

M1.(a) The forces between iodine molecules are stronger 1

(b) anything in range +30 to +120 1

(c) Brown 1

(d)  $2 \text{I}^- + \text{Cl}_2 \rightarrow \text{I}_2 + 2 \text{Cl}^-$  1

(e) It contains ions which can move 1

(f) hydrogen iodine 1

[6]

- M2.(a)** giant structure / lattice / layers / close packed  
*first 3 marks can be obtained from a suitably labelled diagram*  
*incorrect structure or bonding or particle = max 3* 1
- made up of atoms / positive ions 1
- with delocalized / free electrons 1
- so electrons can move / flow through the metal  
*accept so electrons can carry charge through the metal*  
*accept so electrons can form a current* 1
- (b) an alloy (is a metal which) has different types / sizes of atoms  
*accept converse for pure metal throughout*  
*both marks can be obtained from suitable diagrams*  
*allow made of different metals*  
*allow mixture of metals / atoms / elements*  
*ignore particles*  
*ignore properties*  
*do **not** accept compound* 1
- alloy has distorted layers  
*allow layers are unable to slide* 1
- (c) (i) can return to its original shape  
*accept shape memory alloy*  
*accept smart alloy*  
*ignore other properties* 1
- (ii) (pure copper is too) soft  
*accept converse*  
*accept malleable or bends*  
*accept copper is running out*  
*ignore references to strength and weakness* 1

- (iii) aluminium oxide  
*accept alumina*  
*accept  $Al_2O_3$*   
*ignore bauxite / aluminium ore*

1

- (iv) any **one** from:
- different conditions
  - different catalyst
  - different pressure
- allow different concentration*
- different temperature.
- do **not** accept different monomers*

1

- (d) any **two** from:
- accurate
  - sensitive
  - rapid
  - small sample.
- both needed for 1 mark*

1

[11]

- M3.(a) (i) points correctly plotted ( $\pm \frac{1}{2}$  small square)  
*four points = 2 marks*  
*three points = 1 mark*

Max 2

straight line of best fit using full range of points from 0,0

1

- (ii) any **one** from:

*must explain why the point is below the line*

- the solution may not have been properly stirred
- the electrodes may have been a larger distance apart
- the drop of sodium chloride may have been a smaller volume / smaller

*allow not enough sodium chloride added*

*allow smaller amount of sodium chloride*

*do **not** allow too few drops added*

*ignore the student may have misread the conductivity meter*

1

- (iii) any **one** from:

- the volume of pure water  
*allow amount*
- the concentration (of the solutions added)
- the volume (of the drops) of solution added  
*ignore number of drops*
- the distance between the electrodes
- the same electrodes **or** electrodes made of the same material
- same depth **or** surface area of electrodes in the water
- constant power supply  
*ignore current*
- stirred

1

- (b) (i) because (pure) water is covalent / molecular (simple) **or** contains molecules

1

therefore (pure) water has no free / mobile electrons **or** ions  
*molecules do not have a charge or molecules do not contain ions*  
*gains 2 marks*

1

(ii) because there are ions in sodium chloride  
*allow  $\text{Na}^+$  and / or  $\text{Cl}^-$  (ions) or ionic bonding.*  
*Ignore particles other than ions for MP1.*

1

which can move **or** carry the current / charge  
*MP2 must be linked to ions only.*

1

(iii) Hydrogen  
*allow  $\text{H}_2$  / H*

1

[10]

**M4.(a)** any **two** from:

- copper / ores are running out / harder to find
- there are no / very small amounts of high-grade copper ores left
- copper metal is in demand
- copper is expensive
- now economical to extract copper from low-grade ores  
*it = copper*  
*allow new methods of extraction e.g. bioleaching and phytomining*  
*allow high-grade ores are running out for 2 marks*

2

- (b) (i) large amounts / 98% of rock to dispose of as waste  
*accept contains toxic (metal) compounds / bioleacher*

**or**waste rock takes up a lot of space

1

- (ii) (copper sulfide reacts with oxygen to) produce sulfur dioxide /  $SO_2$   
*allow (sulfur reacts with oxygen to) produce sulfur dioxide /  $SO_2$*

1

that causes acid rain

*allow description of effects of acid rain **or** sulfur dioxide*  
*if no other mark awarded allow  $CO_2$  produced which causes global warming **or**  $CO_2$  produced by burning fuel or heating the furnace*  
*for 1 mark*

1

- (iii) any **one** from:

- large amounts of fuels / energy used (for the furnace and electrolysis)  
*allow large amounts of electricity needed*  
*ignore high temperature / electrolysis unqualified*
- (the extraction has) many steps / stages / processes  
*allow (extraction) is a long process / takes a lot of time*

