Question number				Answer	Notes	Marks
1	a	i	M1	bubbles / fizzing / effervescence OR solid/magnesium disappears/dissolves OR flask gets warm	Allow just gas (given off) Ignore wrongly named gas Allow temperature increases but not heat produced	1
		ii	M1	magnesium chloride / $MgCl_2$	Accept phonetic spellings Accept poorly written formulae such as $MGCl_2$ and $MgCL_2$	1
	b	i	M1 M2	$2H_2 + O_2 \rightarrow 2H_2O$	correct formulae = 1 balancing = 1 Ignore heat anywhere Ignore state symbols	1 1
		ii	M1	condensation	Accept phonetic spellings	1
	c	i	M1	blue	Do not accept any other colours even in combination with blue, eg blue-green Accept phonetic spellings Ignore qualifiers such as pale / dark / light Ignore mention of solution / liquid / solid	1

Question number				Answer	Notes	Marks
1	c	ii	M1	measure boiling point / melting/freezing point OR distil / boil / freeze	Ignore heat and cool	1
			M2	100 ºC / 0 ºC	Value must match property Accept º or C in place of ºC Do not award M2 if only value given Ignore evaporates M2 dependent on M1	1

Total 8 marks

<table>
<tr><th>Question number</th><th>Answer</th><th>Notes</th><th>Marks</th></tr>
<tr><td>2 (a) (i)</td><td>

NB H does not need to be shown if touching / overlapping circles are shown</td><td>ACCEPT any combination of dots and crosses

if overlapping / touching circles used both electrons must be within the overlapping/touching area</td><td>1</td></tr>
<tr><td>(ii)</td><td>M1 weak forces (of attraction) between molecules / weak intermolecular forces

M2 (therefore) little (thermal/heat) energy required to overcome these forces / separate the molecules (into the gaseous state)</td><td>ACCEPT particles
ACCEPT bonds for forces for both M1 and M2
ACCEPT correctly named IMF

IGNORE more easily separated / easier to break

REJECT atoms for both M1 and M2

NB any mention of breaking covalent or ionic bonds scores 0</td><td>2</td></tr>
<tr><td>(b) (i)</td><td>M1 <u>atoms</u> of the same element

M2 with different masses</td><td><u>atoms</u> with same atomic number / <u>atoms</u> same number of protons

different mass numbers / different numbers of neutrons

IGNORE references to electrons unless incorrect</td><td>2</td></tr>
<tr><td>(ii)</td><td><table><tr><th></th><th>^{1}H</th><th>^{2}H</th><th>^{3}H</th></tr><tr><td>protons</td><td>1</td><td>1</td><td>1</td></tr><tr><td>neutrons</td><td>0</td><td>1</td><td>2</td></tr><tr><td>electrons</td><td>1</td><td>1</td><td>1</td></tr></table></td><td>one mark for each correct row</td><td>3</td></tr>
</table>

Question number	Answer	Notes	Marks
(c) (i)	exothermic		1
(ii)	$2H_2 + O_2 \rightarrow 2H_2O$ **M1** all formulae correct **M2** balanced	ACCEPT multiples and halves IGNORE state symbols even if incorrect	2
(iii)	**M1** (add to) anhydrous/white copper(II) sulfate **M2** turns blue **M2** dep on **M1** or near miss	turns copper(II) sulfate from white to blue scores 2 ACCEPT equivalent description of test with anhydrous cobalt(II) chloride (blue to pink) IGNORE any references to testing with indicators	2
(iv)	**M1** measure/determine the boiling point **M2** 100 °C **OR** **M1** measure/determine the melting/freezing point **M2** 0 °C **OR** **M1** measure/determine the density **M2** 1 g/cm^3	ACCEPT boil the water / heat until it boils it boils at 100 °C ALLOW "heat it and it boils at 100 °C " for 2 ACCEPT freeze the water / cool until it freezes it freezes at 0 °C ALLOW "cool it and it freezes at 0 °C " for 2	2

