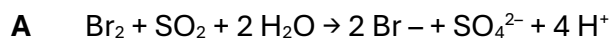
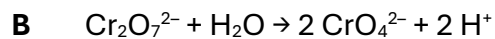
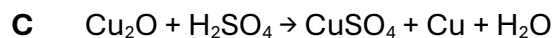


Q1 Which is **not** a redox reaction?

☐☐☐☐

Q2

Bromine is an oxidising agent.

(a) State, in terms of electrons, the meaning of oxidising agent.

(1)

In aqueous solution, bromine oxidises SO_2 to SO_4^{2-} ions.

(b) Write a half-equation for the oxidation of aqueous SO_2 to SO_4^{2-} ions.

(1)

(c) Write an equation for the reaction of bromine with aqueous SO_2

Explain, using oxidation states, how bromine oxidises SO_2 to SO_4^{2-} ions.

Equation

Equation

(3)

(d) A few drops of aqueous bromine are added to a test tube that contains some sodium iodide solution.

State the colour change observed in the test tube.

Write an equation for this reaction.

Colour change _____

Equation

(2)

(Total 7 marks)

Q3

Chlorine reacts with hot concentrated sodium hydroxide.



Identify the element that is oxidised in this reaction.

Explain your answer using oxidation states.

Element oxidised _____

Explanation _____

(2)

Q4

Under some conditions, nitrate(V) ions (NO_3^-) can oxidise Mn^{2+} ions to MnO_2 and the nitrate(V) ions are reduced.

An experiment is used to find the oxidation state of nitrogen at the end of the reaction.

In this experiment, 24.0 cm^3 of $0.150 \text{ mol dm}^{-3}$ aqueous solution of Mn^{2+} ions react with exactly 15.0 cm^3 of $0.0960 \text{ mol dm}^{-3}$ aqueous solution of NO_3^- ions.

Write a half-equation for the oxidation of Mn^{2+} to MnO_2

Calculate the simplest whole-number reacting ratio of Mn^{2+} ions to NO_3^- ions.

Determine the oxidation state of N at the end of the reaction.

Half-equation

Calculation

Reacting ratio

$\text{Mn}^{2+} : \text{NO}_3^-$

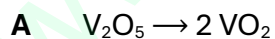
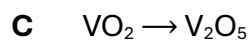
_____ : _____

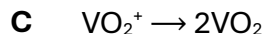
Oxidation state of N at the end of the reaction

(Total 5 marks)

Q5

Which change shows an oxidation of vanadium?

☐☐☐

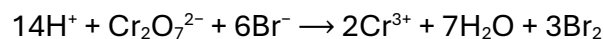
**(Total 1 mark)**

Q6

This question is about Group 7 elements and their compounds.

Bromine is formed when $\text{K}_2\text{Cr}_2\text{O}_7$ reacts with sodium bromide in acidic conditions.

The ionic equation for this redox reaction is shown.



(a) Write the half-equation for the conversion of bromide ions into bromine.

(1)

(b) Give the oxidation state of chromium in the $\text{Cr}_2\text{O}_7^{2-}$ ion.

(1)

(c) Write the half-equation for the conversion of $\text{Cr}_2\text{O}_7^{2-}$ ions, in acidic conditions, into chromium(III) ions and water.

(1)

(d) Chlorine is used as an oxidising agent in the extraction of bromine from seawater. In this process, chlorine gas is bubbled through a solution containing bromide ions.

Write the simplest ionic equation for the reaction of chlorine with bromide ions.

(1)

(e) Explain why chlorine is a stronger oxidising agent than bromine.

(2)

(f) Concentrated sulfuric acid is reduced by some halide ions.

Identify a halide ion that reduces sulfuric acid to hydrogen sulfide.

Write an ionic equation for this reaction.

Halide ion _____

Equation _____

(2)

Q7 Redox and Quantitative

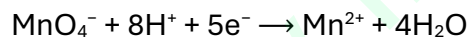
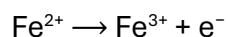
Hydrated ammonium iron(II) sulfate has the formula $(\text{NH}_4)_2\text{Fe}(\text{SO}_4)_2 \cdot x\text{H}_2\text{O}$

The value of x in this formula can be calculated using results from this redox titration.

