

- 1 (a) alumina **or** aluminium oxide [1]
sodium aluminate [1]
iron(III) oxide [1]
filtration **or** centrifuge NOT conditional [1]
- (b) from left to right:
carbon cathode **or** carbon negative electrode [1]
900 to 1000°C [1]
aluminium [1]
cryolite [1]
- (c) (i) $Al^{3+} + 3e = Al$ [2]
not balanced [1]
 $Al^{3+}(aq) = 0$
- (ii) oxygen is formed **NOT** oxide [1]
reacts with carbon anode [1]
- (d) (i) low density **or** light or resistant to corrosion [1]
accept strength/weight ratio **or** alloys are strong
strong on its own is neutral
- (ii) not attacked **or** corroded **or** unreactive
oxide layer
easily shaped **or** malleable **or** ductile
any **TWO** [2]
- (iii) for strength **or** so it does not break **or** does not sag **or** can have pylons further apart [1]
NOT steel is a better conductor
NOT aluminium protects steel from rusting

[Total: 16]

- 2 (a) (i) bauxite [1]
- (ii) to reduce melting point **or** improve conductivity
or as a solvent **or** reduce the working temperature [1]
- (iii) carbon dioxide **or** monoxide **or** fluorine [1]
- (b) aluminium [1]
- (ii) solution goes colourless **or** copper formed
or a brown solid forms **or** blue colour disappears
or bubbles
NOT goes clear **or** copper formed [1]
- (iii) covered with an oxide layer [1]
- (c) reaction no reaction [1]
reaction reaction [1]
- (d) $2Al(OH)_3 = Al_2O_3 + 3H_2O$ [2]
Not balanced [1]
- (ii) Aluminium nitrate = aluminium oxide + nitrogen dioxide + oxygen
only TWO correct products [1] [2]

TOTAL = 12

- 3 (Has to be three different uses.
- any use that depends on malleability **or** ductility-
jewellery, pipes, wires, sheets, roofing, ornaments [1]
NOT that it is malleable **or** ductile
- electrical wires **or** cooking utensils **or** electrodes [1]
(good) conductor
- making alloys **or** named alloy [1]
- (b) ($Cu^{2+} + 2e = Cu$ [1]
- (ii) gas is oxygen [1]
- (copper(II) sulphate) changes to sulphuric acid
or copper ions removed from solution [1]
- (c) copper atoms - electrons = copper ions [1]
accept correct symbol equation
- (ii) concentration of copper ions does not change **or** [1]
amount **or** number of copper ions does not change
- copper ions are removed and then replaced [1]
or copper is transferred from anode to cathode
- (iii) refining copper **or** plating (core) [1]
or extraction of boulder copper

Question	Answer	Marks
4(a)	M1 substance that speeds up a reaction/increases rate; M2 unchanged (chemically) at the end/not used up/lowers activation energy/provides alternative pathway;	2 1 1
4(b)	M1 too slow/slower; M2 lower yield/less product(s)/equilibrium shifts to left/equilibrium shifts in direction of reactants/backward reaction favoured/reverse reaction favoured;	2 1 1
4(c)	fa /increase rate;	1
4(d)	lo yield/less product(s)/equilibrium shifts to left/equilibrium shifts in direction of reactants/backward reaction favoured/reverse reaction favoured; OR higher cost/expensive; OR safety risks;	1
4(e)(i)	M1 breakdown of an ionic compound when molten or in aqueous solution; M2 (using) electricity/electric current/electrical energy;	2 1 1
4(e)(ii)	/graphite/platinum;	1

Question	Answer	Marks
4(e)(iii)	$2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$; OR $2\text{H}_3\text{O}^+ + 2\text{e}^- \rightarrow \text{H}_2 + 2\text{H}_2\text{O}$;	1
4(e)(iv)	/negative electrode;	1
4(e)(v)	M1 damp blue litmus paper; M2 bleaches/loses colour/turns white/turns colourless;	1 1
4(f)	$2\text{NaCl} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{H}_2 + \text{Cl}_2$ all formulae correct; balancing;	2
4(g)	M1 chlorine: treating (drinking) water/treating water in swimming pools/kill bacteria in water/chlorination of water/ (manufacture of) paper products/plastics/PVC/dyes/textiles/medicines/antiseptics/insecticides/herbicides/ fungicides/solvents/paints/disinfectant/bleach/hydrochloric acid; M2 sodium hydroxide: drain cleaner/oven cleaner/extraction of aluminium/purification of bauxite/(manufacture of) biodiesel/paper/ soap/detergents/washing powder/textiles/dyes; M3 hydrogen: fuel/rocket fuel/fuel cells/in welding/(manufacture of) ammonia/ NH_3 /margarine/methanol/hydrochloric acid/ refrigerants;	1 1 1