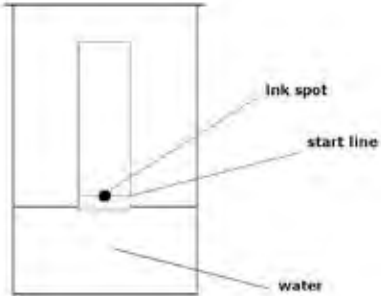


## Paper 1 Higher

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)	<p>Correct position of chromatography paper with start line and ink spot above surface of water.</p> 	(1)

Question number	Answer	Additional guidance	Mark
1(a)(iii)	<ul style="list-style-type: none"> <li><math>R_f = 14.5 / 15.3 = 0.9477</math> (1)</li> <li><math>= 0.95</math> (answer to 2 significant figures) (1)</li> </ul>	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)	<p>An explanation that combines identification via a judgement (1 mark) to reach a conclusion via justification/reasoning (1 mark):</p> <ul style="list-style-type: none"> <li>mixture S (1)</li> <li>because it gives the greatest number of spots/gives four spots (1)</li> </ul>	(2)

Question number	Answer	Additional guidance	Mark
2(a)	An explanation that combines identification via a judgement (1 mark) to reach a conclusion via justification/reasoning (1 mark): <ul style="list-style-type: none"> <li>a negative ion must have more electrons than protons in the particle (1)</li> <li>therefore Z will have a 2- charge (1)</li> </ul>	Do not allow any comparison involving neutrons.	(2)

Question number	Answer	Additional guidance	Mark
2(b)	$40 + 2 \times (14 + 16 \times 3)$ (1) = 164 (1)	Award full marks for correct numerical answer without working.	(2)

Question number	Answer	Mark
2(c)	<ul style="list-style-type: none"> <li>Li ion with empty outer shell (1)</li> <li>1+ charge on Li (1)</li> <li>8 electrons on outer shell of F (1)</li> <li>1- charge on F (1)</li> </ul>	(4)

Question number	Answer	Mark
3(a)(i)	C	(1)

Question number	Answer	Mark
3(a)(ii)	C	(1)

Question number	Answer	Mark
3(b)	Any two of the following points. For the acid, use the same: <ul style="list-style-type: none"> <li>volume (1)</li> <li>concentration (1)</li> <li>temperature (1)</li> </ul>	(2)

Question number	Answer	Mark
3(c)(i)	electrolysis (1)	(1)

Question number	Answer	Mark
3(c)(ii)	An answer that combines identification- knowledge (1 mark) and understanding (1 mark) and reasoning/justification- understanding (1 mark) <ul style="list-style-type: none"> <li>aluminium compounds are more stable than iron compounds (1)</li> <li>so carbon is not a strong enough reducing agent to produce aluminium from its ore (1)</li> </ul>	(2)

Question number	Answer	Mark
3(d)	$\text{Fe}_2\text{O}_3 + 3\text{CO} \rightarrow 2\text{Fe} + 3\text{CO}_2$ <ul style="list-style-type: none"> <li>• Correct formulae (1)</li> <li>• Balancing of correct formulae (1)</li> </ul>	(2)

Question number	Answer	Mark												
4(a)	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>salt</th> <th>soluble</th> <th>insoluble</th> </tr> </thead> <tbody> <tr> <td>ammonium chloride</td> <td style="text-align: center;">✓</td> <td></td> </tr> <tr> <td>lithium sulfate</td> <td style="text-align: center;">✓</td> <td></td> </tr> <tr> <td>magnesium carbonate</td> <td></td> <td style="text-align: center;">✓</td> </tr> </tbody> </table> <ul style="list-style-type: none"> <li>• All three correct (2)</li> <li>• Any two correct (1)</li> </ul>	salt	soluble	insoluble	ammonium chloride	✓		lithium sulfate	✓		magnesium carbonate		✓	(2)
salt	soluble	insoluble												
ammonium chloride	✓													
lithium sulfate	✓													
magnesium carbonate		✓												