Method

- Dissolve a known mass of hydrated ammonium iron(II) sulfate in dilute sulfuric acid to make 250 cm^3 of solution.
- Titrate 25.0 cm^3 portions of this solution with a solution of potassium manganate(VII).

The half-equations for the reactions that occur during this titration are shown.



Results

Mass of hydrated ammonium iron(II) sulfate	8.37 g
Mean titre of potassium manganate(VII) solution	22.85 cm^3
Concentration of potassium manganate(VII) solution	$0.0187 \text{ mol dm}^{-3}$

(a) State the colour change at the end-point of the titration.

(1)(b) Use the results to calculate the relative formula mass of $(\text{NH}_4)_2\text{Fe}(\text{SO}_4)_2 \cdot x\text{H}_2\text{O}$

Relative formula mass _____

(4)(c) Deduce the value of x in $(\text{NH}_4)_2\text{Fe}(\text{SO}_4)_2 \cdot x\text{H}_2\text{O}$ (If you were unable to calculate the relative formula mass in **part (b)**, you should use the value 356.0This is **not** the correct value.) x _____**(2)****(Total 7 marks)**

Q8

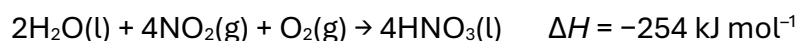
Redox and Enthalpy

(a) Write an equation, including state symbols, for the reaction for which the energy change is the standard enthalpy of formation of nitric acid, $\text{HNO}_3(\text{l})$.

(1)Some standard enthalpy of formation values ($\Delta_f H^\ominus$) are shown in the table.

Substance	$\text{H}_2\text{O}(\text{l})$	$\text{NO}_2(\text{g})$	$\text{O}_2(\text{g})$
$\Delta_f H^\ominus / \text{kJ mol}^{-1}$	-286	+34	0

(b) State why the value for the standard enthalpy of formation of $\text{O}_2(\text{g})$ is zero.

(1)The following equation shows how nitric acid (HNO_3) is formed in the Ostwald Process.

(c) Use the standard enthalpies of formation in the table to calculate the standard enthalpy of formation of nitric acid.

Standard enthalpy of formation _____ kJ mol^{-1}

(3)

(d) Give the oxidation state of nitrogen in nitric acid.

Use oxidation states to explain why the reaction in question (c) involves the oxidation of nitrogen.

Oxidation state of nitrogen in nitric acid _____

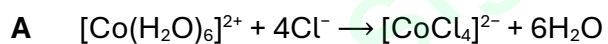
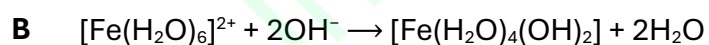
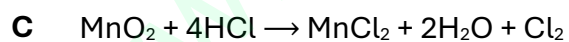
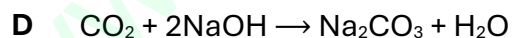
Explanation _____

(2)

(Total 7 marks)

Q9

Which equation represents a redox reaction?

☐☐☐☐

(Total 1 mark)

Q10

Which of the following shows chlorine in its correct oxidation states in the compounds shown?

	HCl	KClO ₃	HClO	
A	-1	+3	+1	☐
B	+1	-5	-1	☐
C	-1	+5	+1	☐
D	+1	+5	-1	☐

(Total 1 mark)

Q11

Iodine reacts with concentrated nitric acid to produce nitrogen dioxide (NO₂).

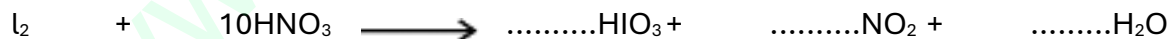
(a) (i) Give the oxidation state of iodine in each of the following.

I₂ _____

HIO₃ _____

(2)

(ii) Complete the balancing of the following equation.

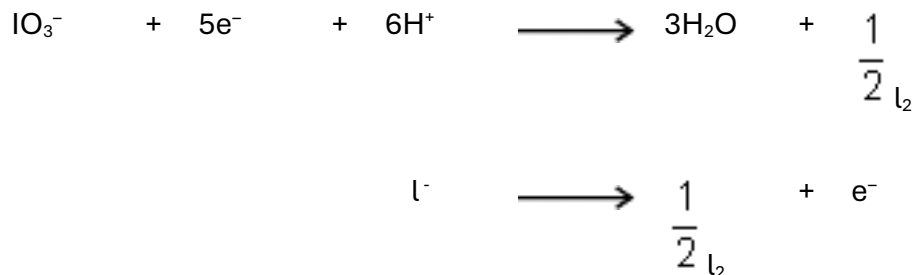


(1)

(b) In industry, iodine is produced from the NaIO₃ that remains after sodium nitrate has been crystallised from the mineral Chile saltpetre.

