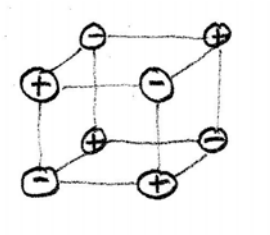
Question number	Answer	Notes	Marks
1 (a)	ethanol/it is more volatile/evaporates more quickly/more easily/evaporates in a shorter time	Accept has a lower boiling point (than water) Ignore reference to melting point(s) Accept reverse arguments for water	1
(b) i	0.3(0) (g)		1
ii	some copper did not stick to (negative) electrode/cathode	Accept some copper dropped off	2
	some copper removed during washing/ drying ~~pos~~itive electrode/anode impure OR formed (anode) sludge	Any two for 1 each	

Question number	Answer	Notes	Marks
1 (c) i	all 9 points plotted correctly to nearest gridline	Deduct 1 mark for each error Award these marks if points too faint to be seen under correct line Ignore point at 0.55	
	straight line of best fit	Must be drawn with a ruler Must go through origin Ignore extrapolation beyond (16,0.5)	
ii	point at (7.40, 0.20) circled		
iii	no charge/current/electricity passed AND no copper deposited/no change in mass/no electrolysis	OWTTE, eg charge = 0, so mass (increase) = 0 Ignore references to direct proportion	
iv	line is straight / fixed gradient AND goes through origin	Ignore re-statements of the information given in the question, eg the greater the charge, the greater the mass (increase)	
v	graph line extrapolated to (at least) 0.55 correct value from candidate graph	Probably 17.4 - 17.8 M2 not dependent on extrapolation	
		Total	**12**

Question number				Answer	Notes	Marks
2	a	(i)	M1	arrow pointing towards negative electrode	Accept by X / on wire / by power supply (as long as pointing in correct direction	1
		(ii)	M1	hydrogen / H_2	Ignore H	1
		(iii)	M1	$4OH^- \rightarrow 2H_2O + (1)O_2 + 4e^-$	Accept fractions and multiples Accept e in place of e^- Accept equation with $– 4e^-$ on LHS	1
	b	(i)	M1	18 ÷ 24000	If division by 24 in place of 24000, no M1 but award M2 for 0.75 No marks for any calculation involving 35.5 or 71 Correct final answer scores 2 marks	1
			M2	0.00075 / 7.5 x 10^{-4}		1
		(ii)	M1	(b)(i) × 96500 × 2	CQ on (b)(i)	1
			M2	Answer in range 140 - 145 using 0.00075	Correct final answer scores 2 marks Accept answer in range 70 – 72.4 for 1 out of 2 No marks if no use of 96500 or no use of answer from (b)(i)	1

Question number				Answer	Notes	Marks
2	c	(i)	M1	bromine / Br / Br_2	Reject bromide / Br^-	1
		(ii)	M1	reduction <u>and</u> oxidation (at the same time)	Accept oxidisation Ignore oxygenation Accept loss <u>and</u> gain of electron(s) Reject loss of electrons by chlorine (molecules) / gain of electrons by bromide (ions) Reject reduction is loss of electrons / oxidation is gain of electrons Ignore references to other reaction types, eg displacement / reversible Ignore references to atoms / ions / molecules / elements	1

Question number				Answer	Notes	Marks
2	d	(i)	M1	reversible / can go in both directions / (both) forward and reverse reactions can occur	Accept just reference to reverse direction, eg reaction goes backwards / reaction goes in opposite direction Ignore equilibrium	1
		(ii)	M1	shifts to right / moves in forward direction / favours forward reaction/direction	Accept more PCl_5 / product (formed) Ignore references to rates M1 can be awarded in explanation part	1
			M2	fewer moles/molecules (of gas) on right / more moles/molecules (of gas) on left / 2 moles/molecules on left and 1 on right / favours side with fewer moles/molecules	Accept particles, but not atoms, in place of molecules Ignore references to pressure, volume and le Chatelier's principle Do not award M2 if M1 if shift is to left or no change	1
						Total 12 marks