Question number	Answer	Additional guidance	Mark
4(b)	<ul style="list-style-type: none"> <li>• mass values in correct places (1)</li> <li>• multiplication by 100 (1)</li> <li>• correct final answer to two significant figures (1)</li> </ul>	$\frac{2.53}{2.85} \times 100 = 88.8\%$ 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): <ul style="list-style-type: none"> <li>• add excess sodium sulfate solution rather than a few drops (1)</li> <li>• so more reaction occurs to form more lead sulfate (1)</li> <li>• filter the reaction mixture rather than pour off the liquid(1)</li> <li>• so none of the lead sulfate is lost on separation(1)</li> <li>• wash the lead sulfate (1)</li> <li>• so the impurities are removed (1)</li> <li>• place the lead sulfate in an oven/warm place (1)</li> <li>• so the lead sulfate is dry (1)</li> </ul>	(4)

Question number	Answer	Mark
4(d)	<ul style="list-style-type: none"> <li>• volumes of solution too large for titration method (1)</li> <li>• large volumes of liquid need to be heated and then allowed to crystallise (1)</li> </ul>	(2)

Question number	Answer	Mark
5(a)(i)	C	(1)

Question number	Answer	Mark
5(a)(ii)	C	(1)

Question number	Answer	Mark
5(b)	reactants are being used up (1)	(1)

Question number	Answer	Mark
5(c)	An explanation that combines identification via a judgement (1 mark) to reach a conclusion via justification/reasoning (1 mark): <ul style="list-style-type: none"> <li>aluminium and copper have different size atoms (1)</li> <li>and so this prevents the layers of metal atoms from sliding over one another (1)</li> </ul>	(2)

Question number	Answer	Additional guidance	Mark
5(d)	proportion gold = $9 \div 24$ (= 0.375) (1)  mass = $0.375 \times 12 = 4.5$ (g) (1)	Award full marks for correct numerical answer without working.	(2)

Question number	Answer	Mark
6(a)	An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark): <ul style="list-style-type: none"> <li><b>J</b> and <b>K</b> are electrolytes (1)</li> <li>because their solutions conduct electricity and are decomposed (1)</li> </ul>	(2)

Question number	Answer	Mark
6(b)	D	(1)

Question number	Answer	Mark
6(c)	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (3 marks): <ul style="list-style-type: none"> <li>hydrogen (<math>H^+</math>) and sodium (<math>Na^+</math>) ions attracted to cathode, hydroxide (<math>OH^-</math>) ions and sulfate (<math>SO_4^{2-}</math>) ions attracted to anode (1)</li> <li>because the ions are attracted to the oppositely charged electrode (1)</li> <li>2 hydrogen ions/2 <math>H^+</math> accept 2 e to form hydrogen molecule/<math>H_2</math> (1)</li> <li>4 hydroxide ions/4 <math>OH^-</math> lose 4 e to form oxygen molecule/<math>O_2</math> (1)</li> </ul>	(4)

Question number	Answer	Mark
6(d)	$\text{Cu}^{2+} + 2\text{e}^{-} \rightarrow \text{Cu}$ <ul style="list-style-type: none"> <li>• all species (1)</li> <li>• balancing (1)</li> </ul>	(2)

Question number	Answer	Mark
7(a)(i)	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (2 marks): <ul style="list-style-type: none"> <li>• rate increased/time to reach equilibrium reduced (1)</li> <li>• because gas molecules closer/more concentrated (1)</li> <li>• so increased collision rate/more frequent collisions(1)</li> </ul>	(3)

Question number	Answer	Mark
7(a)(ii)	A	(1)

Question number	Answer	Mark
7(b)	equilibrium position/usefulness of by-products	(1)

Question Number	Indicative content
<b>7(c)</b>	<p>Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme.</p> <p>The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant.</p> <p style="text-align: center;"><b>AO1 (6 marks)</b></p> <p>The effect of the temperature rise on the rate of attainment of equilibrium and on the equilibrium yield are considered by:</p> <ul style="list-style-type: none"> <li>• higher temperature reaches equilibrium faster because molecules move faster</li> <li>• therefore there are more frequent collisions because molecules have more energy</li> <li>• therefore more collisions have required energy but yield will be lower</li> <li>• because higher temperature favours endothermic reaction and so equilibrium shifts to left hand side</li> <li>• which is decomposition of ammonia / ammonia reforms elements</li> <li>• catalyst causes reaction to reach equilibrium faster / catalyst increases rates (of both forward and back reactions)</li> <li>• lowers the activation energy (of both forward and back reactions) but does not affect yield</li> <li>• equilibrium position not affected.</li> </ul>