The final stage involves the reaction between NaIO₃ and NaI in acidic solution.

Half-equations for the redox processes are given below.

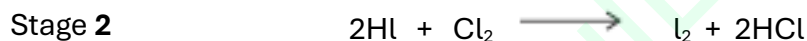
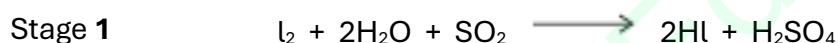


Q12 REDOX AND USES OF CHLORINE

This question is about Group 7 chemistry.

(a) Sea water is a major source of iodine.

The iodine extracted from sea water is impure. It is purified in a two-stage process.



(i) State the initial oxidation state and the final oxidation state of sulfur in Stage 1.

Oxidation state of S in SO_2 _____

Oxidation state of S in H_2SO_4 _____

(2)

(ii) State, in terms of electrons, what has happened to chlorine in Stage 2.

(1)

(b) When concentrated sulfuric acid is added to potassium iodide, iodine is formed in the following redox equations.



(i) Balance the equation for the reaction that forms sulfur.

(1)

(ii) Deduce the half-equation for the formation of iodine from iodide ions.

(1)

(iii) Deduce the half-equation for the formation of hydrogen sulfide from concentrated sulfuric acid.

(1)

(c) A yellow precipitate is formed when silver nitrate solution, acidified with dilute nitric acid, is added to an aqueous solution containing iodide ions.

(i) Write the **simplest ionic** equation for the formation of the yellow precipitate.

(1)

(ii) State what is observed when concentrated ammonia solution is added to this yellow precipitate.

(1)

(iii) State why the silver nitrate solution is acidified when testing for iodide ions.

(1)

(iv) Explain why dilute hydrochloric acid is **not** used to acidify the silver nitrate solution in this test for iodide ions.

(1)

(d) Chlorine is toxic to humans. This toxicity does not prevent the large-scale use of chlorine in water treatment.

(i) Give **one** reason why water is treated with chlorine.

(1)

(ii) Explain why the toxicity of chlorine does **not** prevent this use.

(1)

(iii) Write an equation for the reaction of chlorine with cold water.

(1)

(e) Give the formulas of the **two** different chlorine-containing compounds that are formed when chlorine reacts with cold, dilute, aqueous sodium hydroxide.

Formula 1 _____

Formula 2 _____

(1)

(Total 14 marks)

Q13

Reactions that involve oxidation and reduction are used in a number of important industrial processes.

(a) Iodine can be extracted from seaweed by the oxidation of iodide ions.
In this extraction, seaweed is heated with MnO_2 and concentrated sulfuric acid.

(i) Give the oxidation state of manganese in MnO_2

(1)

(ii) Write a half-equation for the reaction of MnO_2 in acid to form Mn^{2+} ions and water as the only products.

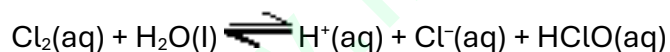
(1)

(iii) In terms of electrons, state what happens to the iodide ions when they are oxidised.

(1)

(b) Chlorine is used in water treatment. When chlorine is added to cold water it reacts to form the acids HCl and HClO

The following equilibrium is established.



(i) Give the oxidation state of chlorine in Cl_2 and in HClO

Cl_2 _____

HClO _____

(2)

(ii) Deduce what happens to this equilibrium as the HClO reacts with bacteria in the water supply. Explain your answer.

(2)

(c) Concentrated sulfuric acid is reduced when it reacts with solid potassium bromide. Concentrated sulfuric acid is **not** reduced when it reacts with solid potassium chloride.

(i) Write the two half-equations for the following redox reaction.



Half-equation 1

Half-equation 2

(2)

(ii) Write an equation for the reaction of solid potassium chloride with concentrated sulfuric acid.

(1)

(iii) Explain why chloride ions are weaker reducing agents than bromide ions.

(2)

(Total 12 marks)

Q14

Iodine reacts with concentrated nitric acid to produce nitrogen dioxide (NO_2).

