



# Mark Scheme (Results)

October 2023

Pearson Edexcel International Advanced  
Subsidiary Level In Chemistry (WCH13)  
Paper 01  
Unit 3: Practical Skills in Chemistry I

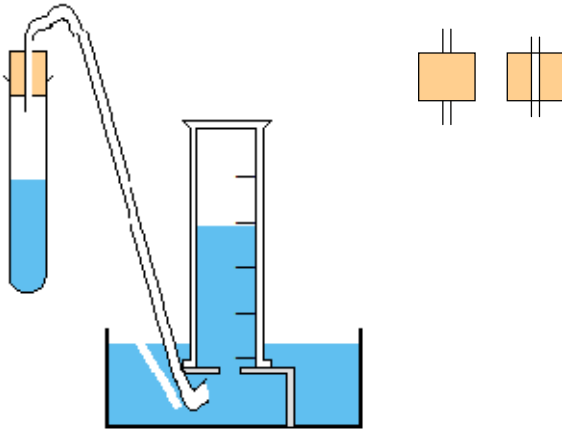
Question Number	Answer	Additional Guidance	Mark
1(a)(i)	<p>A description that makes reference to the following points:</p> <ul style="list-style-type: none"> <li>• use of nichrome / platinum / Pt wire</li> <li>• use of (concentrated) hydrochloric acid / HCl(aq)</li> <li>• flame test method</li> </ul>	<p>(1) Allow nickel-chromium / Ni-Cr Allow silica rod Allow rod for wire Do not award just 'nickel' / just 'chromium' Do not award wooden splint</p> <p>(1) Allow any mention of HCl(aq) e.g. cleaning or mixing solid and acid or making a paste / solution Allow HCl for HCl(aq) Ignore dilute Do not award other acids</p> <p>(1) (wire then) dipped in solid <b>and</b> (placed) in (hot / roaring / colourless / blue-cone / non-luminous) (Bunsen) <b>flame</b></p> <p>Allow salt / compound / substance / paste / sample / solution for 'solid' Allow on / over / under / near / show / above for 'in' Allow spirit / ethanol burner</p> <p>Do not award 'metal' for solid Do not award fire for flame Do not award yellow / luminous flame Ignore 'burn'</p>	<p>(3)</p> <p><b>Expert</b></p>

Question Number	Answer	Additional Guidance	Mark
1(a)(ii)	<p>An answer that makes reference to the following points:</p> <ul style="list-style-type: none"> <li>statement of both flame colours</li> <li>identification of Ba<sup>2+</sup></li> </ul>	<p>(1) Na<sup>+</sup> = (persistent) yellow Allow gold / orange / yellow-orange K<sup>+</sup> = lilac Allow (pale) purple Do not award violet</p> <p>(1) Ignore barium / barium ion Do not award Cu<sup>2+</sup></p>	<p>(2)</p> <p>Graduate</p>

Question Number	Answer	Additional Guidance	Mark
1(b)(i)	<p>An answer that makes reference to the following:</p> <ul style="list-style-type: none"> <li>chloride / Cl<sup>-</sup> <b>and</b> bromide / Br<sup>-</sup> <b>and</b> iodide / I<sup>-</sup></li> </ul>	<p>Allow omission of the charge once Ignore chlorine ion, bromine ion or iodine ion Do not award just chlorine, bromine or iodine</p>	<p>(1)</p> <p>Graduate</p>

