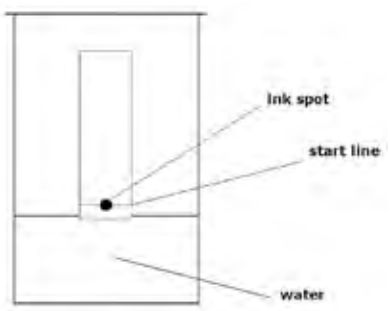
Question number	Answer	Mark
1(a)(i)	Pencil is insoluble in the solvent (but chromatography would separate the ink in an ink line).	(1)

Question number	Answer	Mark
1(a)(ii)	Correct position of chromatography paper with start line and ink spot above surface of water.  	(1)

Question number	Answer	Additional guidance	Mark
1(a)(iii)	• R_f = 14.5 / 15.3= 0.9477 (1) • = 0.95 (answer to 2 significant figures) (1)	Award full marks for correct numerical answer without working.	(2)

Question number	Answer	Mark
1(b)(i)	B	(1)

Question number	Answer	Mark
1(b)(ii)	use a different solvent.	(1)

Question number	Answer	Mark
1(b)(iii)	An explanation that combines identification via a judgement (1 mark) to reach a conclusion via justification/reasoning (1 mark): • mixture S (1) • because it gives the greatest number of spots/gives four spots (1)	(2)

Question Number	Answer	Acceptable answers	Mark
2(a)(i)	B		**(1)**

Question Number	Answer	Acceptable answers	Mark
2(b)(i)	• electrons {shared / between} atoms (1) • {2 pairs of/four} electrons {shared / between} two atoms (1) • 4 additional electrons on both oxygen atoms (1)	ignore any inner electrons shown 3rd Mark is dependent on 2nd	**(3)**

Question Number	Answer	Acceptable answers	Mark
2(b)(ii)	An explanation linking the following second marking point is dependent on the first • forces (between the molecules) are weak (1) • therefore little {<u>heat/energy</u>} needed to separate molecules/break these forces (1)	intermolecular forces/bonds <u>between molecules</u> reject intramolecular force/covalent bond/ionic bond	**(2)**

Question Number	Answer	Acceptable answers	Mark
2(c)	A description including three from • (liquid air enters) (fractionating) column (1) • (liquid air) warms/heats/boils (1) • (gaseous) {nitrogen/lower boiling point} from top of column (1) • (liquid) {oxygen/higher boiling point} from bottom of column (1)	ignore references to cooling air etc. can be separated because they have different boiling points (1) alternative to last two marking points	**(3)**

Question Number	Answers	Acceptable Answers	Mark
3 (a)	A aluminium nitrate and lead sulfate		**(1)**

Question Number	Answers	Acceptable Answers	Mark
3 (b)	An explanation linking two of the following strong (forces of / electrostatic) attraction (1) (between) oppositely charged <u>ions</u> (1) requires lot of heat/energy {to separate ions/overcome forces/break bonds} (1)	Any reference to molecules/molecular/intermolecular/covalent scores 0 marks overall strong bonds ignore "between atoms" for this mark ignore strong lattice / giant structure positive and negative <u>ions</u> reject between bonds reject charged atoms for this mark {high / more} {heat / energy} ignore hard to melt/high temperature needed	**(2)**

Question Number	Answers	Acceptable Answers	Mark
3 (c)(i)	**white** {precipitate /solid}	**white** powder	**(1)**

Question Number	Answers	Acceptable Answers	Mark
3 (c)(ii)	$BaSO_4$ + 2KCl (2) OR $BaSO_4$ + KCl (1)	SO_4Ba / ClK Ignore incorrect use of case, or use of superscript or large number 4	**(2)**

Question Number	Answers	Acceptable Answers	Mark
3(d)(i)	C K^+		**(1)**

Question Number	Answers	Acceptable Answers	Mark
3 (d)(ii)	A description linking three of the following (sequence has to be correct for full marks) M1 add/mix/react only sodium carbonate (solution) and lead nitrate (solution) (1) M2 filter (off precipitate) (1) **M3 dep on M2** M3 wash/rinse (solid/residue with distilled water) OR dry using {filter paper/paper towel/in a (warm/drying) oven} (1)	 add/mix/react the (two) solutions/them for M1 ignore warm/heat mixture if any indication of heating to evaporate anywhere only M1 can be scored if any other reagent added eg acid can score max 2 for question decant (off the solution) reject if wash with acid or other reagent leave to dry / in the sun / on a radiator / near a window reject heat/hot oven	**(3)**

Question number	Answer	Mark
4(a)	<table><tr><th>salt</th><th>soluble</th><th>insoluble</th></tr><tr><td>ammonium chloride</td><td>✓</td><td></td></tr><tr><td>lithium sulfate</td><td>✓</td><td></td></tr><tr><td>magnesium carbonate</td><td></td><td>✓</td></tr></table> • All three correct (2) • Any two correct (1)	**(2)**

Question number	Answer	Additional guidance	Mark
4(b)	• mass values in correct places (1) • multiplication by 100 (1) • correct final answer to two significant figures (1)	$\frac{2.53}{2.85} \times 100 = 88.8\%$ 89% (to 2 s.f.) Award full marks for correct numerical answer without working.	**(3)**

Question number	Answer	Mark
4(c)	An explanation that combines identification – improvement of the experimental procedure (maximum 2 marks) and justification/reasoning, which must be linked to the improvement (maximum 2 marks): • add excess sodium sulfate solution rather than a few drops (1) • so more reaction occurs to form more lead sulfate (1) • filter the reaction mixture rather than pour off the liquid(1) • so none of the lead sulfate is lost on separation(1) • wash the lead sulfate (1) • so the impurities are removed (1) • place the lead sulfate in an oven/warm place (1) • so the lead sulfate is dry (1)	**(4)**

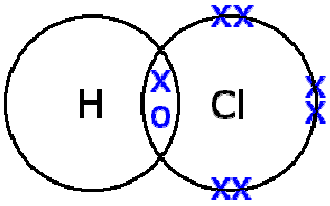
Question number	Answer	Mark
4(d)	• volumes of solution too large for titration method (1) • large volumes of liquid need to be heated and then allowed to crystallise (1)	**(2)**

Question Number	Answer	Acceptable answers	Mark
5(a)	C : copper sulfate and sodium chloride		**(1)**

Question Number	Answer	Acceptable answers	Mark
5(b)	copper sulfate (1) blue-green (1) or sodium chloride (1) yellow (1) colour mark consequential on correct metal (compound)	allow blue or green or green-blue reject orange and yellow-orange	**(2)**

Question Number	Answer	Acceptable answers	Mark
5(c)(i)	An explanation linking weak **inter**molecular forces /weak forces between **molecules** (1) little {heat / energy} needed to separate (molecules) (1)	 bonds / attractions in place of forces intermolecular forces between {atoms / bonds} loses 1st marking point any answer in terms of covalent or ionic bonding scores zero	**(2)**

Question Number	Answer	Acceptable answers	Mark
5(c)(ii)	A description linking use separating funnel (1) run off lower {layer / liquid} / OWTTE (1)	 alternative description of separating funnel eg funnel with a tap at the bottom suitable labelled diagram burette allow layers / liquids to separate ignore fractional distillation	**(2)**

Question Number	Answer	Acceptable answers	Mark
5(d)	 shared pair in molecule (1) rest of molecule consequent on first mark (1)	Allow a diagram without labels for 2 marks any symbols shown must be correct for the 2nd mark allow any combination of dots and crosses for electrons wrong compound = zero marks	**(2)**