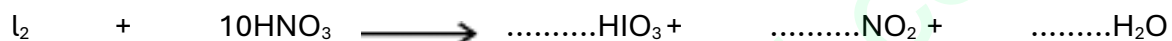
(a) (i) Give the oxidation state of iodine in each of the following.

I_2 _____

HIO_3 _____

(2)

(ii) Complete the balancing of the following equation.

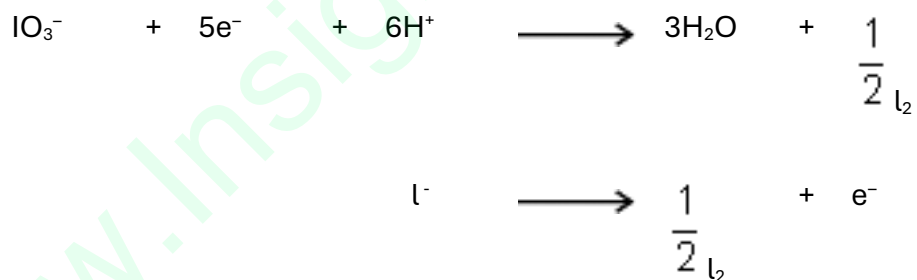


(1)

(b) In industry, iodine is produced from the NaIO_3 that remains after sodium nitrate has been crystallised from the mineral Chile saltpetre.

The final stage involves the reaction between NaIO_3 and NaI in acidic solution.

Half-equations for the redox processes are given below.



Use these half-equations to deduce an overall ionic equation for the production of iodine by this process. Identify the oxidising agent.

Overall ionic equation

The oxidising agent _____

(2)

(c) When concentrated sulfuric acid is added to potassium iodide, solid sulfur and a black solid are formed.

(i) Identify the black solid.

(1)

(ii) Deduce the half-equation for the formation of sulfur from concentrated sulfuric acid.

(1)

(d) When iodide ions react with concentrated sulfuric acid in a different redox reaction, the oxidation state of sulfur changes from +6 to -2. The reduction product of this reaction is a poisonous gas that has an unpleasant smell. Identify this gas.

(1)

(e) A yellow precipitate is formed when silver nitrate solution, acidified with dilute nitric acid, is added to an aqueous solution containing iodide ions.

(ii) Write the **simplest ionic** equation for the formation of the yellow precipitate.

(1)

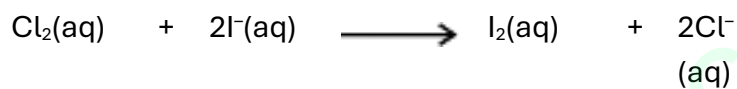
(ii) State what is observed when concentrated ammonia solution is added to this precipitate.

(1)

(iii) State why the silver nitrate is acidified when testing for iodide ions.

(1)

(f) Consider the following reaction in which iodide ions behave as reducing agents.



(i) In terms of electrons, state the meaning of the term *reducing agent*.

(1)

(ii) Write a half-equation for the conversion of chlorine into chloride ions.

(1)

(iii) Suggest why iodide ions are stronger reducing agents than chloride ions.

(2)

(Total 15 marks)

MARK SCHEME

1

B

[1]

Q2

(a) gains electrons / electron acceptor

do not accept gains pair of electrons

1

(b) $\text{SO}_2 + 2\text{H}_2\text{O} \rightarrow \text{SO}_4^{2-} + 4\text{H}^+ + 2\text{e}^-$

1

(c) $\text{Br}_2 + \text{SO}_2 + 2\text{H}_2\text{O} \rightarrow 4\text{H}^+ + 2\text{Br}^- + \text{SO}_4^{2-}$

1

S has oxidation state of +4 in SO_2 and +6 on SO_4^{2-} (S oxidised)

1

Br oxidation state changes from 0 to -1 (Br is reduced)

1

(d) colourless (NaI solution) turns to a brown (solution) / black solid

1

$\text{Br}_2 + 2\text{I}^- \rightarrow 2\text{Br}^- + \text{I}_2$

or

$\text{Br}_2 + 2\text{NaI} \rightarrow 2\text{NaBr} + \text{I}_2$

allow multiples

1

[7]

