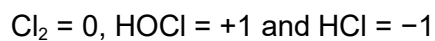


Allow the products shown as ions.

1



1 mark for all three oxidation states correct. Allow a reaction arrow in this equation.

Oxidation states must match the species

1

(b) Hydroxide / alkali ions react with the acids

Mark independently

1

Equilibrium moves to the right

1

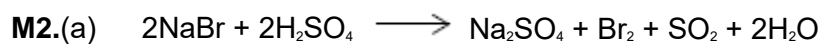
(c) Only used in small amounts

1

The health benefits outweigh the risks

1

[6]



Allow ionic equation



1

Br^- ions are bigger than Cl^- ions

1

Therefore Br^- ions more easily oxidised / lose an electron more easily (than Cl^- ions)

1

- (b) This question is marked using levels of response. Refer to the Mark Scheme Instructions for Examiners for guidance on how to mark this question.

Level 3

All stages are covered and the explanation of each stage is generally correct and virtually complete. Stages 1 and 2 are supported by correct equations.

Answer communicates the whole process coherently and shows a logical progression from stage 1 to stage 2 and then stage 3. The steps in stage 3 are in a logical order.

5–6 marks

Level 2

All stages are covered but the explanation of each stage may be incomplete or may contain inaccuracies OR two stages are covered and the explanations are generally correct and virtually complete.

Answer is mainly coherent and shows a progression through the stages. Some steps in each stage may be out of order and incomplete.

3–4 marks

Level 1

Two stages are covered but the explanation of each stage may be incomplete or may contain inaccuracies, OR only one stage is covered but the explanation is generally correct and virtually complete.

Answer includes some isolated statements, but these are not presented in a logical order or show confused reasoning.

1–2 marks

Level 0

Insufficient correct chemistry to warrant a mark.

0 marks

Indicative chemistry content

Stage 1: formation of precipitates

- *Add silver nitrate*
- *to form precipitates of AgCl and AgBr*
- $\text{AgNO}_3 + \text{NaCl} \rightarrow \text{AgCl} + \text{NaNO}_3$
- $\text{AgNO}_3 + \text{NaBr} \rightarrow \text{AgBr} + \text{NaNO}_3$

Stage 2: selective dissolving of AgCl

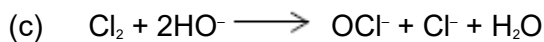
- *Add excess of dilute ammonia to the mixture of precipitates*

- the silver chloride precipitate dissolves
- $\text{AgCl} + 2\text{NH}_3 \rightarrow \text{Ag}(\text{NH}_3)_2^+ + \text{Cl}^-$

Stage 3: separation and purification of AgBr

- Filter off the remaining silver bromide precipitate
- Wash to remove soluble compounds
- Dry to remove water

6



1

OCl⁻ is +1

Cl⁻ is -1

Both required for the mark

1

[11]



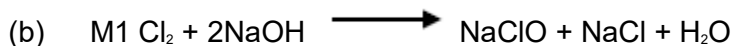
Accept a correct equation using $\frac{1}{2} \text{Cl}_2$ but no other multiples

M2 solution goes orange / yellow (from colourless)

Ignore reference to brown colour

Penalise incorrect observations eg fumes, precipitates

2



(NaOCl)

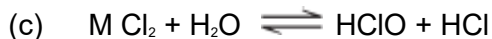
Or a correct ionic equation

Ignore reference to "swimming pools" and to "disinfectant"

M2 bleach or kills bacteria / bactericide / micro-organisms / microbes

M3 sodium chlorate(I) ONLY

3



(HOCl)

*Equilibrium symbol **required** in M1*

Accept ionic RHS

M2

The (health) benefit outweighs the risk or wtte

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

2



For M1

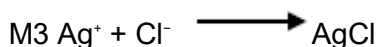
If only the formula is written then it must be correct

If both the formula and the name are written then ignore incorrect attempt at the formula, but penalise an incorrect name

M2 (depends on M1)

white precipitate / white solid

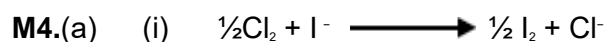
If the reagent is incomplete eg Ag^+ ions, penalise M1 and mark on



Penalise both M1 and M2 for alkaline AgNO_3 OR for the use of HCl to acidify the silver nitrate OR for Tollens' reagent

3

[10]



Only these two equations.

OR



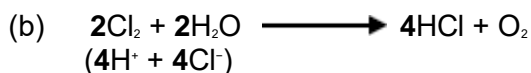
1

(ii) (Solution turns from colourless to) brown / red-brown solution

Allow grey / black solid.

Ignore "purple".

1



Credit multiples.

1

(c) **M1 The relative size (of the molecules / atoms)**

Chlorine is smaller than bromine OR has fewer electrons / electron shells

OR It is smaller / It has a smaller atomic radius / it is a smaller molecule / or has smaller M,

(or converse for bromine)

Ignore general Group 7 statements.

For M1 ignore whether it refers to molecules or atoms.

M2 How size of the intermolecular force affects energy needed

The forces between chlorine / Cl_2 molecules are weaker (than the forces between bromine / Br_2 molecules leading to less energy needed to separate the molecules)

(or converse for bromine)

OR chlorine / Cl_2 has weaker / less / fewer forces between molecules **OR**

chlorine / Cl_2 has weaker / less / fewer intermolecular forces

(or converse for bromine)

CE=0 for reference to (halide) ions.

QoL for clear reference to the difference in size of the force between molecules.

Penalise M2 if (covalent) bonds are broken.

2

[5]

M5.(a) (i) M1 (+) 4 OR IV

M2 (+) 6 OR VI

2

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

OR

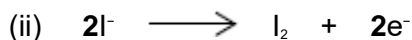
Correctly balanced half-equation eg $\text{Cl}_2 + 2\text{e}^- \longrightarrow 2\text{Cl}^-$

*Credit 1 or 2 electrons but not lone pair.
The idea of 'reduction' alone is not enough.*

1



1



OR



Ignore charge on the electron unless incorrect.

Or multiples.

Credit the electrons being subtracted on the LHS.

Ignore state symbols.

1



OR



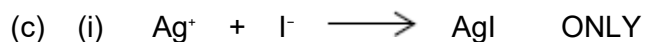
Ignore charge on the electron unless incorrect.

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

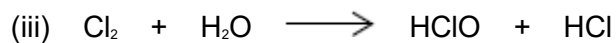
OR

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

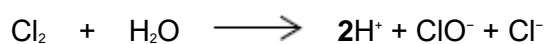
OR

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

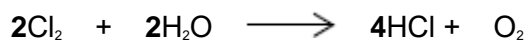
1



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]