Question Number	Answer	Additional Guidance	Mark
1(b)(ii)	<p>An answer that makes reference to the following points:</p> <p>EITHER</p> <ul style="list-style-type: none"> <li>• addition of <b>dilute</b> (aqueous) ammonia (1)</li> <li>• only silver chloride / chloride (precipitate) dissolves (1)</li> <li>• addition of <b>concentrated</b> (aqueous) ammonia (1)</li> <li>• only silver iodide / iodide is insoluble (1)</li> </ul> <p>OR</p> <ul style="list-style-type: none"> <li>• addition of <b>concentrated</b> sulfuric acid /H<sub>2</sub>SO<sub>4</sub> (1)</li> <li>• silver chloride / chloride precipitate gives steamy / misty / white fumes only (1)</li> <li>• silver bromide / bromide precipitate gives brown fumes (1)</li> <li>• silver iodide / iodide precipitate gives purple vapour fumes / gas (1)</li> </ul>	<p>Penalise use of halogen for halide once only Allow use of halogen ion / anion The sequence suggested must allow the ions to be distinguished</p> <p>Allow bromide and iodide do not dissolve</p> <p>Accept only silver bromide / bromide precipitate dissolves if chloride has been eliminated and conc ammonia added to remaining precipitates</p> <p>If no other mark is scored 'addition of (aqueous) ammonia scores (1)</p> <p>Allow addition to A, B and C for this set of tests</p> <p>Allow choking gas evolved / choking smell</p> <p>Allow black / grey solid or 'bad eggs' smell Allow yellow solid (of sulfur) Ignore choking gas evolved / choking smell</p> <p>If no other mark is scored, silver chloride is white, <b>and</b> silver bromide is cream <b>and</b> silver iodide is yellow scores (1)</p>	<p>(4)</p> <p>Expert</p>

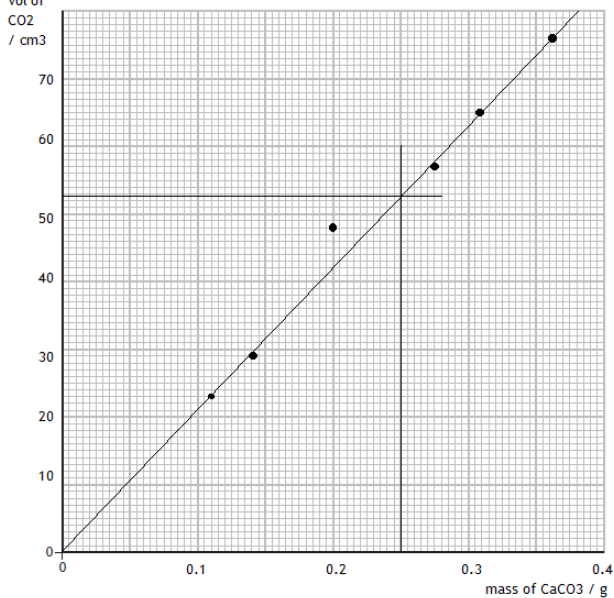
(Total for Question 1 = 10 marks)

Question Number	Answer	Additional Guidance	Mark
2(a)	<p>Diagram showing the following points</p> <ul style="list-style-type: none"> <li>boiling tube</li> <li>delivery tube above the level of the liquid in the boiling tube if shown or above half the height of the tube</li> <li>sealed connection between reaction vessel and delivery tube</li> <li>inverted measuring cylinder containing some water (shown as a line or an annotation indicating it is full)</li> <li>water level in trough over the bottom of the measuring cylinder</li> <li>end of delivery tube below or in the measuring cylinder</li> </ul> <p>6 points scores 3 marks; 5 or 4 points scores 2 marks; 2 or 3 points scores 1 mark</p>	<p>Allow any reaction apparatus that can be fitted with a bung and delivery tube Allow any part of a delivery tube shown</p> <p>Allow bung not shown as cross-section</p> <p>Allow measuring cylinder shown not vertical Allow other collecting vessels with graduations</p> <p>Ignore omission of graduations on measuring cylinder Ignore omission of beehive shelf Ignore gas syringe</p> <p>Ignore the delivery tube passing through the wall of the trough</p> <p>Alternative allowed bungs</p>  <p>The diagram shows a boiling tube containing blue liquid, with a delivery tube extending from its mouth into an inverted measuring cylinder. The measuring cylinder is partially filled with blue liquid and is submerged in a trough of water. To the right, two alternative bung designs are shown: one is a solid orange rectangle with two vertical lines, and the other is an orange rectangle with two vertical lines and a central vertical slot.</p> <p>Ignore apparatus labels including 'heat'</p>	<p><b>(3)</b></p> <p><b>Expert</b></p>