Q3

i) Cl or chlorine

1

oxidation increases from 0 to +5 (in NaClO₃)

allow oxidation state increases by 5

1

Q4



allow multiples

ignore state symbols

1

$$n(\text{Mn}^{2+}) = \frac{24.0 \times 0.150}{1000} = 3.60 \times 10^{-3} (\text{mol})$$

1

$$n(\text{NO}_3^-) = \frac{15.0 \times 0.0960}{1000} = 1.44 \times 10^{-3} (\text{mol})$$

1

$$(\text{reacting ratio } \frac{3.60 \times 10^{-3}}{1.44 \times 10^{-3}} = 2.5)$$



1

(final oxidation state of N is) 0

1

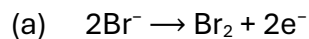
[5]

Q5

C

[1]

Q6

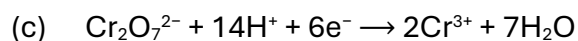


Allow multiples

1



1



1



1

(e) Chlorine (atom / molecule) is smaller OR chlorine has less electron shells OR chlorine has less shielding

Accept converse statement for bromine (atom / molecule)

Attraction to outer electron is less (in Br)

1

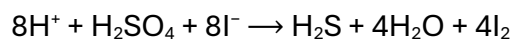
Attraction to (outer / gained) electron in chlorine is stronger OR (gained / outer) electron is more tightly held

1



Allow astatide

1



Allow equations with spectator ions

1

7 Redox and Quantitative

a) colourless to (pale) pink

Both colours needed

1

$$(b) \quad M1 \quad n(\text{MnO}_4^-) = 0.0187 \times 0.02285$$

$$= 0.000427 \text{ (mol)}$$

$$M2 \quad n(\text{Fe}^{2+}) \text{ in } 25.0 \text{ cm}^3 = 5 \times 0.000427$$

$$= 0.002136 \text{ (mol)}$$

$$M2 = M1 \times 5$$

$$M3 \quad n(\text{Fe}^{2+}) \text{ in } 250 \text{ cm}^3 = 10 \times 0.002136$$

$$= 0.02136 \text{ (mol)}$$

$$M3 = M2 \times 10$$

$$M4 \quad M_r (= 8.37 \div 0.02136) = 391.8 / 392$$

$$M4 = 8.37 \div M3$$

Correct final answer scores 4

4

$$(c) \quad M1 \quad M_r (\text{anhydrous}) = 284.0$$

$$M2 \quad x = \frac{392 - 284}{18} = 6$$

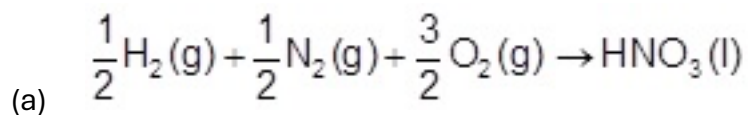
*M2 ECF from (b)**Final answer must be integer**Answer using provided value:*

$$x = \frac{356 - 284}{18} = 4$$

2

[7]

Q8



1

(b) It's an element (in its standard state) or by definition

1

(c) $\Delta H = \sum \Delta_f H \text{ products} - \sum \Delta_f H \text{ reactants}$ OR a correct cycle OR

$$-254 = 4\Delta_f H \text{HNO}_3 - [(2 \times -286) + (4 \times 34)]$$

1

$$4\Delta_f H \text{HNO}_3 = -690 \text{ (kJ mol}^{-1}\text{)}$$

1

$$\Delta_f H \text{HNO}_3 = -172.5 \text{ (kJ mol}^{-1}\text{)}$$

If +172.5 max 1

1

(d) (+)5

1

N goes from +4 to +5 so has lost electron

1

[7]

Q9

C

[1]

Q10

C

[1]

Q11

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

M2 (+) 5

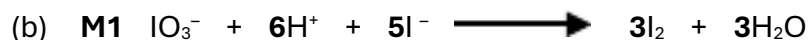
Accept Roman V for M2

2



Accept multiples

1



For M1, ignore state symbols

Credit multiples

Accept $2\frac{1}{2}\text{I}_2 + \frac{1}{2}\text{I}_2$ 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

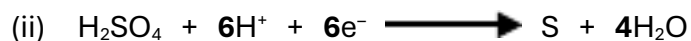
Accept “the iodine / I in iodate ions” but NOT “iodine” alone

