



## Mark Scheme (Results)

January 2025

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

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## General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

## Using the Mark Scheme

Examiners should look for qualities to reward rather than faults to penalise. This does NOT mean giving credit for incorrect or inadequate answers, but it does mean allowing candidates to be rewarded for answers showing correct application of principles and knowledge. Examiners should therefore read carefully and consider every response: even if it is not what is expected it may be worthy of credit.

The mark scheme gives examiners:

- an idea of the types of response expected
- how individual marks are to be awarded
- the total mark for each question
- examples of responses that should NOT receive credit.

/ means that the responses are alternatives and either answer should receive full credit.

( ) means that a phrase/word is not essential for the award of the mark, but helps the examiner to get the sense of the expected answer.

Phrases/words in **bold** indicate that the meaning of the phrase or the actual word is **essential** to the answer.

ecf/TE/cq (error carried forward) means that a wrong answer given in an earlier part of a question is used correctly in answer to a later part of the same question.

Candidates must make their meaning clear to the examiner to gain the mark. Make sure that the answer makes sense. Do not give credit for correct words/phrases which are put together in a meaningless manner. Answers must be in the correct context.

| Question Number | Answer   | Additional Guidance   | Mark     |
|-----------------|--|---|----------|
| <b>1(a)(i)</b>  | <p>A description that makes reference to the following points:</p> <p><b>M1</b> – nichrome wire</p> <p><b>M2</b> – use of (concentrated) hydrochloric acid/HCl((aq))</p> <p><b>M3</b> – transfer of sample to wire <b>and</b> placement in (hot/roaring/colourless/blue/non-luminous) <b>flame</b></p> <p><b>M4 (standalone)</b> – lilac (flame colour of potassium)</p> | <p>(1) Allow loop or rod for wire<br/>Accept nickel-chromium (alloy)/NiCr wire<br/>Allow platinum/Pt wire<br/>Allow silica rod<br/>Do not award just nickel/Ni or chromium/Cr wire<br/>Do not award inoculating loop / sterilising wire / wooden splint</p> <p>(1) Allow any reasonable use of HCl((aq)), eg in cleaning of wire / in making a paste/solution<br/>Do not award any other acid</p> <p>(1) Allow solid/potassium sulfate/K<sub>2</sub>SO<sub>4</sub>/salt/compound/substance/powder/paste/solution for sample</p> <p>Allow any suitable method of transferring sample to the wire, eg dipping wire in sample</p> <p>Ignore spray solution in flame</p> <p>Allow on/over/under/near/show/above for “in” flame</p> <p>Do not award safety/yellow flame<br/>Do not award fire for flame<br/>Do not award burn in flame</p> <p>(1) Ignore violet/mauve/lavender<br/>Do not award pink<br/>Do not award purple</p> | <b>4</b> |

| Question Number | Answer   | Additional Guidance  | Mark     |
|-----------------|--|--|----------|
| <b>1(a)(ii)</b> | An answer that makes reference to the following points: <ul style="list-style-type: none"> <li>• colour of precipitate <b>(1)</b></li> <li>• ionic equation with state symbols <b>(1)</b></li> </ul> | <p>white<br/>Ignore shades, eg pale/bright/dull<br/>Do not award any other colour, eg creamy-white</p> <p><math>\text{Ba}^{2+}(\text{aq}) + \text{SO}_4^{2-}(\text{aq}) \rightarrow \text{BaSO}_4(\text{s})</math><br/>Allow multiples</p> <p>Ignore full equations as working, even if incorrect</p> <p>Do not award uncanceled <math>\text{Cl}^-</math>, <math>\text{K}^+</math> or <math>\text{H}^+</math> spectator ions</p> | <b>2</b> |