Question Number	Answer	Additional Guidance	Mark
2(b)	<p>An explanation that makes reference to the following points:</p> <ul style="list-style-type: none"> <li>ethanoic acid is a weak acid (and hydrochloric acid is a strong acid) (1)</li> <li>(with hydrochloric acid)</li> </ul> <p>gas would escape before the boiling tube was sealed (1)</p>	<p>Allow 'hydrochloric acid is a <b>stronger</b> acid'</p> <p>Allow reaction would be slow</p> <p>Allow reaction would be less vigorous</p> <p>Allow reaction would not be violent</p> <p>Allow reverse arguments</p> <p>Ignore just 'hydrochloric acid is a strong acid'</p> <p>Allow just (with ethanoic acid ) 'less gas would escape'</p>	<p>(2)</p> <p><b>Expert</b></p>

Question Number	Answer	Additional Guidance	Mark
2(c)	<p>An answer that makes reference to the following point:</p> <ul style="list-style-type: none"> <li>to take account of any calcium carbonate left in the weighing bottle</li> </ul>	<p>Ignore just 'gives the mass of CaCO<sub>3</sub> that reacts'</p> <p>Ignore just 'gives exact amount of CaCO<sub>3</sub>'</p>	<p>(1)</p> <p><b>Expert</b></p>

Question Number	Answer	Additional Guidance	Mark
2(d)(i)	<ul style="list-style-type: none"> <li>correct axes with at least 50% of the grid used in both directions (1)</li> <li>axes labelled with correct units (1)</li> <li>all points plotted correctly (1)</li> </ul>	<p>mass on x axis; volume on y axis Allow scale 0.10 g = 1 big square</p> <p>Allow grammatical errors e.g. use of brackets rather than '/' before units Allow mass / g and vol / cm<sup>3</sup> for labels</p> <p>Allow plotting to within half a small square</p> <p>TE for M2 and M3 if axes wrong way round</p>	<p>(3)</p> <p><b>Clip with d(ii) and (d)(iii)</b></p> <p><b>Expert</b></p>

Question Number	Answer	Additional Guidance	Mark
2(d)(ii)	<p>An answer that makes reference to the following points:</p> <ul style="list-style-type: none"> <li>best fit line drawn through five points <b>and</b> passes through the origin</li> <li>structure line from 0.25 g to graph <b>and</b> line to 52.5 cm<sup>3</sup></li> </ul>	<p>(1) Do not award BFL drawn to include value at 0.2 g Allow TE on points plotted in (d)(i) even if it does not go through origin Accept line that stops at 0.11 g data point but would pass through the origin if extrapolated Ignore extrapolation beyond 0.36 / 76</p> <p>(1) Allow just the horizontal structure line if 0.25 g is on a major grid line. Allow vol at 0.25 g clearly marked on BFL by a cross or circle. Allow 51.5-53.5 cm<sup>3</sup> TE only on any <b>straight</b> line covering <b>all</b> the points</p>  <p>Ignore <b>calculation</b> of volume</p>	<p>(2)</p> <p><b>Clip with d(i) and (d)(iii)</b></p> <p><b>Expert</b></p>



