

Electrolysis

Mark Scheme 1

Level	GCSE (9-1)
Subject	Combined Science: Trilogy - Chemistry
Exam Board	AQA
Topic	5.4 Chemical Changes
Sub-Topic	Electrolysis
Difficulty Level	Gold Level
Booklet	Mark Scheme 1

Time Allowed: 58 minutes

Score: /56

Percentage: /100

Grade Boundaries:

M1.(a) electrodes connected to d.c. power supply by wires

*for this diagram ignore the material used for the electrodes
as long as they are made from carbon or metals that are
inert*

1

electrodes labelled anode (+) and cathode (–)

1

(b) copper ions cause the blue colour

answer must be in terms on copper ions

1

copper ions are reduced / converted to copper ions

1

so the concentration of copper ions decreased

1

*if no other mark awarded allow 1 mark for copper ions are
used up during electrolysis*

(c) copper ions are positive

1

so are attracted to the inert cathode **or** inert negative electrode

1

copper ions gain electrons at the inert cathode **or** inert negative electrode

1

so they are reduced to form copper atoms

1

(d) 50 cm³ contains 4 g CuSO₄

1

$$M_r \text{ CuSO}_4 = 159.5$$

1

$$4 \text{ g CuSO}_4 \text{ reacts with } \frac{4}{159.5} \times 56 \text{ g Fe}$$

$$= 1.40(43877)$$

1

$$= 1.4 \text{ (g)}$$

1

accept 1.4(g) with no working shown for 4 marks
allow 1.40(43887) without working shown for 3 marks

[13]

M2.(a) $1\,950 / 2\,500 \times 100$

1

$$78 \text{ (\%)}$$

1

(b) expected mass of aluminium

$$1950 \times 54 / 102$$

1

$$= 1032.35$$

1

mass not collected

$$1032.35 - 1\,000$$

$$= 32.4$$

allow 32.4 with no working shown for 3 marks

1

incorrect number of sig. figs max 2 marks

(c) because oxygen is formed at the anode

1

which reacts with the carbon anode to produce carbon dioxide

1

and wears it away

1

(d) $\text{power} = 1.5 \times 10^5 \times 4$

1

$$= 6.0 \times 10^5 \text{ W}$$

1

$$24 \text{ hours} = 24 \times 60 \times 60 = 8.64 \times 10^4 \text{ seconds}$$

1

$$\text{energy transferred} = 6.0 \times 10^5 \times 8.64 \times 10^4$$

allow ecf from power calculation

1

$$= 5.184 \times 10^{10}$$

allow 5.184×10^{10} with no working for **5** marks

1

(e) 3 moles of electrons are needed to produce 27 g or 0.027 kg aluminium

1

so moles of electrons to produce 1 000 kg = $1\,000 / 0.027 \times 3$

1

= 111 000

allow 111 000 with no working shown for **3** marks

1

incorrect no. of sig. figs max **2** marks

[16]

M3.(a) (i) calcium oxide

in either order

1

carbon dioxide

accept correct formulae

1

(ii) $\text{C(s)} + \text{CO}_2\text{(g)} \rightarrow 2\text{CO(g)}$

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 $\text{Fe}_2\text{O}_3 = 1.875 (\times 10^6)$ or $300 / 160$

moles of Fe = $3.75 (\times 10^6)$ or $2 \times \text{moles Fe}_2\text{O}_3$

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 / $\text{Al}^{3+} + 3\text{e}^- \rightarrow \text{Al}$

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 $\text{C} + \text{O}_2 \rightarrow \text{CO}_2$ gains 1 mark (M3)

1

[13]

M4.(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

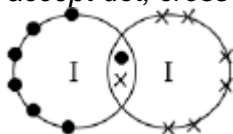
ignore cost

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

max 2 if incorrect structure or bonding or particles

accept small molecules

accept simple / small molecular structure

1

with intermolecular forces

accept forces between molecules

must be no contradictory particles

1

which are weak **or** which require little energy to overcome – must be

linked to second marking point

reference to weak covalent bonds negates second and third marking points

1

(iii) iodine has no delocalised / free / mobile electrons or ions

1

so cannot carry charge

if no mark awarded iodine molecules have no charge gains 1 mark

1

[14]