2

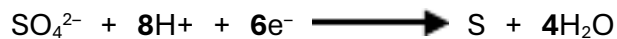
(c) (i) Iodine **OR** I_2

Insist on correct name or formula

1



Ignore state symbols



Credit multiples

Do not penalise absence of charge on the electron

1

(d) hydrogen sulfide

OR H₂S

OR hydrogen sulphide

1

(e) (i) $\text{Ag}^+ + \text{I}^- \longrightarrow \text{AgI}$ 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 electron donor

Penalise “electron pair donor”

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

Penalise “loss of electrons” alone

Accept “electron donator”

1

(ii) $\text{Cl}_2 + 2\text{e}^- \longrightarrow 2\text{Cl}^-$

Ignore state symbols

Do not penalise absence of charge on electron

Credit $\text{Cl}_2 \longrightarrow 2\text{Cl}^- - 2\text{e}^-$

Credit multiples

1

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

Ignore general statements about Group VII trends or about halogen molecules or atoms.

Answers must be specific

M1 Relative size of ions

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

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

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

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

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

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

OR converse for chloride ion

M2 Strength of attraction for electron(s)

Must be comparative in both M1 and M2

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

OR converse for a chloride ion

2

[15]

Q12

(a) (i) **M1 (+) 4 OR IV**

M2 (+) 6 OR VI

2

(ii) It / Chlorine has gained / accepted electron(s)

OR

Correctly balanced half-equation eg $\text{Cl}_2 + 2\text{e}^- \longrightarrow 2\text{Cl}^-$

Credit 1 or 2 electrons but not lone pair.

The idea of 'reduction' alone is not enough.

1

(b) (i) $6\text{KI} + 7\text{H}_2\text{SO}_4 \longrightarrow 6\text{KHSO}_4 + 3\text{I}_2 + \text{S} + 4\text{H}_2\text{O}$

1

(ii) $2\text{I}^- \longrightarrow \text{I}_2 + 2\text{e}^-$

OR

$8\text{I}^- \longrightarrow 4\text{I}_2 + 8\text{e}^-$

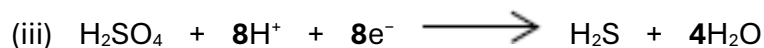
Ignore charge on the electron unless incorrect.

Or multiples.

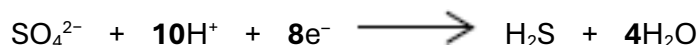
Credit the electrons being subtracted on the LHS.

Ignore state symbols.

1



OR



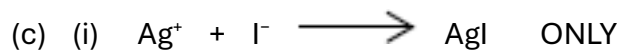
Ignore charge on the electron unless incorrect.

Or multiples.

Credit the electrons being subtracted on the RHS.

Ignore state symbols.

1



Ignore state symbols.

Not multiples.

1

(ii) The precipitate / solid / it does not dissolve / is insoluble / remains

OR a white / cream / yellow solid / precipitate

OR stays the same

OR no (visible / observable) change

OR no effect / no reaction

Ignore 'nothing (happens)'.

Ignore 'no observation'.

1

(iii) The silver nitrate is acidified to

- react with / remove (an)ions that would interfere with the test

Credit a correct reference to ions that give a '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

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

- react with / remove carbonate / hydroxide / sulfite (ions)

Ignore 'sulfate'.

1

(iv) HCl would form a (white) precipitate / (white) solid (with silver nitrate and this would interfere with the test)

*It is not sufficient simply to state either that it will interfere **or** simply that the ions / compounds react to form AgCl*

1

(d) (i) Any **one** from

Ignore 'to clean water'.

- to sterilise / disinfect water

Ignore 'water purification' and 'germs'.

- to destroy / kill microorganisms / bacteria / microbes / pathogens

Credit 'remove bacteria etc' / prevent algae.

1

(ii) The (health) benefit outweighs the risk

OR

a clear statement that once it has done its job, little of it remains

OR

used in (very) dilute concentrations / small amounts / low doses

1

(iii) $\text{Cl}_2 + \text{H}_2\text{O} \longrightarrow \text{HClO} + \text{HCl}$

OR



OR



Credit HOCl or ClOH

Or multiples.

Credit other ionic or mixed representations.

Ignore state symbols.

1

(e) **In either order - Both required for one mark only**

Credit correct ionic formulae.

NaClO (OR NaOCl) **and** NaCl

Give credit for answers in equations unless contradicted.