Question Number	Answer	Additional Guidance	Mark
2(d)(iii)	<ul style="list-style-type: none"> <li>calculation of molar mass of <math>\text{CaCO}_3</math> (1)</li> <li>calculation of amount of <math>\text{CaCO}_3</math> (1)</li> <li>scale volume of <math>\text{CO}_2</math> to 1 mol (1)</li> </ul>	<p>Example of calculation</p> <p>molar mass = <math>40.1 + 12 + 16 \times 3 = 100.1 \text{ (g mol}^{-1}\text{)}</math></p> <p>mol (<math>\text{CaCO}_3</math>) = <math>0.25 \div 100.1 = 2.4975 \times 10^{-3} / 0.0024975</math></p> <p>1 mol <math>\text{CO}_2</math> occupies <math>52.5 \div 2.4975 \times 10^{-3} = 21021 \text{ (cm}^3\text{)} / 21.021 \text{ dm}^3</math>  Units must be correct if given but accept <math>\text{cm}^3 \text{ mol}^{-1} / \text{dm}^3 \text{ mol}^{-1}</math></p> <p>TE at each stage and on volume in (d)(ii)</p> <p>Ignore SF except 1 SF</p> <p>Correct answer with some working scores (3)</p> <p>Allow use of <math>M_r (\text{CaCO}_3) = 100</math> (<math>V_m = 21</math>)</p> <p>Use of 51.5 gives <math>20621 \text{ cm}^3</math> (20600 for <math>M_r = 100</math>)  Use of 52 gives <math>20821 \text{ cm}^3</math> (20800 for <math>M_r = 100</math>)  Use of 53 gives <math>21221 \text{ cm}^3</math> (21200 for <math>M_r = 100</math>)  Use of 53.5 gives <math>21421 \text{ cm}^3</math> (21400 for <math>M_r = 100</math>)</p> <p>Calculation of moles of acid (0.030) divided by 2 (0.015)  Vol of <math>\text{CO}_2 \div 0.015</math> e.g. <math>52.5 \div 0.015 = 3500 \text{ cm}^3</math> scores M3 only</p>	<p>(3)</p> <p>Clip with d(i) and (d)(ii)</p> <p>Expert</p>

Question Number	Answer	Additional Guidance	Mark
2(e)	<p>An answer that makes reference to the following points:</p> <ul style="list-style-type: none"> <li>some carbon dioxide / CO<sub>2</sub> / gas will escape before the boiling tube can be sealed</li> <li>some carbon dioxide / gas will dissolve in the water</li> </ul>	<p>(1) Allow Some CO<sub>2</sub> / gas will escape in Step 5 Allow Some CO<sub>2</sub> / gas will escape when the solid is added Allow reaction starts before the boiling tube can be sealed  Ignore just 'Some carbon dioxide / gas will escape'</p> <p>(1) Accept carbon dioxide is soluble (in water)  Ignore reference to temperature or pressure not rtp Ignore 'some CO<sub>2</sub> remains in apparatus' Ignore 'incomplete reaction'</p> <p>Do not award references to measurement errors loss of reactant apparatus damaged or not working properly</p>	<p>(2)</p> <p><b>Expert</b></p>

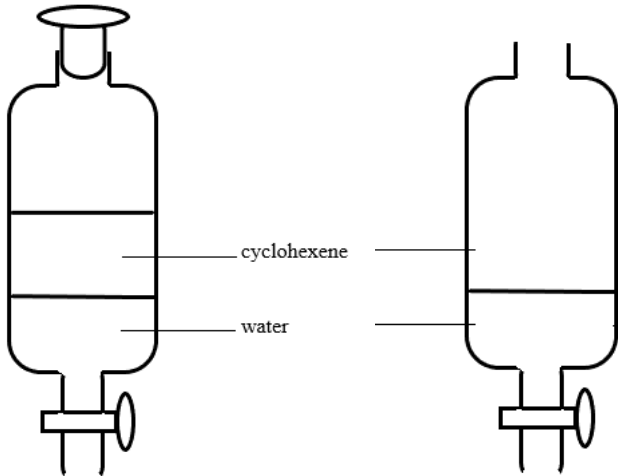
(Total for Question 2 = 16 marks)

Question Number	Answer	Additional Guidance	Mark
3(a)(i)	<p>An answer that makes reference to the following points:</p> <ul style="list-style-type: none"> <li>flammable symbol identified</li> </ul> <p><b>and</b></p> <p>harmful to the environment symbol identified</p>	<p>Allow inflammable Ignore combusts / burns easily</p> <p>Allow alternatives to 'harmful to' e.g. 'damages' / 'bad for' / 'poisonous' / 'toxic' / 'hazard' to the environment Allow 'living things' / 'organisms' for 'the environment' Ignore type of environment e.g. aquatic Ignore pollutes the environment</p> <p>Do not award 'biohazard' Do not award symbols the wrong way round Do not award just 'toxic' / 'poisonous' / 'harmful'</p>	<p><b>(1)</b></p> <p><b>Clip with (a)(ii)</b></p> <p><b>Expert</b></p>

