1) B (1)
2) C (1)
3) D (1)
4) A (1)
5) A (1)
6) B (1)
7) D (1)
8) D (1)
9) A (1)
10) A (1)
11) C (1)
12) B (1)
13)

(a) (i)	$2Al(s) + 2OH^-(aq) + 2H_2O(l) \rightarrow 2AlO_2^-(aq) + 3H_2(g)$	$2O_2^{2-}(aq)$	**1**

Question Number	Acceptable Answers	Reject	Mark
(a)(ii)	$\frac{2 \times 10}{1000} = 0.02 / 2 \times 10^{-2}$ Ignore trailing zeroes		**1**

Question Number	Acceptable Answers	Reject	Mark
(a)(iii)	$0.02 / 2 \times 10^{-2}$ Accept TE answer to (ii)		**1**

Number			
(a)(iv)	$0.02 \times 27.0 = 0.54 / 5.4 \times 10^{-1}$ (g) TE answer to (iii) OR (ii) x 27.0 Ignore sf except 1	Other unit	**1**

Question Number	Acceptable Answers	Reject	Mar
(a)(v)	$(1.1 \times 0.54) = 0.59(4) / 5.9(4) \times 10^{-1}$(g) TE answer to (iv) x 1.1 Ignore sf except 1 Only penalise sf once		**1**

(a)(vi)	**Potassium hydroxide / KOH** (solution) is corrosive / burns / caustic **OR** **KOH** damages / harms / is harmful to / dissolves / reacts with **skin / eye(s)** **(1)** **OR** **KOH** in **eye(s)** **(1)** **Ignore** Harmful, irritant, highly reactive alone **Hydrogen / H_2** is flammable / explodes / explosive **(1)** Allow mention of both potassium hydroxide and hydrogen alone scores **(1)** Allow Al foil can cut your skin **(1)** Correct answer with additional incorrect chemistry e.g. KOH is oxidising so corrosive scores **(0)**	Toxic, carcinogenic, alone or in combination with correct answer Burns alone Additional chemicals	**2**

Question Number	Acceptable Answers	Reject	Ma
(b)(i)	$KAlO_2(aq) + 2H_2SO_4(aq) \rightarrow KAl(SO_4)_2(aq) + 2H_2O(l)$ Allow multiples		**1**

Question Number	Acceptable Answers	Reject	Ma
(b)(ii)	$\frac{2 \times 1000 \times 0.02}{1} = 40\ (cm^3)$ Allow 0.04(0) **dm^3** TE answer to (a)(ii) x 2000 and TE from (b)(i)		**1**

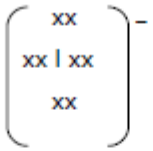
(b)(iii)	Litmus (paper / solution) **(1)** Red / pink (in acid) **(1)** OR any other named acid-base indicator including universal indicator **(1)** with a correct acidic colour **(1)** NB phenolphthalein must be spelt correctly to score **(1)** and no mark for colour Notice that other indicators only require recognisable spellings Red litmus turns blue scores for the indicator **(1)** OR pH meter / universal indicator **(1)** with value < 7 **(1)** NB measure pH alone (0) pH < 7 **(1)** OR add a (metal) carbonate / suitable metal eg Mg **(1)** bubbles / fizzing **(1)** Calculation of amounts / moles of **both** reactants (1 maximum)		**2**

(b)(iv)	**Each point must be made in full** **The second and final scoring points, which are asterisked, can only be gained through these statements. Two further marks can be scored for any two of the other four points.** 1 Filter (to remove any aluminium / impurities) **(1)** NB This mark can only be awarded if it is the first action **and** the mixture is subsequently heated. 2 *Boil / heat / evaporate to reduce the volume of water **(1)** NB boil / heat to remove water only gets the mark if it is clear, subsequently, that some solution is left 3 Cool / set aside / leave to allow crystals to form **(1)** 4 Filter OR pick out / remove / take out crystals (to separate) **(1)** 5 Wash with a **little/cold** water **(1)** 6 *Place between filter papers / dab with paper towel / use dessicator (to dry) **(1)**	Leave in the sun If boiled to dry stop marking here Heat in oven	**4**

Question Number	Acceptable Answers	Reject	Ma
(b)(v)	White / colourless Ignore clear / transparent / cloudy / opaque e.g. accept clear and colourless	Any other colours with or without white	**1**

Number			
(b)(vi)	Cr^{3+}/ Fe^{3+}/ Sc^{3+} / Ga^{3+} Accept any feasible triply positive metal ion Allow B^{3+} Allow any name or symbol for a Group 3 element Allow named existing transition metal ions with (III) after the name (if they exist) Fully correct formula for an alum or intermediate starting entity Eg $KGa(SO_4)_2$ / $KGaO_2$	Al^{3+} and anything else Group 3 element with incorrect charge	**1**

