

Question number	Answer	Accept	Reject	Marks
1 (a)	M1 (negative electrode) – graphite M2 (positive electrode) – graphite	carbon carbon		2
(b) (i)	it/aluminium oxide/alumina has a (very) high m. IGNORE high b.pt/references to strong bonding/bauxite has a high m.pt/lot of energy needed to melt it		aluminium has a high melting point	1
(ii)	aluminium oxide/alumina is dissolved in/mixed with (molten/liquid) cryolite IGNORE cryolite lowers the m.pt of aluminium oxide/alumina	added to Na_3AlF_6 for cryolite cryolite is used as the solvent (for aluminium oxide/alumina)	aluminium is dissolved in cryolite	1
(c)	M1 reduction M2 (it/aluminium ions/ Al^{3+}) gain of electron(s) IGNORE references to loss of oxygen M2 dep on M1	reacts with/combines with decrease in oxidation number/oxidation number changes from +3 to 0	redox for M1 only Al/aluminium gains electrons	1 1
(d)	M1 oxygen formed/produced (at the positive electrode/anode) IGNORE oxygen from the aluminium oxide M2 reacts with the carbon/the (positive) electrode M2 not dep on M1 , but must mention oxygen	oxygen from the electrolysis anode / graphite	any indication that the oxygen is from the air for M1 only cathode/negative electrode	1 1
(e)	Any two from: M1 malleable M2 low density	easy to shape/easy to bend/easy to extrude bend		2

	M3 does not react <u>with food/drink(s)</u>	non-toxic/does not corrode		
	IGNORE light(er)/high strength to weight ratio/references to cost/lightweight/does not rust			
			Total	10

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2 (a)	(i) electrolysis		1
	(ii) carbon / graphite		1
	(iii) negative		1
	(iv) cryolite solvent (for alumina)	Accept Na_3AlF_6 Reject to lower melting or boiling point of alumina / aluminium oxide / aluminium	1 1
	OR to lower operating temperature / to lower melting point of mixture / electrolyte	Ignore refs to boiling point of mixture / electrolyte Accept to reduce (heat) energy requirement Accept to increase conductivity of electrolyte Ignore references to boiling point Reject acts as catalyst M2 indep of M1	
(b)	(i) oxygen / O_2	Ignore O	1
	(ii) decreases capacity of blood to carry oxygen	Accept correct reference to haemoglobin / oxyhaemoglobin / carboxyhaemoglobin Accept ref to CO bonding to red blood cells but not to <u>white</u> blood cells	1
	(iii) (pass through) limewater / calcium hydroxide solution turns milky / cloudy / white	Ignore incorrect formulae eg CaOH Accept $\text{Ca}(\text{OH})_2$ solution / $\text{Ca}(\text{OH})_2(\text{aq})$ but not just $\text{Ca}(\text{OH})_2$ Accept chalky / white ppte etc Ignore refs to later going clear M2 dep on M1	1 1

2	(c)	(i)	(positive) ions / cations / Al ³⁺	Do not accept atoms / negative ions / anions as alternative	1
			(delocalised) electrons		1
		(ii)	layers of ions/particles	Accept planes / sheets / rows Do not penalise atoms instead of ions here Reject molecules / protons / electrons	1
			slide over each other	Accept explanation in terms of non-directional bonding Do not award mark if wrong particles named, eg protons / electrons	1
		(iii)	delocalised / sea of electrons move (through structure) / mobile	Accept free "ions free to move" scores 0	1 1
		(iv)	low density / high strength to weight ratio	Ignore light Accept lightweight / not dense	1

Total 16 marks

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3 (a)	<p>M1 chromate (ions) are negative</p> <p>M2 so they are attracted/move towards positive electrode/electrode B</p>	<p>accept 'anions'</p> <p>accept 'anode'</p>	2
(b) (i)	2 2 (1) (1)	accept halves and multiples	1
(ii)	B (HCl(aq))		1
(c) (i)	aq aq aq s	Do not accept words eg aqueous	1
(ii)	<p>M1 filter (off the precipitate)</p> <p>M2 wash (with distilled/deionised/pure water)</p> <p>M3 dry in a warm oven / leave to dry / dry with filter paper</p>	<p>allow 'decant'</p> <p>reject refs to crystallisation for M2 and M3</p> <p>allow 'heat it'</p>	3