Question Number	Answer	Additional Guidance	Mark
3(a)(ii)	<p>An answer that makes reference to the following points:</p> <ul style="list-style-type: none"> <li>(cyclohexanol(flammable)) use an electric heater</li> </ul> <p><b>(1)</b></p> <ul style="list-style-type: none"> <li>(cyclohexene (harmful to the environment)) use an organic waste bottle / separate container</li> </ul> <p><b>(1)</b></p>	<p>Ignore use of fume cupboard, goggles, lab coat</p> <p>Accept isomantle Allow water bath / oil bath Allow 'no (naked) flame / fire' Ignore 'keep away from oxidising agents' Ignore keep away from Bunsen burner</p> <p>Accept do <b>not</b> pour the (organic) waste down the sink / drain Allow do not release into the environment</p> <p>Allow one use of 'use small amounts' in M1 or M2 No TE on incorrect identification of hazard symbols</p>	<p><b>(2)</b></p> <p><b>Expert</b></p>

Question Number	Answer	Additional Guidance	Mark
3(b)	<p>An answer that makes reference to the following:</p> <ul style="list-style-type: none"> <li>(anti-bumping granules) provides a nucleus on which gas bubbles grow</li> </ul>	<p>Accept provide a surface /site for bubbles to form on</p> <p>Allow prevent local heating / superheating</p> <p>Allow 'distribute the heat'</p> <p>Allow prevent the (sudden) production of large gas bubbles (which cause bumping)</p> <p>Allow ensures that gas bubbles are small</p> <p>Ignore stir the reaction mixture</p> <p>Ignore prevent flash boiling / sudden boiling</p>	<p><b>(1)</b></p> <p><b>Expert</b></p>

Question Number	Answer	Additional Guidance	Mark
3(c)	<p>An answer that makes reference to the following points:</p> <ul style="list-style-type: none"> <li>(fractional distillation) gives better separation of the substances in the reaction flask (than simple distillation)</li> <li>(fractional distillation column) gives longer reaction time</li> </ul> <p>OR</p> <ul style="list-style-type: none"> <li>'better separation of cyclohexene and water' scores 2 marks</li> </ul>	<p><b>(1)</b> Allow (fractional distillation) is more effective / efficient (than simple distillation)</p> <p>Allow just 'better separation' is achieved</p> <p>Allow purer product obtained</p> <p>Ignore reference to increased yield</p> <p>Ignore 'more accurate'</p> <p>Ignore 'similar boiling temperatures'</p> <p><b>(1)</b> Accept fractional distillation column acts like a reflux condenser</p> <p>Accept cyclohexanol has a higher boiling temperature (than cyclohexene) so is returned to the flask, increasing reaction time / yield</p> <p>Allow to give (more) complete reaction</p> <p>Just 'separation of cyclohexene and water' scores (1)</p>	<p><b>(2)</b></p> <p><b>Expert</b></p>

Question Number	Answer	Additional Guidance	Mark
3(d)	<p>A diagram that shows the following:</p> <ul style="list-style-type: none"> <li>separating funnel</li> <li>top layer labelled cyclohexene / organic <b>and</b> lower layer labelled water / aqueous</li> </ul>	<p>(1) The funnel must have a tap <b>and</b> have a <b>neck</b> capable of being closed with a stopper or a bung Allow round separating funnel Allow bung / stopper not shown Ignore tap at the top</p> <p>Do not award a filter funnel Do not award funnel without some sort of tapering at the neck</p> <p>Allow for (2)</p>  <p>(1)</p> <p>Allow minor error in organic name e.g. cyclohexane Ignore 'inorganic lower layer' Do not award if cyclohexanol is in the lower layer</p>	<p>(2)</p> <p><b>Expert</b></p>

