect test reagent the mark for the observation can also not be awarded.

The above notes are intended for the small minority of centres experiencing difficulty in meeting the coursework criteria. They must not be allowed to detract unduly from the very healthy overall picture. Given the pressures on centres to deliver the teaching programme, this was once again a very positive and encouraging session. Centres are again warmly commended for the trouble taken to assemble a sample which proved to be easy to moderate. Their efforts continue to be much appreciated by the moderator team.

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