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1-2	<ul style="list-style-type: none"> <li>• Demonstrates elements of chemical understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1)</li> <li>• Presents an explanation with some structure and coherence. (AO1)</li> </ul>
Level 2	3-4	<ul style="list-style-type: none"> <li>• Demonstrates chemical understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1)</li> <li>• Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1)</li> </ul>
Level 3	5-6	<ul style="list-style-type: none"> <li>• Demonstrates accurate and relevant chemical understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1)</li> <li>• Presents an explanation that has a well-developed structure which is clear, coherent and logical. (AO1)</li> </ul>

Question number	Answer	Additional guidance	Mark
8(a)(i)	<ul style="list-style-type: none"> <li>particles are same size when they should be different sizes (1)</li> <li>model is in 2D but crystal is 3D (1)</li> </ul>	Allow reverse statements giving correct information.	(2)

Question number	Answer	Mark
8(a)(ii)	<p>An explanation that combines identification – knowledge (1 mark) and reasoning/justification – understanding (2 marks):</p> <ul style="list-style-type: none"> <li>very strong bonds/ionically bonded (1)</li> <li>between 2+ cations and 2- anions (1)</li> <li>so requires lot of energy to separate magnesium and oxide ions to melt the solid (1)</li> </ul>	(3)

Question number	Answer	Additional guidance	Mark
8(b)(i)	$\text{CaCO}_3 + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{H}_2\text{O} + \text{CO}_2$ <ul style="list-style-type: none"> <li>all formulae on correct side (2)</li> <li>balancing (1)</li> </ul>	Allow 3/4 formulae (1)	(3)

Question number	Answer	Additional guidance	Mark
8(b)(ii)	<p>relative formula mass copper carbonate  <math>= 63.5 + 12.0 + (3 \times 16.0)</math>  <math>= 123.5</math>            relative formula mass copper oxide  <math>= 63.5 + 16.0</math>  <math>= 79.5</math> (1)</p> <p>mass copper oxide  <math>= \frac{15.0 \times 79.5}{123.5} = 9.7 \text{ g to 2 s.f.}</math> (1)            Answer must be to two significant figures</p> <p>OR</p> <p>moles of copper carbonate  <math>= \frac{15.0}{123.5} = 0.12145</math> (1)            mass of copper oxide  <math>= \text{moles CuCO}_3 \times 79.5</math>  <math>= 9.7 \text{ g to 2sf}</math> (1)            Answer must be to two significant figures</p>	Award full marks for correct numerical answer without working.	(2)

Question number	Answer	Additional guidance	Mark
8(c)	<p>2.4/24 moles Mg = 0.1 mol (1)</p> <p>and 0.2 moles H<sub>2</sub>O has mass 0.2 × formula mass H<sub>2</sub>O = 3.6 g (1)</p> <p>total mass reactants = 2.4 + 3.6 = 6.0 g is the same as total mass products = 5.8 + 0.2 = 6.0 g (1)</p>	Award full marks for correct numerical answer without working.	(3)

Question number	Answer	Mark
9(a)(i)	<p>An explanation that makes reference to: identification – knowledge (1 mark) and reasoning /justification – knowledge (1 mark):</p> <ul style="list-style-type: none"> <li>• a strong acid is completely ionised in solution/exists completely as ions (1)</li> <li>• but a weak acid is only partly ionised/exists mainly as molecules with very few ions present (1)</li> </ul>	(2)

Question number	Answer	Mark
9(a)(ii)	hydroxide ions react with hydrogen ions and reduce the hydrogen ion concentration therefore increase pH (1)	(1)

Question number	Answer	Mark
9(b)	<p>ZnO + 2HNO<sub>3</sub> → Zn(NO<sub>3</sub>)<sub>2</sub> + 2H<sub>2</sub>O</p> <ul style="list-style-type: none"> <li>• zinc nitrate formula (1)</li> <li>• full, balanced equation (1)</li> </ul>	(2)

Question number	Answer	Additional guidance	Mark
9(c)	$\text{mass} = 50 \times \frac{40}{1000} (1) = 2 \text{ (g) (1)}$	Award full marks for correct numerical answer without working.	(2)



