M1.(a) (i) **M1** **0**

M2 **(+) 5**

Accept Roman V for M2

2

(ii) I_2 + 10HNO_3 ⟶ **2**HI + **10**NO_3 + **4**H$_2$OO_2

Accept multiples

1

(b) **M1** IO_3^- + **6**H^+ + **5**I^- ⟶ **3**I_2 + **3**H_2O

For M1, ignore state symbols

Credit multiples

Accept 2½I_2 + ½I_2 as alternative to 3I_2

Electrons must be cancelled

M2 $NaIO_3$ ***OR*** IO_3^- ***OR*** iodate ions ***OR*** iodate(V) ions etc.

For M2 Do not penalise an incorrect name for the correct oxidising agent that is written in addition to the formula.

Accept "the iodine in iodate ions" but NOT "iodine" alone

Accept "the iodine / I in iodate ions" but NOT "iodine" alone

2

(c) (i) Iodine ***OR*** I_2

Insist on correct name or formula

1

(ii) H_2SO_4 + **6**H^+ + **6**e^- ⟶ S + **4**H_2O

Ignore state symbols

SO_4^{2-} + **8**H+ + **6**e^- ⟶ S + **4**H_2O

Credit multiples

Do not penalise absence of charge on the electron

1

(d) hydrogen sulfide

OR H_2S

OR hydrogen sulphide

1

(e) (i) $Ag^+ + I^- \longrightarrow AgI$ ONLY

Ignore state symbols
No multiples

1

(ii) The (yellow) precipitate / solid / it does not dissolve / is insoluble
ignore "nothing (happens)"

OR turns to a white solid
ignore "no observation"

OR stays the same

OR no (visible/ observable) change

OR no effect / no reaction

1

(iii) The silver nitrate is acidified to

- react with / remove (an)ions that would interfere with the test
  Ignore reference to "false positive"
- prevent the formation of other silver precipitates / insoluble silver compounds that would interfere with the test
  Do not penalise an incorrect formula for an ion that is written in addition to the name.
- remove (other) ions that react with the silver nitrate
- react with / remove carbonate / hydroxide / sulfite (ions)
  If only the formula of the ion is given, it must be correct

1

(f) (i) An <u>electron donor</u>

Penalise "electron pair donor"

OR (readily) <u>donates / loses / releases / gives (away) electron(s)</u>

Penalise "loss of electrons" alone

Accept "electron donator"

1

(ii) $Cl_2 + 2e^- \longrightarrow 2Cl^-$

Ignore state symbols

Do not penalise absence of charge on electron

Credit $Cl_2 \longrightarrow 2Cl^- - 2e^-$

Credit multiples

1

(iii) For M1 and M2, iodide ions are stronger reducing agents than chloride ions, because

Ignore <u>general statements</u> about Group VII trends or about halogen molecules or atoms. Answers must be specific

M1 Relative size of <u>ions</u>

CE=0 for the clip if "iodine ions / chlorine ions" ***QoL***

Iodide ions / they are <u>larger</u> /have more <u>electron levels(shells)</u>(than chloride ions) / <u>larger atomic / ionic radius</u>

CE=0 for the clip if "iodide ions are bigger molecules / atoms" ***QoL***

OR <u>electron to be lost/outer shell/level</u> (of the iodide ion) is <u>further</u> the nucleus

OR <u>iodide ion(s)</u> / they have <u>greater / more shielding</u>

Insist on <u>iodide</u> ions in M1 and M2 or the use of it / they / them, in the correct context (or <u>chloride</u> ions in the converse argument)

OR converse for <u>chloride ion</u>

M2 Strength of attraction for electron(s)

Must be comparative in both M1 and M2

<u>The electron(s) lost /outer shell/level electron from (an) iodide</u> ion(s) <u>less strongly held by the nucleus</u> compared with that lost from a <u>chloride</u> ion

OR converse for a <u>chloride ion</u>

2

[15]

M2. (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
- remove (other) <u>ions that react</u> 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 <u>Fluoride</u> (ion) OR <u>F^-</u>

M2 • <u>Silver fluoride / AgF</u> is soluble / dissolves (in water)

• <u>no precipitate</u> would form / <u>no visible /observable</u> 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.

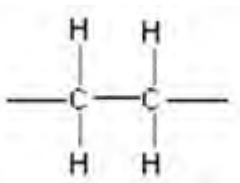
OR

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

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

($H_2C{=}CH_2$)

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 <u>imprecise value in M2</u>, since this does not mean ''the same''

For M3, accept CH_2=CH_2 OR CH_2CH_2

For M4, <u>all bonds</u> 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]

M3. (a) Iodine has more electrons / iodine is bigger (atom or molecule) / iodine has bigger M_r / bigger surface area

1

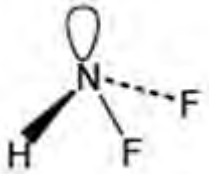
<u>Stronger</u> / <u>more</u> van der Waals forces / vdw / London / temporarily induced dipole / dispersion forces <u>between molecules</u>

1

Stronger VdW intermolecular forces = M2

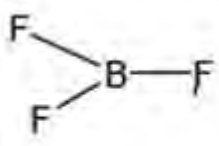
If stated VdW between atoms lose M2

(b) (i)



Mark is for 3 bp and 1 lp attached to N (irrespective of shape)

1



Mark is for 3 bp and 0 lp attached to B (irrespective of shape)

1

NHF_2 shape - pyramidal / trigonal pyramid

Accept tetrahedral / triangular pyramid

1

BF_3 shape - trigonal planar

Not triangular or triangular planar

1

(ii) 107°

Allow 106-108°

1

(c) Hydrogen bonds

Allow H-Bonds

Not just Hydrogen

Apply list principle eg Hydrogen bonding and dipole-dipole = 0

1

(d) Coordinate / dative covalent / dative

If covalent mark on

If ionic / metallic CE = 0

1

Lone pair / both electrons/ 2 electrons on $N(HF_2)$ donated (to BF_3)

Direction of donation needed here

1

[10]

M4. (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

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]