- large amounts of ore / material have to be mined  
*allow ores contain a low percentage of copper*

1

(iv) (copper ions move towards) the negative electrode / *cathode*

1

because copper ions /  $\text{Cu}^{2+}$  are positively charged **or** are oppositely charged **or**  
copper ions need to gain electrons

*allow because metal ions are positive **or** opposites attract*

1

(v) (growing) plants

1

[9]

M5. (a) any **one** from:

- they are negative / anions  
*allow Cl<sup>-</sup>*  
*ignore atoms / chlorine*  
*do **not** accept chloride ions are negative electrodes*
- they are attracted
- they are oppositely charged

1

(b) hydrogen is less reactive than sodium

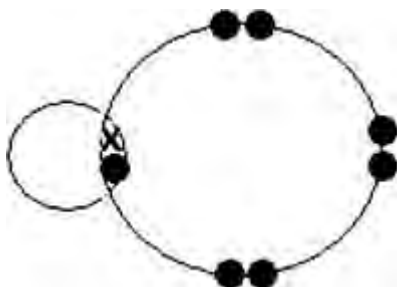
1

(c) hydroxide (ions) / OH<sup>-</sup>

*ignore OH*

*do **not** accept NaOH / sodium hydroxide*

1



(d) (i)

*allow any combination of dots or crosses*  
*ignore chemical symbols*

1

(ii) covalent

*allow close spelling errors*  
*apply list principle*

1



- (iii) hydrogen (ion) /  $H^+$   
*ignore (aq) / H*  
*do not accept hydrochloric acid / HCl*  
*apply list principle*

1

[6]

- M6.** (a) (i) low percentage / very little of metal (in the ore)  
*accept only 0.5% metal in the ore **or** over 99% waste in the ore **or** nearly 100% waste in the ore*  
*ignore reference to percentage of metal in the Earth's crust **or** energy used or pollution*

1

- (ii) any **one** from

*(it = iron)*

- iron uses less energy / fuel for extraction  
*ignore electrolysis / uses electricity / reactivity*
- iron has more uses
- more demand for iron  
*ignore high abundance in the Earth's crust / high percentage of metal in ore*
- iron is stronger  
*ignore harder*
- cheaper / costs less
- easier to extract

1

- (b) (i) has melting point lower than 950°C  
*(it = aluminium)*  
*allow has a low melting point*  
*ignore boiling point*

1

- (ii) electrode(s) made of carbon

1

oxygen reacts with electrode(s) / carbon  
*accept  $C + O_2 \rightarrow CO_2$*

*NB oxygen reacts with the carbon electrode(s) = 2 marks*

**1**

*(iii) any **two** from:*

- saves resources / non-renewable  
accept aluminium / ore will run out **or** conserves aluminium*
- landfill problem  
accept aluminium does not corrode*
- saves energy / fuel / electricity  
ignore global warming*
- less carbon dioxide / carbon emissions **or** reduces carbon footprint  
ignore consequences of quarrying / mining*
- less quarrying / mining  
ignore pollution / harms environment / costs / easy to recycle*

**2**

**[7]**

**M7.** (a) the ions can move / travel / flow / are free  
accept particles / they for ions  
allow delocalised ions

or

ignore delocalised / free electrons  
ignore references to collisions  
accept converse with reference to solid

the ions carry the charge / current  
ignore ions carry electricity

1

(b) any **one** from:

- because they are negative / anion  
allow  $Cl^-$   
ignore chlorine
- opposite charges / attract

1

(c) 13

1

(d) (i) reasonable attempt at straight line which misses the anomalous point  
must touch all five crosses  
do **not** allow multiple lines

1

(ii) 40

ignore 2.2

1

(iii) any **two** sensible errors from:

ignore systematic / human / apparatus / zero / experimental /

*random / measurement / reading errors unless qualified*

- *gas escapes*
- *weighing error*  
*allow NaCl not measured correctly*
- *error in measuring (volume / amount) of hydrogen*
- *error in measuring (volume / amount) of water*  
*allow error in measuring volume / scale for 1 mark if neither hydrogen or water mentioned*
- *incorrect concentration*  
*allow NaCl not fully dissolved or spilled or impure*
- *timing error*
- *change in voltage / current*  
*allow faulty power supply*
- *change in temperature*
- *recording / plotting error*

2

(iv) any **one** from:

*ignore 'do more tests'*

- *repeat the experiment*
- *results compared with results from /other students / other groups / other laboratories / internet / literature.*
- *results compared with another method*

1

(v) *increases owtte*

*allow directly proportional or positive correlation*

*allow rate / it is faster / quicker*

1

[9]