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

1

(b) anything in range +30 to +120

1

(c) Brown

1

(d) $2\ I^- + Cl_2 \rightarrow I_2 + 2\ Cl^-$

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 / <u>positive</u> 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 (± ½ 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 <u>ions</u> in sodium chloride

*allow Na^+ and / or 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 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

orwaste 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 / 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^-

  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

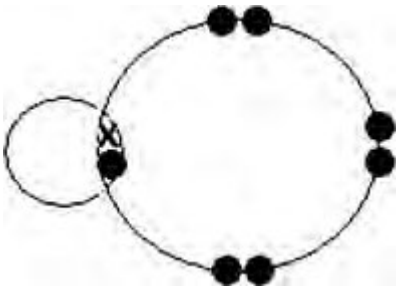
1

(c) hydroxide (ions) / OH^-

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 <u>only</u> 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 <u>mel</u>ting point lower than 950°C

(it = aluminium)

allow has a low <u>mel</u>ting point

ignore boiling point

1

(ii) electrode(s) made of carbon

1

oxygen reacts with electrode(s) / carbon

accept C + O_2 (→ 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 <u>move</u> / <u>travel</u> / <u>flow</u> /are <u>free</u>*

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 <u>carry</u> 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]