**M1.**(a)     any **one** from:

•        protection / improve lifespan

•        improve appearance.

**1**

(b)     (i)      Bleach

**1**

(ii)     Hydrogen is less reactive than sodium

**1**

(iii)    1 bonding pair of electrons 6 unbonded electrons on Cl

*accept dot, cross or e or − or any combination*

**1**

(iv)    Covalent

**1**

(v)     Hydrogen chloride has a low boiling point.

**1**

Hydrogen chloride is made of simple molecules.

**1**

(c)     (i)      oxygen

*accept carbon dioxide*

**1**

(ii)     aluminium ions are positive

**1**

so are attracted (to the negative electrode)

*allow opposites attract*

**1**

(iii)    Reduction

**1**

(iv)    slide

*allow move*

**1**

(d)     (i)      C

**1**

(ii)     strong covalent bonds

**1**

**[14]**

**M2.**         (a)      (i)     A

**1**

(ii)     E

**1**

(b)     (i)      insoluble

precipitation

**2**

(ii)     filtration

*accept decant* ***or*** *centrifuge*

**1**

(iii)    hydrochloric acid

**1**

(c)     (i)      melt

*allow add to / dissolve in water*

*allow heat until liquid*

*allow turn it to liquid / make it molten*

*ignore heat*

**1**

(ii)     they are positive

**or**

opposite charges **or** opposites attract

*do* ***not*** *accept electrodes attracting*

*do* ***not*** *accept positive electrons*

**1**

(iii)    chlorine

*accept Cl2*

*do* ***not*** *accept chloride*

**1**

**[9]**

**M3.**(a)     (i)      ions cannot move

*allow only conducts as a liquid*

**1**

(ii)     chlorine

**1**

(iii)    they are positively / oppositely charged

**or**

they are attracted

**1**

(iv)    2

**1**

(b)     (i)      any **one** from:

•        not all the magnesium was collected

*allow some magnesium was lost*

•        *used less time* ***or*** *lower current* ***or*** *different battery / power pack* ***or*** *different balance* ***or*** *lower voltage*

•        error in reading balance

•        error in recording result

**1**

(ii)     1.11

*correct answer with or without working gains* ***2*** *marks.*

*if answer incorrect, allow* ***1*** *mark for 0.99*

***or*** *for 1.13 + 1.11 + 1.09*

**2**

(c)     (i)      *25 – 25.3*

*correct answer with or without working gains* ***2*** *marks.*

*If answer incorrect, allow* ***1*** *mark for 24 / 95*

**2**

(ii)     71

**1**

(d)     (i)      reversible reaction

**1**

(ii)     decreases

**1**

**[12]**

**M4.**          (a)     (i)     cryolite

**1**

(ii)     lower the melting point of the aluminium oxide

**1**

(b)     (i)      opposite charges **or** oxide ions are negative

**1**

attract

**1**

(ii)     carbon

**1**

(iii)     reacts with oxygen **or** forms carbon dioxide

*accept burns*

**1**

(c)     **Structure mark:**

**either** Al (atoms) in layers / rows

*accept Al (atoms) all the same size
allow Al (atoms) in lines*

**or** alloy (atoms) not in layers / rows

*accept different sizes of atoms in alloy
allow alloy (atoms) not in lines*

**1**

**Sliding mark:**

**either** so (Al layers) can slide

**or** so (alloy) layers cannot slide

**1**

**[8]**

**M5.**          (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]**

**M6.**          (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]**

**M7.**(a)     (i)      so ions can move (and carry charge)

*accept so current can flow*

*allow so it can conduct (electricity)*

*allow so charged particles can move*

*do* ***not*** *accept so electrons can move*

**1**

(ii)     because zinc ions gain electrons

*accept because zinc ions are reduced*

**1**

2 (electrons)

**1**

zinc is formed

*accept correct half equation for* ***3*** *marks*

*if no mark gained allow*

*positive ions go to negative electrode* ***or***

*opposites attract* ***or***

*reduction (of zinc)* ***or***

*(zinc) gains electrons for* ***1*** *mark*

**1**

(iii)    **2 Cl–**   Cl2 + **2** e–

*must be completely correct*

**1**

(b)     (i)      because the magnesium is *a gas*

*allow magnesium goes from solid to gas*

**1**

(ii)     (a reaction which) takes in energy (from the surroundings)

