

## Mark schemes

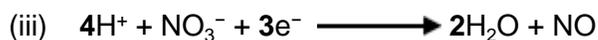
1



1

(ii) (+) 5  
(+) 2

2



*Ignore state symbols.*

*Credit multiples of **this equation only**.*

*Ignore absence of charge on the electron.*

1



*Ignore state symbols.*

*Credit multiples of **this equation only**.*

*Ignore absence of charge on the electron.*

1

(b) M1 add scrap / recycled / waste iron (or steel) to the aqueous solution

*If **M1** refers to iron / steel, but does not make it clear in the text that it is "scrap" / "waste" / "recycled", penalise **M1** but mark on.*

M2 the iron is a more reactive metal **OR** Fe is a better reducing agent

*Credit zinc or magnesium as an alternative to iron for **M2**, **M3** and **M4** only, penalising **M1***

M3 Cu<sup>2+</sup> / copper ions are reduced / gain electrons



**OR** copper / Cu is displaced by Fe

*Ignore absence of charge on the electron.*



*For **M4**, ignore state symbols*

4

[9]

2

- (a) Ti is not produced

**OR**

TiC / carbide is produced OR titanium reacts with carbon

**OR**

Product is brittle

**OR**

Product is a poor engineering material

*Penalise "titanium carbonate"*

*Ignore "impure titanium"*

*Credit "it / titanium is brittle"*

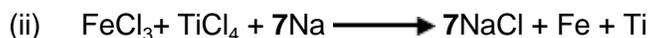
1



*Ignore state symbols*

*Credit multiples*

1



**OR** (for example)



*Ignore state symbols*

*Credit multiples including ratios other than 1:1*

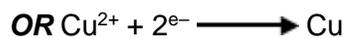
*Ignore working*

1

- (c) Either order

*Penalise reference to incorrect number of electrons in M1*

**M1** The  $\text{Cu}^{2+}$  / copper(II) ions / they have gained (two) electrons



*For M1, accept "copper" if supported by correct half-equation or simplest ionic equation*

**OR** oxidation state / number decreases (or specified from 2 to 0)

*Ignore charge on the electron*

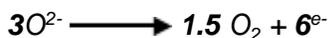
**M2** The  $\text{Cu}^{2+}$  / copper(II) ions / they have been reduced

*For M2 do not accept "copper" alone*

2



*Or multiples including*



*Ignore state symbols*

*Ignore charge on the electron*

*Credit the electrons being subtracted on the LHS*

1

[6]

3



*Ignore state symbols*

*Credit multiples of either equation*

**OR**



1

(ii) (fractional) distillation

**OR**

G(L)C or gas (–liquid–) chromatography

1



*Ignore state symbols*

*Credit multiples*

*Penalise ionic HCl*

1

(ii) Reducing agent / reductant / reduces  $\text{SiCl}_4$  / reduces (silicon) / electron donor

1

(iii) Explosion / explosive

**OR**

(highly) flammable / inflammable

**OR**

readily / easily ignites / burns / combusts

1



*Ignore state symbols*

*Credit multiples*

1

[6]

4

(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  $3\text{I}_2$*

*Electrons must be cancelled*

**M2**  $\text{NaIO}_3$  **OR**  $\text{IO}_3^-$  **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

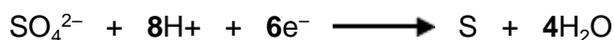
(c) (i) Iodine **OR**  $\text{I}_2$

*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<sub>2</sub>S

**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



*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

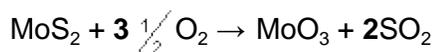
2

[15]

5



OR



*Allow multiples*

*Ignore state symbols*

1

(ii) **M1 Environmental problem**

Acid rain

OR

An effect either from acid rain or from an acidic gas in the atmosphere.

**M2 Use**

SO<sub>2</sub> could be used to make / to form / to produce  
(or wtte) H<sub>2</sub>SO<sub>4</sub> / sulfuric acid

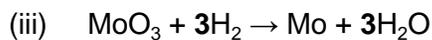
OR

To make / to form / to produce (or wtte) gypsum / CaSO<sub>4</sub>  
or plaster of Paris / plaster board

*Ignore references to the greenhouse effect*

*Penalise reference to the ozone layer using the list principle*

2



*Allow multiples*

*Ignore state symbols*

1

(iv) One from

H<sub>2</sub> is

- Explosive
- (in)flammable
- easily ignited  
*Ignore "burns"*

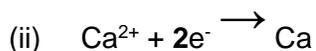
1

(b) (i) To allow ions to move (when molten)

OR

Ions cannot move in the solid

1



*Or multiples*

*Ignore state symbols*

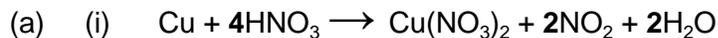
*Ignore charge on the electron unless incorrect and accept loss of two electrons on the RHS*

1

- (iii) (High) electricity / electrical energy (cost)  
*Ignore “energy” and ignore “current”*

[8]

6



*Or multiples*

*Ignore state symbols*

1

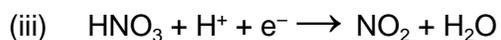


*Ignore working out*

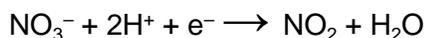
*M1 Credit (V)*

*M2 Credit (IV)*

2



OR



*Or multiples*

*Ignore state symbols*

*Ignore charge on the electron unless incorrect and accept loss of electron on the RHS*

1

- (b) (i) **In either order**

**M1** Concentration(s) (of reactants and products)  
remain(s) constant / stay(s) the same / remain(s)  
the same / do(es) not change

**M2** Forward rate = Reverse / backward rate

*For M1 accept [ ] for concentration*

*NOT “equal concentrations” and NOT “concentration(s) is/are the same”*

*NOT “amount”*

*Ignore “dynamic” and ignore “speed”*

*Ignore “closed system”*

*It is possible to score both marks under the heading of a single feature*

2

(ii) **M1**

The (forward) reaction / to the right is endothermic  
or takes in / absorbs heat

OR

The reverse reaction / to the left is exothermic or gives  
out / releases heat

**M2 depends on correct M1 and must refer to temperature/heat**

The equilibrium shifts / moves left to right to oppose the increase in temperature

*M2 depends on a correct statement for M1*

*For M2, the equilibrium shifts/moves*

*to absorb the heat OR*

*to lower the temperature OR*

*to cool the reaction*

2

(iii) **M1 refers to number of moles**

There are fewer moles (of gas) on the left OR more  
moles (of gas) on the right.

OR there is one mole (of gas) on the left and 2 moles  
on the right.

**M2 depends on correct M1 and must refer to pressure**

The equilibrium shifts / moves right to left to oppose the  
increase in pressure

*M2 depends on a correct statement for M1*

*For M2, the equilibrium shifts/moves to lower the pressure.*

2

[10]