Question Number	Answer	Additional Guidance	Mark
3(e)	<p>An explanation that makes reference to the following points:</p> <ul style="list-style-type: none"> <li>(the organic layer) changes from cloudy to clear</li> <li>(anhydrous calcium chloride) removes the (traces of) water</li> </ul>	<p>(1) Allow just 'becomes clear / transparent' Ignore 'less cloudy', clearer, more transparent Ignore white Ignore colourless Ignore the drying agent clumps together Ignore layers disappear</p> <p>(1) Accept (anhydrous calcium chloride) dries the cyclohexene Allow (anhydrous) calcium chloride is a drying agent Ignore calcium chloride becomes hydrated</p>	<p>(2)</p> <p><b>Expert</b></p>

Question Number	Answer	Additional Guidance	Mark
3(f)	<p>An answer that makes reference to the following point:</p> <ul style="list-style-type: none"> <li>lower temperature within a suitable range <b>and</b> upper temperature within a suitable range</li> </ul>	<p>79–82 (°C)</p> <p>84–88 (°C)</p> <p>Do not award a range which starts or ends with 83 (°C)</p>	<p>(1)</p> <p><b>Graduate</b></p>

Question Number	Answer	Additional Guidance	Mark
3 (g)	<ul style="list-style-type: none"> <li>calculation of mass of cyclohexene formed from 3.96 g of cyclohexanol with 100% yield (1)</li> <li>calculation of percentage yield (1)</li> </ul>	<p>Example of calculation</p> <p>100 g of cyclohexanol forms 82 g of cyclohexene and (so) 3.96 g forms <math>3.96 \times 82 \div 100 = 3.2472</math> (g)</p> <p>% yield = <math>100 \times 2.09 \div 3.2472 = 64.363\%</math></p> <p>Method using calculation of moles mol of cyclohexanol = <math>3.96 \div 100</math> = <math>3.96 \times 10^{-2} / 0.0396</math> = mol cyclohexene mass of cyclohexene for 100% yield = <math>82 \times 0.0396 = 3.2472</math> (g) (1) % yield = <math>100 \times 2.09 \div 3.2472</math> = <math>64.363\%</math> (1)</p> <p>Ignore SF except 1 SF</p> <p>TE for <b>numerical</b> errors in M1 unless %&gt;100</p> <p>Allow any correct method Correct answer with some working scores (2)</p> <p><math>100 \times 2.09 \div 3.96 = 52.778\%</math> scores zero</p>	<p>(2)</p> <p>Expert</p>

Question Number	Answer	Additional Guidance	Mark											
3(h)	<p>An answer that makes reference to the following points:</p> <ul style="list-style-type: none"><li>any three correct observations (1)</li><li>fourth correct observation (1)</li></ul>	<table><tr><th rowspan="2">Test</th><th colspan="2">Observations</th></tr><tr><th>cyclohexanol</th><th>cyclohexene</th></tr><tr><td>addition of phosphorus(V) chloride</td><td>steamy / misty / white fumes</td><td>no change / no reaction / no observation</td></tr><tr><td>addition of bromine water</td><td>brown /orange / yellow Br<sub>2</sub>(aq) unchanged</td><td>brown / orange / yellow Br<sub>2</sub>(aq) turns colourless</td></tr></table> <p>For PCl<sub>5</sub> do not award white smoke</p> <p>For Br<sub>2</sub>(aq) and cyclohexanol allow no change / no reaction / no observation</p> <p>For Br<sub>2</sub>(aq) and cyclohexene allow just ‘decolourised’ / ‘turns colourless’</p> <p>Do not award red or red-brown for colour of Br<sub>2</sub>(aq)</p> <p>Do not award additional incorrect observations</p>	Test	Observations		cyclohexanol	cyclohexene	addition of phosphorus(V) chloride	steamy / misty / white fumes	no change / no reaction / no observation	addition of bromine water	brown /orange / yellow Br <sub>2</sub> (aq) unchanged	brown / orange / yellow Br <sub>2</sub> (aq) turns colourless	<p>(2)</p> <p>Expert</p>
Test	Observations													
	cyclohexanol	cyclohexene												
addition of phosphorus(V) chloride	steamy / misty / white fumes	no change / no reaction / no observation												
addition of bromine water	brown /orange / yellow Br <sub>2</sub> (aq) unchanged	brown / orange / yellow Br <sub>2</sub> (aq) turns colourless												