| Question Number | Answer   | Additional Guidance   | Mark     |
|-----------------|--|---|----------|
| <b>1(b)(i)</b>  | An explanation that makes reference to the following points: <ul style="list-style-type: none"> <li>• (gas turned litmus) blue <b>(1)</b></li> <li>• (showing formation of) ammonia/<math>\text{NH}_3</math> <b>(1)</b></li> </ul> | <p>Allow (litmus showed) production of alkaline/basic gas</p> <p>Ignore purple for blue<br/>Ignore effervescence<br/>Ignore pungent smell<br/>Ignore universal indicator paper<br/>Ignore litmus turned blue by ammonium ions/<math>\text{NH}_4^+</math></p> <p>Do not award litmus turned blue by solution/sodium hydroxide<br/>Do not award other incorrect observations, eg rotten-egg smell</p> <p>Allow any indication of production of ammonia/<math>\text{NH}_3</math>, eg<br/><math>(\text{NH}_4^+ + \text{OH}^- \rightarrow) \text{NH}_3 (+ \text{H}_2\text{O})</math></p> | <b>2</b> |

| Question Number | Answer  | Additional Guidance   | Mark     |
|-----------------|---|---|----------|
| <b>1(b)(ii)</b> | An answer that makes reference to the following points: <ul style="list-style-type: none"><li data-bbox="376 419 987 456">• formula of gas evolved (1)</li><li data-bbox="376 496 987 564">• formula of precipitate that dissolved in dilute nitric acid (1)</li><li data-bbox="376 604 987 673">• formula of precipitate that dissolved in concentrated ammonia solution (1)</li></ul> | Penalise use of names for formulae once only<br>Ignore state symbols, even if incorrect<br><br>CO <sub>2</sub><br><br>Ag <sub>2</sub> CO <sub>3</sub><br><br>AgBr | <b>3</b> |

(Total for Question 1 = 11 marks)

| Question Number | Answer  | Additional Guidance  | Mark |
|-----------------|---|--|------|
| 2(a)            | <p>An answer that makes reference to the following points:</p> <p><b>M1</b></p> <ul style="list-style-type: none"> <li>moles magnesium added</li> </ul> <p><b>M2</b></p> <ul style="list-style-type: none"> <li>moles hydrochloric acid required</li> <li>or</li> <li>volume of hydrochloric acid required</li> <li>or</li> <li>moles of magnesium required</li> <li>or</li> <li>mass of magnesium required</li> </ul> <p><b>M3 – dependent on M1 and M2</b></p> <ul style="list-style-type: none"> <li>HCl is in excess</li> <li>or</li> <li>Mg is limiting</li> </ul> | <p><u>Examples of calculation</u></p> <p><b>(1)</b> <math>= 0.030 \div 24.3 = 0.0012346 / 1.2346 \times 10^{-3}</math> (mol)<br/> Allow <math>0.00125 / 1.25 \times 10^{-3}</math> (mol) from <math>A_r = 24</math></p> <p><math>= 0.0012346 \times 2 = 0.0024692 / 2.4692 \times 10^{-3}</math> (mol)</p> <p><math>= 0.0012346 \times 2 = 0.0024692 / 2.4692 \times 10^{-3}</math> (mol)<br/> and<br/> <math>= 0.0024692 \div 2.0 = 0.0012346 \text{ dm}^3 = 1.2346 \text{ cm}^3</math></p> <p><math>= 0.05 \div 2 = 0.025</math> (mol)</p> <p><b>(1)</b> <math>= 0.05 \div 2 = 0.025</math> (mol)<br/> and<br/> <math>= 0.025 \times 24.3 = 0.6075</math> (g)</p> <p>Allow just moles HCl added = <math>2.0 \times 0.025 = 0.05</math> in M2<br/> (which is allowed to be given to 1SF)</p> <p>Allow any indication that HCl is in excess,<br/> eg <math>0.05 / \text{moles of HCl} &gt; 0.0024692 / \text{twice moles of Mg}</math><br/> eg <math>25 \text{ (cm}^3\text{)} / \text{added volume} &gt; 1.2346 \text{ (cm}^3\text{)} / \text{required volume}</math></p> <p><b>(1)</b> Allow any indication that Mg is limiting,<br/> eg <math>0.0012346 / \text{moles of Mg} &lt; 0.025 / \text{half moles of HCl}</math><br/> eg <math>0.03 \text{ (g)} / \text{added mass} &lt; 0.6075 \text{ (g)} / \text{required mass}</math></p> | 3    |