14)

(a)	[:Li]$^+$ (1)  (1) Accept all or mixture of dots and crosses **Check inner electrons present on lithium** If no element symbols but fully correct with Li first give **1 max** If no / incorrect charge(s) if the electrons are correct **1 max** If arrow drawn from third / outer shell electron on lithium to join electrons in iodine / iodide with correct charges scores **1 max** Brackets are not essential		**2**

Question Number	Acceptable Answers	Reject	Mark
(b)	Li(s) **and** $Li^+(g)$ **and** $I^-(g)$ **(1)** $\frac{1}{2}I_2(s)$ **and** I(g) **(1)** $(\Delta H_{at})[\frac{1}{2}I_2(s)]$ **(1)** Notice the square brackets are essential for this mark If wrong state for iodine element ie if $\frac{1}{2}I_2(g/l)$ and consistent $(\Delta H_{at})[\frac{1}{2}I_2(g/l)]$ allow third mark If I(s) given for element and (ΔH_{at}) [I(s)] allow third mark If wrong state with monatomic iodine both the last two marks lost If $Li^+(g)$ + e appears ignore electron		**3**

(c)	**First mark for one of:** −270 = + 159 + 107 + 520 + electron affinity − 759 Or Electron affinity = −270 − (159 + 520 + 107 − 759) **(1)** OR Electron affinity = −270 - 159 - 520 - 107 + 759 **(1)** **Second mark for:** (Electron affinity =) −297 (kJ mol^{-1}) **(1)** −297 (kJ mol^{-1}) alone scores **(2)** NB providing method is recognisable with one transcription error eg 795 for 759 and the final answer is consistent **1 max** NB (+) 297 (kJ mol^{-1}) **1 max**	Wrong unit e.g. J	**2**

(d)	(Experimental lattice energy is) more negative / exothermic **(1)** OR Theoretical lattice energy is less negative / exothermic **(1)** OR Recognition that more energy **released** **(1)** Irrespective of first answer then, any two from: Due to a degree of covalency **(1)** Deviation from pure ionic model (in experimental value) OR The theoretical model is pure ionic bonding **(1)** **Polarization / distortion** of the iod**ide** / negative ions (by the lithium ion). Can be shown by diagram **(1)** Iodine/ I / I_2 ion is not acceptable but iodine / I **anion** is allowed Note I_2 anion is not allowed	Greater / less Increase / decrease alone	**3**

(e)	Electron affinities become less negative / less exothermic / more positive (going down Group 7) **(1)** As (added) **electron** further from the nucleus OR **More** shielding / shielded (from the nucleus) **(1)** Second mark stands alone Ignore larger (ionic) radius / atom / ion / charge density	Greater / less / Increase / decrease alone Any indication of ionization/ removing an electron	**2**

15)

(a)(i)	$CuO(s) + 2H^+(aq) \rightarrow Cu^{2+}(aq) + H_2O(l)$ Left hand side (1) right hand side (1) If SO_4^{2-} are on both sides max one mark ALLOW correct entities and balancing with no or incorrect state symbols for one mark. ALLOW multiples It is sometimes difficult to be sure of the '2' on the Cu^{2+}. Give BOD provided $2H^+$ on the left of the equation	Charges within water molecule	**2**

estion mber	Acceptable Answers	Reject	Mar
(a)(ii)	1.749/1.75/1.7 with or without working scores 2 If answer incorrect look for Mass = 79.5 x 0.02 OR =1.59 (1) OR TE from incorrect mass for one mark Their mass x 1.1= their correct answer to 2/3/4SF (g) (1) Accept crossed 7's ALLOW both ways of writing 4 and be generous if 4 looks like 9	1.74 1.8	**2**

estion mber	Acceptable Answers	Reject	Mar
(b)(i)	Add in small portions / use a spatula / use a **small** spoon / slowly / gradually **(1)** To prevent (mixture / acid) boiling over / frothing / spilling / splashing / splash back **(1)** Mark independently Bubbles are neutral IGNORE add carefully / cautiously alone	Spitting / violent reaction / fizzing Because reaction is exothermic alone Bubbles of carbon dioxide	**2**

(b)(ii)	Dip in glass rod. Remove and allow to cool. See if crystals form ALLOW any workable suggestion Examples: See crystals / salt forming around edge of beaker Depth of colour of solution increases Solution / colour becomes darker Solution / colour becomes deeper blue Dark blue solution Reduce volume by at least half / until crystals form	Solution thickens Precipitate forming	1

estion mber	Acceptable Answers	Reject	Ma
(b)(iii)	Blue	Any mention of green or other colour	1

estion mber	Acceptable Answers	Reject	Ma
(b)(iv)	(The ions are arranged in a) regular (way) / lattice OR The ions are arranged in the same way / have same arrangement / have uniform arrangement The term structure is neutral and should be ignored IGNORE statements about ions attracting or repelling	The ions are arranged in a similar / fixed way	1

