

- M1.(a) (i) calcium oxide
in either order 1
- carbon dioxide
accept correct formulae 1
- (ii) $C(s) + CO_2(g) \rightarrow 2CO(g)$
allow multiples 1
- (iii) 210 (tonnes)
award 3 marks for the correct answer with or without working
allow ecf for arithmetical errors
if answer incorrect allow up to 2 marks for any of the steps below:
160 \rightarrow 112
300 \rightarrow 112 / 160 \times 300
or
moles $Fe_2O_3 = 1.875 (\times 10^6)$ or 300 / 160
moles of Fe = 3.75 ($\times 10^6$) or 2 \times moles Fe_2O_3
mass Fe = moles Fe \times 56
105 (tonnes) scores 2 (missing 1:2 ratio)
420 (tonnes) scores 2 – taken M_r of iron as 112 3
- (b) (i) aluminium is more reactive than carbon **or** carbon is less reactive than aluminium
must have a comparison of reactivity of carbon and aluminium
accept comparison of position in reactivity series. 1
- (ii) (because) aluminium ions are positive
ignore aluminium is positive 1
- and are attracted / move / go to the negative electrode / cathode 1
- where they gain electrons / are reduced / $Al^{3+} + 3e^- \rightarrow Al$
accept equation or statements involving the wrong number of electrons. 1
- (iii) (because) the anodes **or** (positive) electrodes are made of carbon / graphite 1

oxygen is produced (at anode)

1

which reacts with the electrodes / anodes

*do **not** accept any reference to the anodes reacting with oxygen from the air*

equation $C + O_2 \rightarrow CO_2$ gains 1 mark (M3)

1

[13]

M2.(a) lattice / giant structure

max 3 if incorrect structure or bonding or particles

1

ionic **or** (contains) ions

1

Na⁺ and Cl⁻

accept in words or dot and cross diagram: must include type and magnitude of charge for each ion

1

electrostatic attraction

allow attraction between opposite charges

1

(b) hydrogen

allow H₂

1

sodium hydroxide

allow NaOH

1

(c) any **one** from, eg:

- people should have the right to choose
- insufficient evidence of effect on individuals
- individuals may need different amounts.

allow too much could be harmful

ignore religious reasons

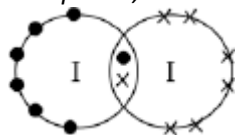
ignore cost

ignore reference to allergies

1

(d) (i) one bonding pair of electrons

accept dot, cross or e or – or any combination, eg



1

6 unbonded electrons on each atom	1
(ii) simple molecules	
<i>max 2 if incorrect structure or bonding or particles</i>	
<i>accept small molecules</i>	
<i>accept simple / small molecular structure</i>	1
with intermolecular forces	
<i>accept forces between molecules</i>	
<i>must be no contradictory particles</i>	1
which are weak or which require little energy to overcome – must be linked to second marking point	
<i>reference to weak covalent bonds negates second and third marking points</i>	1
(iii) iodine has no delocalised / free / mobile electrons or ions	1
so cannot carry charge	
<i>if no mark awarded iodine molecules have no charge gains 1 mark</i>	1
	[14]

M3.(a) (i) any **one** from:

- one electron in the outer shell / energy level
- form ions with a 1+ charge

1

(ii) any **one** from:

- hydrogen is a non-metal
 - (at RTP) hydrogen is a gas
 - hydrogen does not react with water
 - hydrogen has only one electron shell / energy level
 - hydrogen can gain an electron **or** hydrogen can form a negative / hydride / H⁻ ion
 - hydrogen forms covalent bonds **or** shares electrons
- accept answers in terms of the Group 1 elements*

1

(b) (i) (bromine) gains electrons

it = bromine

*do **not** accept bromide ion gains electrons*

ignore loss of oxygen

1

(ii) I₂

must both be on the right hand side of the equation

1

+ 2e⁻

2I - 2e⁻ → I₂ for 2 marks

1

(iii) fluorine is the smallest atom in Group 7 **or** has the fewest energy levels in Group 7 **or** has the smallest distance between outer shell and nucleus

*the outer shell **must** be mentioned to score 3 marks*

1

fluorine has the least shielding **or** the greatest attraction between the nucleus and the outer shell

1

therefore fluorine can gain an electron (into the outer shell) more easily

1

[8]

M4. (a) $52.9(411765) / 53$

correct answer with or without working = 2 marks

if answer incorrect allow $2 \times 27 = 54$ or $27/102 \times 100$ 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) 2O^{2-} 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]

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

- outer shell electrons / electrons in highest energy level (in metals)
- electrons are delocalised / sea of electrons
- electrons are free **or** electrons move around **or** electrons are free to flow **or** electrons attracted to positive terminal
- electrons carry charge / current **or** electrons form the current / electrons transfer charge / electrons pass charge

ignore electrons carry electricity

ignore reference to positively charged atoms / ions

if they state electrons have +ve charge = max 1 mark

if they state covalent bonding then max 1 mark

2

(b) ions can move / are attracted to electrode

accept ions are free

allow 'they' for ions

or

attracted to named electrode

or

ions are charged **or** ions form / carry the current **or** ions form the charge

1

(c) (i) electron gain

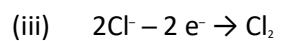
ignore hydrogen reduces charge

1

(ii) sodium hydroxide **or** NaOH **or** caustic soda

*do **not** allow hydroxide alone*

1



or



*allow fractions **or** multiples*

*allow e **or** e⁻*

*do **not** allow e⁺*

1

[6]

- M6.** (a) (i) any **one** from:
- they are positive / cations
 - they are H⁺
 - opposite charges attract
ignore atom

1

- (ii) potassium is more reactive (or reverse)
assume 'it' refers to hydrogen
allow potassium reacts with water
*allow potassium is very reactive **or** most reactive metal / element*
allow hydrogen gains electrons more easily / is reduced more easily
accept potassium is higher up the reactivity series

1

- (b) **6 and 2**
accept correct multiples and fractions

1

- (c) (i) the reaction / it is reversible **or** a description of a reversible reaction
allow 'it is an equilibrium'
allow reversible symbol drawn correctly
allow 'the reverse / back reaction'

1

- (ii) **lithium nitride**

assume that 'it' or if they do not specify means lithium nitride

assume lithium / lithium nitrate refers to lithium nitride

- hydrogen is bonded / held / absorbed / has formed a compound / reacted with lithium nitride

1

plus **one** of:

- does not explode / cause a fire
- is not free / less hydrogen
- is not under pressure
- does not leak
- is only released slowly

1

- compound of hydrogen with lithium nitride / product is (more) stable / less reactive / less chance of a reaction
accept converse for hydrogen as below

assume that gas / hydrogen means gas in the cylinder

- *hydrogen (in cylinder) / gas is not bonded / held absorbed / in a compound / reacted with lithium nitride*

1

plus one of:

- *can explode / cause a fire*
- *is free*
- *is under pressure*
- *can leak*
- *releases quickly*

1

- (d) (i) loss of an electron **or** loses electrons
do not accept any ref. to oxygen

1

- (ii) full outer shell of 8 electrons on circle
need not be paired
can be x, dot or e
*do **not** accept if extra electrons added to inner shell*

1

[10]