| Question Number | Answer  | Additional Guidance  | Mark     |
|-----------------|---|--|----------|
| 2(b)            | <p>An answer that makes reference to one of the following points:</p> <ul style="list-style-type: none"> <li>(Mg is) not in contact with hydrochloric acid/HCl(aq)</li> </ul> <p><b>or</b></p> <p>hydrochloric acid/HCl(aq) has not yet diffused (down burette)</p> | <p>Accept (Mg is) only in contact with water<br/> Allow (Mg) does not react / reacts slowly with water<br/> Allow (Mg is) not in contact with reactant(s)</p> <p>Ignore just water is at the top (of the burette)<br/> Ignore (Mg has) magnesium oxide coating / (Mg) does not react until magnesium oxide coating removed<br/> Ignore slow rate</p> <p>Do not award small surface area (of Mg)</p> <p>Allow contents of burette are not mixed / homogeneous<br/> Allow takes time for acid/mixture to reach Mg</p> <p>Ignore takes time for the liquids to switch places<br/> Ignore takes time for the reaction to start<br/> Ignore hydrochloric acid/HCl(aq) is too dilute<br/> Ignore hydrochloric acid is more dense than water</p> <p>Do not award hydrochloric acid is less dense than water</p> | <b>1</b> |

| Question Number | Answer   | Additional Guidance   | Mark |
|-----------------|--|---|------|
| 2(c)            | <ul style="list-style-type: none"> <li>burette reading in Step 4<br/><b>and</b><br/>burette reading in Step 5</li> <li>volume of hydrogen gas</li> </ul> | Ignore units, even if incorrect<br><br>46.25<br><b>and</b><br>10.7(0)<br>Do not award any other answers<br><br>(= 46.25 – 10.70 =) 35.55<br>TE on M1 provided answer is to 2 d.p. | 2    |

| Question Number | Answer  | Additional Guidance   | Mark |
|-----------------|---|---|------|
| 2(d)            | <ul style="list-style-type: none"> <li>moles (of hydrogen = moles Mg) (1)</li> <li>volume of 1 mol of hydrogen gas in cm<sup>3</sup> (1)</li> </ul> | <u>Example of calculation</u><br>$= 0.030 \div 24.3 = 0.0012346 / 1.2346 \times 10^{-3} \text{ (mol)}$<br>Allow $0.00125 / 1.25 \times 10^{-3}$ from $A_r = 24$<br>Do not award moles of HCl = $2 \times 0.0012346 = 0.0024691$<br><br>$= 35.55 \div 0.0012346 = 28796 \text{ (cm}^3\text{)} / 2.8796 \times 10^4 \text{ (cm}^3\text{)}$<br>Allow $28.796 \text{ dm}^3 / 28.796 \text{ L}$<br>Ignore SF except 1SF<br>TE on 2(c)<br>TE on M1<br><br>Correct answer with some working scores (2) | 2    |