Question number	Answer	Notes	Marks
3 a	$CaCl_2$(**aq**) + H_2SO_4(**aq**) → $CaSO_4$(**s**) + 2HCl(**aq**)	All four must be correct to score Do not penalise upper case letters	1
b		M1 filter paper in filter funnel Do not penalise inappropriate size M2 everything else correct Not essential that funnel touches flask Reject beaker/tube for M2 Ignore labels Ignore relative sizes	2
c i	Ca^{2+} / calcium (ion)	Reject Ca with incorrect or missing charge Mark (i) and (ii) independently	1
ii	calcium sulfate/$CaSO_4$ is partially/slightly soluble OR contains unreacted/excess calcium chloride/$CaCl_2$ (solution)	Accept <u>unreacted/excess</u> calcium ions	1

Question number	Answer	Notes	Marks
3 d i	white precipitate	Accept solid / ppt / ppte / suspension in place of precipitate Reject other colours Reject other observations eg fizzing Ignore cloudy/milky/grey	1
ii	silver chloride	Accept correct formula Ignore incorrect formula Award both marks if both answers in either (i) or (ii)	1
iii	(hydrochloric/sulfuric) acid / H^+ there OR solution acidic	Accept because there are no other ions that could form a precipitate Accept no carbonate/hydroxide (ions)	1
e	M1 wash/rinse (with water) M2 leave it (to dry) / leave in a warm place / place in an oven / place in desiccator / heat it / dry with absorbent paper (eg kitchen/filter/blotting)	Reject methods that refer to filtrate /solution /crystallisation Ignore other named solvents Accept leave on a window ledge Ignore evaporate it / boil it Award 1 mark for both M1 and M2 correct but in wrong order	2
			Total 10 marks

Question number			Answer	Notes	Marks
4	a		bromine: (red-)brown fluorine: gas AND astatine: solid	Accept red Reject orange / yellow	1 1
4	b	i	Mg^{2+} Cl^-	Accept H^+ / H_3O^+ Ignore OH^- Award 1 for both ions correct but in wrong order	1 1
		ii	hydrogen / H_2 burns with a pop / squeak OR use burning/lit splint/flame to see if pop/squeak	Ignore H Must be reference to test and result Reference to splint/match with no indication of flame is not enough Reject reference to glowing splint Ignore flame extinguished 'Squeaky pop test' alone is not sufficient No ECF from wrong gas M2 DEP on M1 correct or missing	1 1
		iii	white precipitate silver chloride to prevent other precipitates forming	Accept white solid / ppt / ppte / suspension Accept AgCl Accept to react with carbonate (ions) Accept to react with hydroxide (ions) Accept carbonates/hydroxides (also) form (white) precipitates	1 1 1

Question number			Answer	Notes	Marks
4	b	iv	hydrogen chloride/HCl does not dissociate / does not form/produce ions OR hydrochloric acid is not formed (in methylbenzene) /HCl is not an acid (in methylbenzene) / no H^+ ions (present/formed) OR only dissociates/forms H^+ ions in water	Accept hydrogen chloride covalent bonds do not break Ignore there is no water Ignore there are no ions (unspecifiied) Ignore all references to not reacting with methylbenzene	1

(Total for Question 4 = 10 marks)

Question number	Answer	Notes	Marks
5 (a) (i)	electrolysis		1
(ii)	carbon / graphite		1
(iii)	negative		1
(iv)	cryolite solvent (for alumina) OR to lower operating temperature / to lower melting point of mixture / electrolyte	Accept Na_3AlF_6 Reject to lower melting or boiling point of alumina / aluminium oxide / aluminium 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	1 1
(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 $Ca(OH)_2$ solution / $Ca(OH)_2(aq)$ but not just $Ca(OH)_2$ Accept chalky / white ppte etc Ignore refs to later going clear M2 dep on M1	1 1

5 (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		Accept free	1
	move (through structure) / mobile		"ions free to move" scores 0	1
(iv)	low density / high strength to weight ratio		Ignore light Accept lightweight / not dense	1

Total 16 marks