Question number			Answer	Notes	Marks
3	(a)			M1 for front face all correct M2 for rear face all correct M2 DEP on M1 Do not penalise X in place of + Ignore symbols such as K and Cl Do not penalise use of Na^+ in place of K^+	2
	(b)	(i)	M1 (damp blue/red) litmus (paper) M2 bleached / goes colourless / goes white	Ignore red as intermediate colour Accept use of universal indicator (paper) / pH paper	2
		(ii)	$2H_2O + 2e^- \rightarrow H_2 + 2OH^-$ OR $2H^+ + 2e^- \rightarrow H_2$	M1 for H_2O on lhs AND H_2 and OH^- on rhs and no other formulae M1 for H^+ on lhs AND H_2 on rhs and no other formulae M2 for $e^{(-)}$ and balancing of correct equation Accept M1 $H^+ + e^- \rightarrow H$ M2 $2H \rightarrow H_2$ M2 DEP on M1 Ignore state symbols	2

		(iii)	M1 alkaline / alkali formed M2 OH^-	Accept pH above 7 Ignore names Mark independently	2

Question number			Answer	Notes	Marks
3	(c)	(i)	0.0250 ÷ 2 / 0.0125 (mol)		1
		(ii)	M1 24 × 0.0125 OR 24000 × 0.0125	CQ on (c)(i)	
			M2 0.3(0) dm^3 / 300 cm^3 / 0.0003(0) m^3	Unit needed for M2 Accept 1 or more significant figures Correct final answer with no working scores (2)	2
				Total for Question 3	**11**

Question number	Answer	Accept	Reject	Marks
4 (a)(i)	(damp / moist) litmus paper bleaches / turns white **OR** (damp / moist) starch-iodide paper turns blue / black (allow observation mark only for starch-iodine paper) **OR** (bubble through) (potassium) iodide solution (solution) turns brown (ignore the starting colour)	 decolourised / loses its colour orange / orange-brown / red-brown	 yellow / red	1 1 1
(ii)	hydrogen	H_2 / H^2 / H2 / h_2 / h^2 / h2	H / 2H / h / 2h	
(b)	(solution is) alkali(ne) / hydroxide ions (present) / OH^- ignore references to sodium ions	sodium hydroxide / NaOH (is present)	any other named ion or substance	1

Question number	Answer	Accept	Reject	Marks
4 c) (i)	(10 / 2) = 5			1
(ii)	(5 x 24)			1
	= 120 dm^3 (units required)	12000 cm^3		1
	mark part (ii) consequentially on part (i) award second mark only for use of 22.4 Final answer must be to 2 or more sig fig			
			Total	**7**

Question number				Answer	Notes	Marks
5	a	(i)	M1	Iron(III) oxide	Accept Iron oxide / ferric oxide Ignore formula whether right or wrong	1
		(ii)	M1	calcium carbonate	Ignore formula whether right or wrong	1
	b	(i)	M1	A		1
		(ii)	M1	E		1
		(iii)	M1	B		1
		(iv)	M1	C		1
	c		M1	slag	Accept calcium silicate Ignore formula	1
	d	(i)	M1	aluminium/it is more reactive than iron/carbon OR above iron/carbon in reactivity series OR cannot be reduced by/does not react with carbon (monoxide) OR cannot be displaced by carbon	Comparison with iron or carbon must be stated or implied, eg not just aluminium is (very/too) reactive Accept reverse argument for iron	1
		(ii)	M1	(cost of) electricity	Accept keeping electrolyte molten Accept high current Ignore energy Ignore references to electrode replacement	1

Question number				Answer	Notes	Marks
5	e		M1	electrode(s) / to conduct electricity	Accept cathode / anode	1
	f		M1	$Al^{3+} + 3e \rightarrow Al$	M1 for both aluminium formulae on correct sides of equation M2 for both oxygen formulae on correct sides of equation M3 for balancing both equations even if one or both reversed	3
			M2	$2O^{2-} \rightarrow O_2 + 4e$ / $2O^{2-} - 4e \rightarrow O_2$		
			M3			
					Accept in either order	
					Total 13 marks	