| Question Number | Answer  | Additional Guidance   | Mark     |
|-----------------|---|---|----------|
| 2(e)            | <p>An explanation that makes reference to the following points:</p> <ul style="list-style-type: none"> <li>• moles of magnesium/Mg (reacting) would be smaller</li> </ul> <p><b>or</b></p> <p>moles of hydrogen (used in calculation) would be too high <b>(1)</b></p> <ul style="list-style-type: none"> <li>• (cannot account for difference and) effect on (calculated) volume of 1 mole of hydrogen gas <b>(1)</b></li> </ul> | <p>Allow mass for moles<br/> Allow just less magnesium/Mg (reacting)<br/> Allow moles/mass of magnesium/Mg used <b>in calculation</b> would be too high</p> <p>Allow actual mass of magnesium could be (as low as) 0.0294 (g)<br/> Allow actual moles of magnesium could be (as low as) 0.0012099</p> <p>Allow less hydrogen produced (in reaction)</p> <p>Do not award can account for difference (calculated molar) volume would be (even) higher</p> <p>Allow (calculated molar) volume could be (as high as) 29383 (cm<sup>3</sup>)</p> <p>Allow answer for volume</p> <p>If no other marks awarded, (cannot account for difference and) difference between calculated and Data Book values is greater than 2% scores (1)</p> | <b>2</b> |

| Question Number | Answer   | Additional Guidance  | Mark |
|-----------------|--|--|------|
| 2(f)(i)         | <ul style="list-style-type: none"> <li>percentage uncertainty in mass</li> </ul> | <p><u>Example of calculation</u></p> $\left( \frac{2 \times 0.0025}{0.030} \times 100 \right) = 16.667 \%$ <p>Ignore SF except 1SF</p> <p>Correct answer with no working scores (1)</p> <p>Do not award any other answer</p> | 1    |

| Question Number | Answer   | Additional Guidance   | Mark |
|-----------------|--|---|------|
| 2(f)(ii)        | <p>An answer that makes reference to the following point:</p> <ul style="list-style-type: none"> <li>volume of hydrogen/gas (produced) would be greater than burette volume</li> </ul> | <p>Allow volume of hydrogen/gas (produced) too large</p> <p>Allow just too much hydrogen/gas produced</p> <p>Allow titre too large / cannot be measured by burette / capacity of burette too small</p> <p>Allow not enough space (in burette) for hydrogen/gas</p> <p>Allow 71.1(0) cm<sup>3</sup> is greater than 50 cm<sup>3</sup>/burette (volume)</p> <p>Do not award hydrogen/gas produced too quickly</p> <p>Do not award any reference to magnesium being in excess / hydrochloric acid being limiting</p> | 1    |

(Total for Question 2 = 12 marks)

| Question Number | Answer   | Additional Guidance  | Mark     |
|-----------------|--|--|----------|
| 3(a)            | An answer that makes reference to the following point: <ul data-bbox="376 347 1008 383" style="list-style-type: none"><li>• (solution of accurately) known concentration</li></ul> | Allow known mass/amount (of solute) <b>and</b> volume (of solution)<br>Allow specific/stated for known<br>Ignore constant/fixed/uniform/precise/exact for known<br>Ignore solution prepared from a primary standard<br>Ignore any reference to standard conditions | <b>1</b> |

| Question Number | Answer   | Additional Guidance  | Mark     |
|-----------------|--|--|----------|
| <b>3(b)</b>     | <p>A description that makes reference to the following points:</p> <p><b>M1</b> – molar mass of ethanedioic acid dihydrate</p> <p><b>M2</b> – required mass of ethanedioic acid dihydrate</p> <p><b>M3</b> – use of volumetric flask (as final piece of apparatus)</p> <p><b>M4</b> – use of distilled/deionised water (to make solution)</p> <p><b>M5</b> – complete transfer of required mass of solid (to final piece of apparatus with washings if needed) and dissolving</p> <p><b>M6</b> – making (solution) up to the mark / a total volume of 100 cm<sup>3</sup> <b>and</b> mixing</p> | <p><u>Example of calculation</u></p> <p><math>= 2 \times 1 + 2 \times 12 + 4 \times 16 + 2 \times 18 = 126(.0) \text{ (g mol}^{-1}\text{)}</math></p> <p><math>n = 0.0500 \times 0.1000 = 0.005(00) \text{ (mol)}</math><br/> mass = <math>0.005(00) \times 126(.0) = 0.63(0) \text{ (g)}</math><br/> TE on M1</p> <p>Allow standard flask / graduated flask<br/> Do not award conical flask<br/> Do not award round-bottomed flask<br/> Do not award beaker</p> <p>Allow use of distilled/deionised water anywhere in the preparation<br/> <b>Ignore volume of water in M4 and M5</b></p> <p>eg dissolve in beaker and transfer with washings<br/> eg transfer solid, dissolve and add washings from container<br/> eg weigh into flask and dissolve<br/> Do not award any method that would result in only partial transfer of the required mass of solid, eg some remaining in the weighing container</p> <p>Do not award any method that would lead to a solution volume greater than 100 cm<sup>3</sup><br/> Allow any indication of mixing, eg shaking/swirling/stirring/inverting</p> | <b>6</b> |