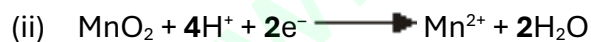
1

[14]

Q13

(a) (i) MnO_2 (+) 4

1



Or multiples

Ignore state symbols

Credit electrons subtracted from RHS

Ignore absence of charge on e

1

(iii) Iodide ion(s) is/are oxidised because they have lost electron(s)

Do not penalise reference to iodine; the mark is for electron loss

1

(b) (i) **M1** Cl_2 0

M2 HClO (+) 1

2

(ii) **M1** Equilibrium will shift/move to the right

OR L to R

OR to favour the forward reaction

OR to produce more HClO

M2 Consequential on correct M1

To oppose the loss of HClO

OR replaces the HClO (that has reacted)

for M2

NOT just "to oppose the change"

2

(c) (i) The answers can be in either order

M1 $2\text{Br}^- \longrightarrow \text{Br}_2 + 2\text{e}^-$

M2 $4\text{H}^+ + \text{SO}_4^{2-} + 2\text{e}^- \longrightarrow \text{SO}_2 + 2\text{H}_2\text{O}$

OR

$2\text{H}^+ + \text{H}_2\text{SO}_4 + 2\text{e}^- \longrightarrow \text{SO}_2 + 2\text{H}_2\text{O}$

NOT multiples

Ignore state symbols

Credit electrons subtracted from incorrect side

Ignore absence of charge on e

2

(ii) $\text{KCl} + \text{H}_2\text{SO}_4 \longrightarrow \text{KHSO}_4 + \text{HCl}$

OR



Credit ionic equations

1

(iii) For M1 and M2, chloride ions are weaker reducing agents than bromide ions, because

M1 Relative size of ions

Chloride ions are smaller than bromide ions OR
chloride ion electron(s) are closer to the nucleus
OR chloride ion has fewer (electron) shells/levels
OR chloride ion has less shielding (or converse for bromide ion)

M2 Strength of attraction for electron being lost

Outer shell/level electron(s) OR electron(s) lost
from a chloride ion is more strongly held by the
nucleus compared with that lost from a bromide
ion (or converse for bromide ion)

If the forces are described as intermolecular or Van der Waals then CE = 0

Ignore general reference to Group 7 trend

*For M1 accept reference to chlorine/bromine or reference to atoms of these but NOT
"chloride/bromide atoms" or "chlorine/bromine molecules"*

For M2 insist on reference to the correct ions

*This is the expected answer, but award credit for a candidate who gives a correct
explanation in terms of hydration enthalpy, electron affinity and atomisation enthalpy.*

2

[12]

Q14

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

M2 (+) 5

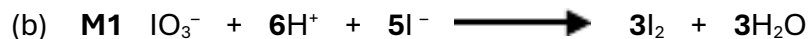
Accept Roman V for M2

2



Accept multiples

1



For M1, ignore state symbols

Credit multiples

Accept $2\frac{1}{2}\text{I}_2 + \frac{1}{2}\text{I}_2$ 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

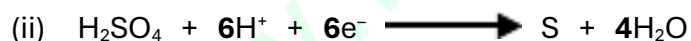
Accept “the iodine / I in iodate ions” but NOT “iodine” alone

2

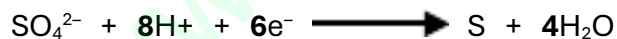
(c) (i) Iodine **OR** I_2

Insist on correct name or formula

1



Ignore state symbols



Credit multiples

Do not penalise absence of charge on the electron

1

(d) hydrogen sulfide

OR H_2S

OR hydrogen sulphide

1



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 electron donor

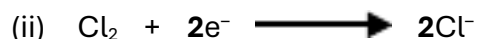
Penalise “electron pair donor”

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

Penalise “loss of electrons” alone

Accept “electron donator”

1



Ignore state symbols

Do not penalise absence of charge on electron

Credit $\text{Cl}_2 \longrightarrow 2\text{Cl}^- - 2\text{e}^-$

Credit multiples

1

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

Ignore general statements about Group VII trends or about halogen molecules or atoms.

Answers must be specific

M1 Relative size of ions

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

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

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

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

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

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

OR converse for chloride ion

M2 Strength of attraction for electron(s)

Must be comparative in both M1 and M2

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

OR converse for a chloride ion

2

[15]

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