

Electrolysis

Mark Scheme 2

Level	IGCSE(9-1)
Subject	Chemistry
Exam Board	Edexcel IGCSE
Module	Single Award (Paper 2C)
Topic	Principles of Chemistry
Sub-Topic	Electrolysis
Booklet	Mark Scheme 2

Time Allowed: 51 minutes

Score: /42

Percentage: /100

Grade Boundaries:

9	8	7	6	5	4	3	2	1
>90%	80%	70%	60%	50%	40%	30%	20%	10%

Question number		Answer	Notes	Marks
1	a i	M1 (A) reduced AND (B) oxidised	<p>If first column blank, M1 can be scored from words in second column: eg reduction is gain of electrons in 2nd column for A scores M2 oxidation is gain of oxygen in 2nd column for B scores M3 Both above statements would score M1 as well</p> <p>If M1 wrong way round, then 0/3</p> <p>If 1st column has oxidation $\times 2$ or reduction $\times 2$, then no M1, but it will sometimes be possible to award either M2 or M3 for a correct matching statement.</p>	1
		M2 (A) gain of electrons	If species identified, must be correct, eg not aluminium gains electrons Ignore reference to loss of oxygen	1
		M3 (B) gain of oxygen	Ignore reference to loss of electrons	1
	ii	M1 $2\text{O}^{2-} \rightarrow \text{O}_2 + 4\text{e}^{(-)}$	Both formulae correct and on correct sides of equation	1
		M2	Balancing including electrons	1
			Accept electrons lost on LHS Accept $\text{O}^{2-} \rightarrow \text{O} + 2\text{e}^{(-)}$ followed by $2\text{O} \rightarrow \text{O}_2$	
	iii	electrodes burn /get smaller / decrease (in mass) / have to be replaced	Ignore erode / corrode / wear / damage	1

Question number			Answer	Notes	Marks
1	a	iv	M1 coke	Ignore coal / carbon Reject other raw materials such as limestone/haematite	1
			M2 produces heat / exothermic (reaction)	M2 independent Accept makes carbon dioxide which then produces CO/reducing agent	1
	b	i	carbonating drinks / in drinks		1
			M2 soluble (in water) / reacts with water	M2 dependent on M1 Accept just solubility, ignoring qualifying statements such as only slightly soluble, or only dissolves under pressure	1
			M3 fire extinguishers / putting out fires		1
			M4 denser than air / does not support combustion	Accept denser than oxygen Ignore does not burn M4 dependent on M3 Ignore references to covering / sitting on fire	1
				Accept M1+M2, and M3+M4 reversed	

Question number			Answer	Notes	Marks	
1	b	ii	M1	$\text{SO}_2 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{SO}_3$	Accept $\text{SO}_2 + \text{H}_2\text{O} + \frac{1}{2}\text{O}_2 \rightarrow \text{H}_2\text{SO}_4$	1
					Do not accept unconventional formulae such as SO_3H_2	
			M2	adverse effect on plants/trees/crops/vegetation OR adverse effect on fish / water animals / aquatic life OR adverse effect on iron/steel/metal OR adverse effect on stonework/limestone/marble	eg kills / harms / damages / destroys / stunts growth eg kills / harms / damages / destroys / reduces fish population eg damages / causes rusting/corrosion eg causes corrosion / damages Not just buildings/structures/statues Ignore changes in pH Ignore effects on animals/birds Ignore just habitats Do not accept burning/weathering/erosion as adverse effects Not just affects plants/fish/etc	1
					Do not apply list principle	

Question number		Answer	Notes	Marks
1	c	M1 $M_r(\text{PbCO}_3) = 267 / A_r(\text{Pb}) = 207$	Accept 414 for Pb	1
		M2 $n(\text{PbCO}_3) / n(\text{Pb}) = 1.87 \text{ mol}$	Accept 1.9	1
		M3 $m(\text{Pb}) = 387 - 388 \text{ g}$		1
		OR		
		M1 $M_r(\text{PbCO}_3) = 267 / A_r(\text{Pb}) = 207$		1
		M2 $m(\text{Pb}) = \frac{207 \times 500}{267}$		1
		M3 $m(\text{Pb}) = 387 - 388 \text{ g}$		1
		OR		
		M1 $M_r(\text{PbCO}_3) = 267 / A_r(\text{Pb}) = 207$		1
		M2 $\% \text{ Pb} = \frac{207 \times 100}{267} = 77.5 \%$		1
		M3 $m(\text{Pb}) = 500 \times 0.775 = 387.5 \text{ g}$		1
			Correct final answer with or without working scores 3 Accept answer in kg Apply ECF throughout Accept other valid methods 774-776 scores 2	
			Total	17

Question number	Answer	Notes	Marks
2 (a)	<p>M1 coke</p> <p>M2 limestone</p> <p>accept answers in either order</p>	<p>ignore 'carbon' / 'charcoal'</p> <p>ignore 'calcium carbonate'</p> <p>ignore formulae</p>	2
(b) (i)	<p>$\text{Fe}_2\text{O}_3 + 3\text{CO} \rightarrow 2\text{Fe} + 3\text{CO}_2$</p> <p>M1 all formulae correct</p> <p>M2 balanced</p>	<p>M2 dep on M1</p>	2
(ii)	<p>M1 iron / Fe</p> <p>M2 (it has) lost oxygen</p>	<p>M2 dep on M1 or near miss eg Fe_2O_3 accept 'iron (III) ions / Fe^{3+} has gained electrons' accept 'oxidation number of iron decreases / oxidation number of iron changes from +3 to 0'</p>	2
(c) (i)	$\text{C} + \text{O}_2 \rightarrow \text{CO}_2$		1
(ii)	C (neutralisation)		1

(d)	(i)	M1 oxygen M2 water	accept 'air' accept 'moisture' / 'water vapour' ignore 'steam' accept answers in either order	2
	(ii)	prevents oxygen/water from coming into contact with the iron	accept refs to acting as a barrier	1
(e)	(i)	galvanising	ignore 'sacrificial protection'	1
	(ii)	M1 zinc is more reactive than iron / loses electrons more readily M2 (and therefore) corrodes in preference (to the iron)	ignore 'sacrificial protection' accept 'reacts (with oxygen/water) in preference (to the iron)' accept refs to zinc converting iron(II) ions to iron (atoms) reject 'zinc rusts' for M2	2
(f)	(i)	(aluminium/it) is too reactive / more reactive than carbon / <u>above</u> carbon in the reactivity series	accept 'carbon is less reactive than aluminium' accept 'the temperature required is too high' ignore refs to carbon monoxide	1
	(ii)	energy costs are too great / electricity is expensive	allow 'it is cheaper to use the blast furnace' ignore refs to iron being below carbon in the reactivity series	1

Question number	Answer	Notes	Marks
3 b i	B (the products are both elements)		1
ii	electrons on wrong side / should be on right /should be $- 2e^-$ $2Br$ should be Br_2	Accept + in front of electrons (should be $-$) Accept product is shown as a bromine atom / should be shown as a bromine molecule Equation correctly rewritten scores both marks	1 1
iii	ions stop moving / ions not free to move OR electrons stop moving (through wires)	Ignore liquid becomes solid / no free ions Accept electric current in place of electrons Reject implication that electrons stop flowing through liquid	1
Total 9 marks			