| Question Number | Answer  | Additional Guidance  | Mark     |
|-----------------|---|--|----------|
| 3(c)(i)         | An answer that makes reference to the following point: <ul style="list-style-type: none"> <li>(25.0 cm<sup>3</sup> volumetric) pipette</li> </ul> | Ignore graduated/adjustable<br>Ignore pipette filler<br><br>Do not award incorrect volume, eg 50.0 cm <sup>3</sup><br><br>Do not award Pasteur/dropping/teat pipette<br>Do not award burette<br>Do not award syringe | <b>1</b> |

| Question Number | Answer  | Additional Guidance   | Mark     |
|-----------------|---|---|----------|
| 3(c)(ii)        | An answer that makes reference to the following points: <ul style="list-style-type: none"> <li>(from) colourless</li> <li>(to pale) pink</li> </ul> | (1) Ignore clear<br><br>(1) Do not award purple<br>Do not award red<br><br>Reverse colour change scores (1) | <b>2</b> |

| Question Number | Answer  | Additional Guidance   | Mark     |
|-----------------|---|---|----------|
| 3(c)(iii)       | An answer that makes reference to the following point: <ul style="list-style-type: none"> <li>BaC<sub>2</sub>O<sub>4</sub> / barium ethanedioate</li> </ul> | If name and formula given then both must be correct<br><br>Accept Ba(COO) <sub>2</sub> / barium oxalate<br>Allow Ba(HC <sub>2</sub> O <sub>4</sub> ) <sub>2</sub> / barium hydrogenethanedioate<br><br>Do not award BaCO <sub>3</sub> / barium carbonate<br>Do not award Ba(HCO <sub>3</sub> ) <sub>2</sub> / barium hydrogencarbonate<br>Do not award BaSO <sub>4</sub> / barium sulfate | <b>1</b> |

| Question Number | Answer   | Additional Guidance  | Mark |
|-----------------|--|--|------|
| 3(c)(iv)        | <p><b>M1</b></p> <ul style="list-style-type: none"> <li>moles of <math>\text{H}_2\text{C}_2\text{O}_4 / \text{Ba}(\text{OH})_2</math> (1)</li> </ul> <p><b>M2 and M3 – method 1</b></p> <ul style="list-style-type: none"> <li>concentration of <math>\text{Ba}(\text{OH})_2</math> (in <math>\text{mol dm}^{-3}</math>) (1)</li> <li>concentration of <math>\text{Ba}(\text{OH})_2</math> (in <math>\text{g dm}^{-3}</math>)<br/><b>and</b><br/>to 2SF or 3SF (1)</li> </ul> <p><b>M2 and M3 – method 2</b></p> <ul style="list-style-type: none"> <li>mass of <math>\text{Ba}(\text{OH})_2</math> (1)</li> <li>concentration of <math>\text{Ba}(\text{OH})_2</math> (in <math>\text{g dm}^{-3}</math>)<br/><b>and</b><br/>to 2SF or 3SF (1)</li> </ul> | <p><u>Example of calculation</u></p> <p><math>= \frac{0.0500 \times 25}{1000} = 0.00125 = 1.25 \times 10^{-3}</math></p> <p><math>= \frac{0.00125 \times 1000}{31.55} = 0.039620 \text{ (mol dm}^{-3}\text{)}</math><br/>TE on M1</p> <p><math>(= 0.039620 \times 171.3 = 6.7868)</math></p> <p>6.8 / 6.79 (<math>\text{g dm}^{-3}</math>)<br/>TE on M2</p> <p><math>= 1.25 \times 10^{-3} \times 171.3 = 0.21413 \text{ (g)}</math><br/>TE on M1</p> <p><math>(= 0.21413 \div 0.03155 = 6.7868)</math></p> <p>6.8 / 6.79 (<math>\text{g dm}^{-3}</math>)<br/>TE on M2</p> <p>Correct answer to <b>2SF or 3SF</b> with some working scores (3)</p> | 3    |