(c)(i)	249.6 g mol^{-1} ALLOW 249.5 g mol^{-1} ALLOW 250 g mol^{-1} value **(1)** units **(1)** Common wrong values are 159.5 / 6, 185.5 / 6, 249 ALLOW unit mark with any or no value. ALLOW g / mol for unit	 g/mol^{-1}	2

(c)(ii)	Max yield = 249.6 x 0.02 = 4.992(g) **(1)** Percentage yield = $\frac{2.7 \times 100}{4.992}$ = (54.0865) = 54% **(1)** If 249.5 is used = (54.1082) = 54% OR 2.7 / 249.6 = 0.01082 **(1)** Percentage yield = 0.01082 x 100/0.02 = 54% **(1)** ALLOW TE from any value in (i), and note 159.6 gives 84.6% 185.6 gives 72.7% IGNORE SF except one SF Correct answer, no working scores (2)		**2**

estion mber	Acceptable Answers	Reject	Ma
(c)(iii)	(Copper(II) sulfate is soluble) so some remains in solution / some remains on the **filter paper** IGNORE other transfer errors Incomplete crystallization / not all the crystals are formed	Experimental error/ incomplete reaction Filtering alone Efflorescence	**1**
mber			
(d)	This is a (chemical) test for (the presence of) water Invisible ink Moisture / humidity test Test to see if solutions are aqueous	Check to see if substance is hydrated Drying agent Quantitative measurements of water content.	**1**

16)

mber			
.(a)(i)	25 x 4.18 x 11 = 1149.5 (J) ALLOW 1.1495 **kJ** Otherwise ignore units even if incorrect IGNORE sign IGNORE SF except one or two SF	1149.5 **kJ**	**1**

(a)(ii)	-115 kJ mol^{-1} ALLOW -115000 J mol^{-1} Sign with correct value **(1)** Units and three significant figures **(1)** Mark independently ALLOW TE from (i) -114 kJ mol^{-1} (rounding error) scores 1 -115.0 kJ mol^{-1} scores 1 Values of -4600 and -3.86 are quite common ALLOW K and j in any case in units	J or kJ alone	**2**

(b)	$2NaHCO_3(s) \rightarrow Na_2CO_3(s) + CO_2(g) + H_2O(l)$ $2HCl(aq)$ $(2HCl(aq))$ $2NaCl(aq) + 2CO_2(g) + 2H_2O(l)$ **First mark** Arrow from products in top line to lower line and correct entities **(1)** $NaCl + CO_2 + H_2O$ **Second mark** **2**$NaCl$**(aq)** + **2**CO_2**(g)** + **2**H_2O**(l)** Correct state symbols and balancing **(1)** $\Delta H^\circ = +91.6$ OR $+91.7$ (kJ mol^{-1}) ALLOW no positive sign only if correct Working with correct signs given **(3)** OR **Third mark** Correct use of Hess's Law (in numbers or symbols) consistent with arrow direction **(1)** **Fourth mark** **2x**$(-115) = \Delta H^\circ - 321.6$ Correct multiples and numbers **(1)** ALLOW 2 x any number (including -4600 and -3.86) except 2 x +/- 321.6 Notice Third and Fourth marks can be scored by $\Delta H^\circ = 2(-115) - (-321.6)$	**5**

	Fifth mark $\Delta H^{\circ} = 2(-115) - (-321.6)$ $= +91.6$ (kJ mol^{-1}) OR $\Delta H^{\circ} = 2(-114.95) - (-321.6)$ $= +91.7$ (kJ mol^{-1}) Correct value for their calculation with correct sign IGNORE SF except 1 ALLOW no positive sign only if correct working with correct signs given **(1)** Omitting 2x gives +206.6 (could get 4 marks) -4600 gives -598.4 -3.86 gives +313.88		

uestion umber	Acceptable Answers	Reject	Mar
1(c)	((±) 0.5 x 2 x 100 /11) = (±)9.09 (%) ALLOW at 9.0909/9.091/9.1 and 9	 9.10/9.0	**1**
(d)	**First mark** It is used as a raising agent / self raising flour / baking soda / baking powder OR Causes cakes / (soda) bread to rise / expand. **(1)** **Second mark** Carbon dioxide (released on heating causes cakes / bread to rise) OR It reacts with acid to form carbon dioxide (in baking powder) providing bread /cake etc is mentioned **(1)** ALLOW Used in cooking green vegetables To keep green colour	To make pastry rise Bicarbonate of soda Gas Air Neutralizing acid foods	**2**