(Total for Question 3 = 15 marks)



Question Number	Answer	Additional Guidance	Mark
4(a)	<p>An answer that makes reference to the following points:</p> <ul style="list-style-type: none"> <li>• (from) yellow (1)</li> <li>• (to) orange (1)</li> </ul>	<p>Do not award 'red / pink'</p> <p>From orange to yellow scores (1)</p>	<p>(2)</p> <p>Graduate</p>

Question Number	Answer	Additional Guidance	Mark
4(b)	<p>An answer that makes reference to the following:</p> <ul style="list-style-type: none"> <li>• 23.40 (cm<sup>3</sup>)</li> </ul>	<p>Allow 23.4 (cm<sup>3</sup>)</p>	<p>(1)</p> <p>Expert</p>

Question Number	Answer	Additional Guidance	Mark
4(c)	<p>A description that makes reference to the following points:</p> <ul style="list-style-type: none"> <li>• add the acid (quickly) until just short of the rough end-point</li> <li>• add the acid drop-by-drop</li> <li>• with swirling</li> </ul> <p><b>and</b></p> <p>until the indicator colour (just) changes</p>	<p>(1) Accept within 1– 4 cm<sup>3</sup> (any value in this range) before the rough titre Allow to a value in the range 19.4 – 22.4 cm<sup>3</sup> Allow ‘until close to the rough value’ Ignore ‘carbonate added’ Do not award ‘until the rough value is reached’</p> <p>(1) Standalone mark (award even if M1 not given) Allow ‘dropwise’ Allow ‘a few drops at a time’ Ignore ‘add very slowly’</p> <p>Allow any indication of mixing Allow shaking Allow stirring</p> <p>(1) Allow until the end-point Allow any stated final colour</p> <p>Ignore references to filling the burette, use of the pipette, white tiles</p>	<p><b>(3)</b></p> <p><b>Expert</b></p> <p><b>Clip with (b)</b></p>

Question Number	Answer	Additional Guidance	Mark
4(d)	<ul style="list-style-type: none"> <li>calculation of moles of sodium carbonate (1)</li> <li>use of 2:1 ratio to gives moles of HCl in 22.65 cm<sup>3</sup> (1)</li> <li>concentration of hydrochloric acid in mol dm<sup>-3</sup> (1)</li> </ul>	<p>Example of calculation</p> <p>mol Na<sub>2</sub>CO<sub>3</sub> = 25.0 × 0.105 ÷ 1000 = 2.625 × 10<sup>-3</sup> / 0.002625</p> <p>2 × 2.625 × 10<sup>-3</sup> = 5.25 × 10<sup>-3</sup></p> <p>5.25 × 10<sup>-3</sup> × 1000 ÷ 22.65 = 0.23179 / 2.3179 × 10<sup>-1</sup> (mol dm<sup>-3</sup>)</p> <p>The reacting volumes transposed gives the final concentration of hydrochloric acid = 0.19026 (mol dm<sup>-3</sup>). This scores (2)</p> <p>The same volume used twice will give the final concentration of hydrochloric acid = 0.2100 (mol dm<sup>-3</sup>). These score (2)</p> <p>TE at each stage Ignore SF except 1 SF Allow any correct method Correct answer with some working scores (3)</p>	<p>(3)</p> <p>Expert</p>

(Total for Question 4 = 9 marks)

(Total for Paper = 50 marks)