(Total for Question 3 = 14 marks)

| Question Number | Answer   | Additional Guidance   | Mark     |
|-----------------|--|---|----------|
| <b>4(a)</b>     | <p>An answer that makes reference to one of the following points:</p> <ul style="list-style-type: none"> <li>• (to prevent) acid spray</li> </ul> <p><b>or</b></p> <p>(to prevent production of) toxic fumes (of HCl)</p> <p><b>or</b></p> <p>(to prevent mixture getting) too hot</p> <p><b>or</b></p> <p>(to prevent) build up of pressure</p> | <p>Ignore just vigorous/violent/aggressive reaction<br/>Ignore just to control rate</p> <p>Allow (to prevent) splashing/spilling of acid due to vigorous/violent/aggressive reaction<br/>Ignore just splashing/spilling of acid</p> <p>Allow (to prevent production of) corrosive fumes (of HCl)<br/>Allow vapour(s)/gas(es) for fumes<br/>Ignore just hydrochloric acid/HCl is toxic/corrosive<br/>Do not award incorrect identification of fumes, eg Cl<sub>2</sub></p> <p>Allow (to prevent) boiling (over)<br/>Ignore just exothermic<br/>Ignore just to control temperature</p> <p>Allow (to prevent) stopper shooting off<br/>Do not award (to prevent) explosion</p> | <b>1</b> |



| Question Number | Answer  | Additional Guidance  | Mark     |
|-----------------|---|--|----------|
| 4(c)            | <p>An answer that makes reference to one of the following points:</p> <ul style="list-style-type: none"> <li>• reacts with organic product/layer</li> </ul> <p><b>or</b></p> <p>reforms alcohol</p> <p><b>or</b></p> <p>acts as a nucleophile</p> | <p>Ignore cannot tell when neutralisation/reaction is complete<br/>Ignore more hazardous, eg (more) corrosive</p> <p>Accept reacts with 2-chloro-2-methylpropane/<math>(\text{CH}_3)_3\text{CCl}</math><br/>Ignore damages/destroys/decomposes for reacts<br/>Ignore just too reactive / to prevent vigorous reaction<br/>Ignore side reactions<br/>Ignore reacts with hydrochloric acid<br/>Do not award reacts with water/alcohol</p> <p>Accept reforms 2-methylpropan-2-ol/<math>(\text{CH}_3)_3\text{COH}</math><br/>Allow forms alkene/2-methylpropene/<math>\text{CH}_2\text{C}(\text{CH}_3)_2</math></p> <p>Allow hydrolyses (organic product)<br/>Allow (causes) elimination (reaction)<br/>Do not award reference to incorrect reaction type</p> <p>Do not award other incorrect reasons, eg build up of pressure</p> | <b>1</b> |

| Question Number | Answer  | Additional Guidance  | Mark     |
|-----------------|---|--|----------|
| <b>4(d)</b>     | An answer that makes reference to the following point: <ul style="list-style-type: none"><li data-bbox="376 347 591 379">• drying agent</li></ul> | Ignore any reference to making clear<br><br>Allow to remove/absorb water<br>Allow drying reagent<br>Allow just to dry<br><br>Ignore to react with water<br><br>Do not award dehydrating agent<br>Do not award any other reason | <b>1</b> |