Question Number	Indicative content
<b>9(d)</b>	<p>Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme.</p> <p>The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant.</p> <p style="text-align: center;"><b>AO2 (3 marks)</b></p> <ul style="list-style-type: none"> <li>• suitable acid: sulfuric acid</li> <li>• suitable substance : magnesium oxide / magnesium carbonate / magnesium hydroxide / magnesium</li> <li>• equation for reaction:  <math>MgO + H_2SO_4 \rightarrow MgSO_4 + H_2O/</math>  <math>Mg(OH)_2 + H_2SO_4 \rightarrow MgSO_4 + 2H_2O/</math>  <math>MgCO_3 + H_2SO_4 \rightarrow MgSO_4 + H_2O + CO_2/</math>  <math>Mg + H_2SO_4 \rightarrow MgSO_4 + H_2</math></li> </ul> <p style="text-align: center;"><b>AO3 (3 marks)</b></p> <ul style="list-style-type: none"> <li>• add solid to warmed acid until in excess solid remains (oxide and hydroxide) / add solid a little at a time until no more bubbles (carbonate/metal)</li> <li>• filter off the excess solid, pour remaining solution into an evaporating basin</li> <li>• {heat solution / leave the water to evaporate}</li> <li>• until pure salt crystals form and then dry salt crystals with absorbent paper/leave to dry.</li> </ul>

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1–2	<ul style="list-style-type: none"> <li>• The plan attempts to link and apply knowledge and understanding of scientific enquiry, techniques and procedures, flawed or simplistic connections made between elements in the context of the question. (AO2)</li> <li>• Analyses the scientific information but understanding and connections are flawed. An incomplete plan that provides limited synthesis of understanding. (AO3)</li> </ul>
Level 2	3–4	<ul style="list-style-type: none"> <li>• The explanation is mostly supported through linkage and application of knowledge and understanding of scientific enquiry, techniques and procedures, some logical connections made between elements in the context of the question. (AO2)</li> <li>• Analyses the scientific information and provides some logical connections between scientific enquiry, techniques and procedures. A partially completed plan that synthesises mostly relevant understanding, but not entirely coherently. (AO3)</li> </ul>
Level 3	5–6	<ul style="list-style-type: none"> <li>• The explanation is supported throughout by linkage and application of knowledge and understanding of scientific enquiry, techniques and procedures, logical connections made between elements in the context of the question. (AO2)</li> <li>• Analyses the scientific information and provide logical connections between scientific concepts throughout. A well-developed plan that synthesises relevant understanding coherently. (AO3)</li> </ul>

Question number	Answer	Additional guidance	Mark
10(a)	Formula mass ammonium chloride $= 14.0 + 4.00 + 35.5 = 53.5$  moles of ammonium chloride $= \frac{10.0}{53.5} = 0.187$ (1)  volume ammonia $= 0.187 \times 24$ $= 4.49 \text{ dm}^3$ (1) or <ul style="list-style-type: none"> <li><math>2 \times 53.5 = 107 \text{ g}</math> ammonium chloride produces <math>2 \times 24 = 48 \text{ dm}^3</math> ammonia (1)</li> <li>10.0 g ammonium chloride produces  <math>\frac{10.0}{2 \times 53.5} \times 2 \times 24 = 4.49 \text{ dm}^3</math>                ammonia (1)</li> </ul>	Award full marks for correct numerical answer without working.	(2)

Question number	Answer	Additional guidance	Mark
10(b)(i)	$25 \div 1000 \times 0.1 = 0.0025$ (1)  $35 \div 1000 \times 0.075 = 0.002625$ (1)  The acid is in excess (1)	Third mark only awarded as conclusion from calculated data.	(3)

Question number	Answer	Mark
10(b)(ii)	$\frac{36.20 + 36.30}{2} = 36.25$ (1)	(1)

Question number	Answer	Mark
10(b)(iii)	D	(1)

Question number	Answer	Additional guidance	Mark
10(c)	mol of acid = $24.80 \div 1000 \times 0.200$ (= 0.004 96 mol) (1)  mol NaOH = $2 \times 0.004\ 96$ (= 0.009 92) (1)  conc. of NaOH = $0.009\ 92 \div 25.0 \times 1000$ (1)  = 0.3968/0.397 (mol dm <sup>-3</sup> ) (1)  or  $(25.00 \times \text{conc NaOH}) \div 2 = 24.80 \times 0.200$ (2)  conc NaOH = $2 \times 24.80 \times 0.200 \div 25.00$ (1)  = 0.3968/0.397 (mol dm <sup>-3</sup> ) (1)	Award full marks for correct numerical answer without working.  Allow max 3 marks if missing '2 ×' in step 2.	(4)