*accept more energy needed to break bonds than released by forming bonds*

*accept correct reference to energy level diagram*

*allow (a reaction which) takes in heat (from the surroundings)*

**1**

(iii)    (*M*r MgO =) 40

*accept (2 Mr MgO =) 80*

**1**

1.2 / 24 (x40) **or** 0.05 (x40)

**or**

40 / 24 (x1.2) **or** 1.67 (x1.2)

*allow ecf from step 1*

**1**

2(.0)

*allow ecf carried through from step 1*

*correct answer with or without working gains* ***3*** *marks*

**1**

(iv)    75(%)

**1**

(v)     any **one** from:

•        the reaction is reversible

*accept incomplete reaction*

*ignore equilibrium not reached*

•        *some lost / escaped / released (when* separated)

•        some of the reactant may react in different ways from the expected reaction

•        *impure reactant(s)*

*ignore measurement and calculation errors*

**1**

**[12]**

**M8.**          (a)     52.9(411765) / 53

*correct answer with or without working =* ***2*** *marks*

*if answer incorrect allow 2 x 27= 54* ***or*** *27/102 x 100* ***or*** *26.5 for* ***1*** *mark*

**2**

(b)     (i)     because it lowers the melting point (of the aluminium oxide)

*allow lowers the temperature needed*

*do* ***not*** *accept lowers boiling point*

**1**

so less energy is needed (to melt it)

*accept so that the cell / equipment does not melt*

**1**

(ii)      **2** O2–   on left hand side

*accept correct multiples or fractions*

**1**

**4e–**         on right hand side

*accept****–4e–****on left hand side*

**1**

(iii)     because the electrode reacts with oxygen **or**

because the electrode burns

**1**

to form carbon dioxide **or**

electrode made from carbon / graphite

**1**

**[8]**

**M9.**(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 ions 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 H2 / H*

**1**

**[10]**

**M10.**(a)

 

*more than one line from test negates the mark*

**1**

(b)     (i)      place a lighted splint at the mouth of the tube

**1**

there is a squeaky pop

*dependent on correct test*

**1**

(ii)     hydrogen is less reactive than magnesium

*accept converse*

*accept magnesium is too reactive*

**1**

(c)     (i)      any **one** from:

•        to improve appearance or make it look nice

•        to prevent corrosion

•        to make it more durable

•        cheaper than solid silver

**1**

(ii)     solution must be silver nitrate **or** contain silver ions

**1**

otherwise copper will be deposited **or** silver will not be deposited

**1**

spoon must be the negative electrode / cathode

**1**

because silver ions have a positive charge **or** go to negative electrode **or** are discharged at the negative electrode.

**1**

(iii)    because (plastic is an) insulator **or** does not conduct electricity

*accept does not contain mobile electrons*

**1**

**[10]**

**M11.**(a)     because sulfur dioxide causes acid rain

**1**

which kills fish / aquatic life **or** dissolves / damages statues / stonework **or** kills / stunts growth of trees

*if no other mark awarded then award 1 mark for sulfur dioxide is toxic or causes breathing difficulties.*

**1**

(b)     (i)      electrons are lost

**1**

(ii)     Cu2+ + 2e−→ Cu

*allow Cu2+→ Cu − 2e−*

*ignore state symbols*

**1**

(iii)    copper sulfate

*allow any ionic copper compound*

**1**

(c)     (lattice of) positive ions

**1**

delocalised electrons

*accept sea of electrons*

**1**

(electrostatic) attraction between the positive ions and the electrons

**1**

electrons can move through the metal / structure **or** can flow

*allow electrons can carry charge through the metal / structure*

*if wrong bonding named or described or attraction between oppositely charged ions then do not award M1 or M3 − MAX 2*

**1**

(d)     (copper compounds are absorbed / taken up by) plants

*allow crops*

**1**

which are burned

**1**

the ash contains the copper compounds

*do not award M3 if the ash contains copper (metal)*

**1**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|   | (e) | / Ar | 55.6 / 63.5 | 16.4 / 56 | 28.0 / 32 |
|   |   | moles | 0.876 | 0.293 | 0.875 |
|   |   | ratio | 3 | 1 | 3 |
|   |   | formula | Cu3FeS3 |

*award* ***4*** *marks for Cu3FeS3 with some correct working*

*award* ***3*** *marks for Cu3FeS3 with* ***no*** *working*

*if the answer is not Cu3FeS3 award up to* ***3*** *marks for correct steps from the table apply ecf*

*if the student has inverted the fractions award* ***3*** *marks for an answer of CuFe3S*

**4**

**[16]**