

- 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 [2]  
oxide layer  
easily shaped **or** malleable **or** ductile  
any **TWO**
- (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 [1]  
**NOT** goes clear **or** copper formed  
(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 [2]  
only TWO correct products [1]

**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)	<b>M1</b> substance that speeds up a reaction/increases rate; <b>M2</b> unchanged (chemically) at the end/not used up/lowers activation energy/provides alternative pathway;	2 1 1
4(b)	<b>M1</b> too slow/slower; <b>M2</b> 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; <b>OR</b> higher cost/expensive; <b>OR</b> safety risks;	1
4(e)(i)	<b>M1</b> breakdown of an ionic compound when molten or in aqueous solution; <b>M2</b> (using) electricity/electric current/electrical energy;	2 1 1
4(e)(ii)	/graphite/platinum;	1

Question	Answer	Marks
4(e)(iii)	$2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$ ; <b>OR</b> $2\text{H}_3\text{O}^+ + 2\text{e}^- \rightarrow \text{H}_2 + 2\text{H}_2\text{O}$ ;	1
4(e)(iv)	/negative electrode;	1
4(e)(v)	<b>M1</b> damp blue litmus paper; <b>M2</b> 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)	<b>M1 chlorine:</b> 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;  <b>M2 sodium hydroxide:</b> drain cleaner/oven cleaner/extraction of aluminium/purification of bauxite/(manufacture of) biodiesel/paper/ soap/detergents/washing powder/textiles/dyes;  <b>M3 hydrogen:</b> fuel/rocket fuel/fuel cells/in welding/(manufacture of) ammonia/ $\text{NH}_3$ /margarine/methanol/hydrochloric acid/ refrigerants;	1  1  1