| Question Number | Answer   | Additional Guidance  | Mark |
|-----------------|--|--|------|
| 4(e)            | <p>An answer that makes reference to the following points:</p> <p><b>M1 (first change)</b> – reverse (condenser) water flow</p> <p><b>M2 (reason for first change)</b>– to fill (condenser) with water</p> <p><b>M3 (second change)</b> – stopper/seal (still head with thermometer)</p> <p><b>M4 (reason for second change)</b> – to prevent escape of gas/vapour/product</p> | <p>Accept changes given in either order<br/>Allow changes to be shown on the diagram</p> <p>Ignore any reference to a heat source<br/>Ignore any reference to adding (more) water to the ice-water mixture</p> <p><b>(1)</b> Allow any indication, eg water should enter at bottom / leave at top / “swap tap and sink”</p> <p><b>M2 must relate to (condenser) water flow</b><br/><b>(1)</b> Allow to remove air/bubbles (from condenser)<br/>Allow for more efficient/better cooling</p> <p><b>(1)</b> Allow block<br/>Allow just bung/cork<br/>Ignore lid<br/>Ignore just thermometer<br/>Do not award stopper/seal conical flask<br/>Do not award diagrams showing thermometer with gap in still head / bulb in the organic liquid</p> <p><b>(1)</b> <b>M4 must relate to stopper/thermometer (in still head)</b><br/>Allow thermometer to measure temperature</p> | 4    |

| Question Number | Answer   | Additional Guidance  | Mark |
|-----------------|--|--|------|
| 4(f)            | <p><b>M1</b></p> <ul style="list-style-type: none"> <li>• mass of 2-methylpropan-2-ol (1)</li> </ul> <p><b>M2 to M4 – method 1</b></p> <ul style="list-style-type: none"> <li>• theoretical moles for 100% yield (1)</li> <li>• theoretical mass for 100% yield (1)</li> <li>• mass of 2-chloro-2-methylpropane for 70% yield (1)</li> </ul> <p><b>M2 to M4 – method 2</b></p> <ul style="list-style-type: none"> <li>• theoretical moles for 100% yield (1)</li> <li>• theoretical moles for 70% yield (1)</li> <li>• mass of 2-chloro-2-methylpropane for 70% yield (1)</li> </ul> <p><b>M2 to M4 – method 3</b></p> <ul style="list-style-type: none"> <li>• theoretical mass for 70% yield (1)</li> <li>• theoretical moles for 70% yield (1)</li> <li>• mass of 2-chloro-2-methylpropane for 70% yield (1)</li> </ul> | <p>Allow TE throughout<br/>Ignore SF except 1SF</p> <p>Correct answer with some working scores (4)</p> <p><u>Examples of calculation:</u><br/> <math>= 0.78 \times 9.0 = 7.02 \text{ (g)}</math><br/> <math>= 7.02 \div 74.0 = 0.094865 \text{ (mol)}</math><br/> <math>= 0.094865 \times 92.5 = 8.775 \text{ (g)}</math><br/> <math>= 0.70 \times 8.775 = 6.1425 \text{ (g)}</math><br/> <math>= 7.02 \div 74.0 = 0.094865 \text{ (mol)}</math><br/> <math>= 0.70 \times 0.094865 = 0.066405 \text{ (mol)}</math><br/> <math>= 0.066405 \times 92.5 = 6.1425 \text{ (g)}</math><br/> <math>= 0.70 \times 7.02 = 4.914 \text{ (g)}</math><br/> <math>= 4.914 \div 74.0 = 0.066405 \text{ (mol)}</math><br/> <math>= 0.066405 \times 92.5 = 6.1425 \text{ (g)}</math></p> | 4    |

(Total for Question 4 = 13 marks)

Total for Paper = 50 marks

