

M1.(a) M1 acidified potassium dichromate or $\text{K}_2\text{Cr}_2\text{O}_7 / \text{H}_2\text{SO}_4$

OR $\text{K}_2\text{Cr}_2\text{O}_7 / \text{H}^+$ **OR** acidified $\text{K}_2\text{Cr}_2\text{O}_7$

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

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

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 $\text{KMnO}_4 / \text{H}_2\text{SO}_4$

M1 acidified potassium manganate(VII) / potassium permanganate or $\text{KMnO}_4 / \text{H}_2\text{SO}_4$

OR $\text{KMnO}_4 / \text{H}^+$ **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

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 concentrated 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 brown precipitate or solution goes green

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 soluble chloride including hydrochloric acid (ignore concentration)

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

OR as an alternative

M1 Any soluble iodide including HI

M2 yellow precipitate or yellow solid / yellow suspension

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 soluble bromide including HBr

M2 cream precipitate or cream solid / cream suspension

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 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

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]

M2.(a) $1s^22s^22p^63s^23p^64s^2$

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

(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]

M3.(a) 0.155 g per 100 cm³

M1

Allow 0.153 – 0.157

1

$(0.155 / 74.1) \times 10 = 0.0209 \text{ mol dm}^{-3}$

M2

Allow 0.0206 – 0.0212

1

Answer to 3 significant figures

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 HNO₃

1

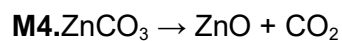
Weigh the residue

.....of known / specified concentration

Ignore any references to indicators

1

[6]



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

$$\frac{81.4}{125.4} \times 100 = 64.9$$

Accept answer to at least 2 significant figures

1

[3]

M5.(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

The carbonate ion releases CO₂

1

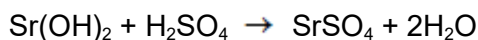
but the BaSO₄ formed is highly insoluble.

1

1

(c) Compound 4

1



Allow ionic equation; ignore state symbols

1

[8]

M6.(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) Ba(OH)₂

This MUST be a formula so ignore the name

*Credit $\text{Ba}^{2+} 2\text{OH}^-$
Ignore state symbols*

1

[5]