

# Mark Scheme (Results)

January 2014

IAL Chemistry (WCH03/01)

Unit 3: Chemistry Laboratory Skills 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.
- Mark schemes will indicate within the table where, and which strands of QWC, are being assessed. The strands are as follows:
  - i) ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear
  - ii) select and use a form and style of writing appropriate to purpose and to complex subject matter
  - iii) organise information clearly and coherently, using specialist vocabulary when appropriate

## 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.

## Quality of Written Communication

Questions which involve the writing of continuous prose will expect candidates to:

- write legibly, with accurate use of spelling, grammar and punctuation in order to make the meaning clear
- select and use a form and style of writing appropriate to purpose and to complex subject matter
- organise information clearly and coherently, using specialist vocabulary when appropriate.

Full marks will be awarded if the candidate has demonstrated the above abilities.

Questions where QWC is likely to be particularly important are indicated (QWC) in the mark scheme, but this does not preclude others.

| Question Number | Acceptable answers                                                                                      | Reject                                                                                         | Mark     |
|-----------------|---------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|----------|
| <b>1(a)</b>     | Ba <sup>2+</sup> / barium (ion)<br><br>If charge is given must be correct<br><br>ALLOW Ba <sup>+2</sup> | Ba<br>Ba <sup>+</sup><br>Cu <sup>2+</sup><br>Correct name with incorrect formula or vice versa | <b>1</b> |

| Question Number | Acceptable answers                                                                                                                                                                                                           | Reject                          | Mark     |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|----------|
| <b>1(b)</b>     | Carbonate / CO <sub>3</sub> <sup>2-</sup><br><br>ALLOW<br>Hydrogencarbonate / HCO <sub>3</sub> <sup>-</sup> / sulfite / sulfate (IV) / SO <sub>3</sub> <sup>2-</sup> / hydroxide / OH <sup>-</sup> / oxide / O <sup>2-</sup> | Barium carbonate<br><br>sulfate | <b>1</b> |

| Question Number | Acceptable answers                                                                | Reject                                                                                       | Mark     |
|-----------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|----------|
| <b>1(c)</b>     | Cl <sup>-</sup> / chloride (ion)<br><br>ALLOW Cl <sup>-1</sup> , Cl <sup>1-</sup> | Cl, Cl <sub>2</sub> ,<br>Chlorine (ion)<br>Correct name with incorrect formula or vice versa | <b>1</b> |

| Question Number | Acceptable answers                                           | Reject                                                   | Mark     |
|-----------------|--------------------------------------------------------------|----------------------------------------------------------|----------|
| <b>1(d)(i)</b>  | (The white precipitate goes ) darker / purple / grey / lilac | (Goes) black, silver, silvery, cream, pale yellow, green | <b>1</b> |

| Question Number | Acceptable answers     | Reject          | Mark     |
|-----------------|------------------------|-----------------|----------|
| <b>1(d)(ii)</b> | Silver<br><br>ALLOW Ag | Ag <sup>+</sup> | <b>1</b> |

| Question Number | Acceptable answers                                                 | Reject            | Mark     |
|-----------------|--------------------------------------------------------------------|-------------------|----------|
| <b>1(e)(i)</b>  | White precipitate<br><br>ALLOW<br>White solid<br>Both words needed | Just "goes white" | <b>1</b> |

| Question Number | Acceptable answers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Reject                                                                                                                                                                                                                                                                                                                                                    | Mark     |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| <b>1(e)(ii)</b> | <p><math>\text{BaCl}_2(\text{aq}) + \text{H}_2\text{SO}_4(\text{aq}) \rightarrow \text{BaSO}_4(\text{s}) + 2\text{HCl}(\text{aq})</math></p> <p>OR</p> <p><math>\text{Ba}^{2+}(\text{aq}) + \text{SO}_4^{2-}(\text{aq}) \rightarrow \text{BaSO}_4(\text{s})</math></p> <p>OR</p> <p><math>\text{Ba}^{2+}(\text{aq}) + 2\text{Cl}^-(\text{aq}) + 2\text{H}^+(\text{aq}) + \text{SO}_4^{2-}(\text{aq}) \rightarrow \text{BaSO}_4(\text{s}) + 2\text{Cl}^-(\text{aq}) + 2\text{H}^+(\text{aq})</math></p> <p><b>First mark</b></p> <p>All formulae correct (1)</p> <p>TE from the cation in 1(a) and the anion in 1(c) if the charge on the ion chosen is correct eg <math>\text{Cu}^{2+}</math></p> <p><b>Second mark</b></p> <p>Balancing and state symbols (1)</p> <p>ALLOW second mark for ss and balancing in equation with mixture of ions and molecules</p> <p><math>\text{Ba}^{2+}(\text{aq}) + \text{H}_2\text{SO}_4(\text{aq}) \rightarrow \text{BaSO}_4(\text{s}) + 2\text{H}^+(\text{aq})</math> scores 1</p> <p>TE for second mark based on incorrect formulae only if a balanced equation forming a precipitate is given eg</p> <p><math>2\text{BaCl}(\text{aq}) + \text{H}_2\text{SO}_4(\text{aq}) \rightarrow \text{Ba}_2\text{SO}_4(\text{s}) + 2\text{HCl}(\text{aq})</math> scores 1</p> <p>No TE for equations with incorrect products e.g. <math>\text{H}_2</math> and <math>\text{Cl}_2</math></p> | <p>Any incorrect formulae</p> <p>For first mark, equation with mixture of ions and molecules eg</p> <p><math>\text{Ba}^{2+}(\text{aq}) + \text{H}_2\text{SO}_4(\text{aq}) \rightarrow \text{BaSO}_4(\text{s}) + 2\text{H}^+(\text{aq})</math></p> <p><math>\text{HCl}(\text{g})</math></p> <p>Equations in which hydrogen or sulfur dioxide is formed</p> | <b>2</b> |

| Question Number | Acceptable answers                                                      | Reject                                          | Mark     |
|-----------------|-------------------------------------------------------------------------|-------------------------------------------------|----------|
| <b>1(f)(i)</b>  | HCl / hydrogen chloride<br><br>ALLOW<br>(Droplets of) hydrochloric acid | Hydrogen chloride ions<br>Hydrochloric acid gas | <b>1</b> |

| Question Number | Acceptable answers                                                                                                                                                                                                                                                                                                                                                                                                           | Reject                                                                                                                            | Mark     |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|----------|
| <b>1(f)(ii)</b> | (mix gas being tested with )<br>ammonia / hold open ammonia<br>bottle near fumes (1)<br><br>ALLOW<br>(test with) ammonia (gas)<br>Use of ammonia solution if clearly on<br>a glass rod / stopper<br><br>White smoke / white solid forms (1)<br><br>Allow <b>dense white</b> fumes, <b>white</b><br>precipitate<br><br>No TE if gas in (f)(i) is not HCl<br>No TE in second mark if test given<br>for first mark is incorrect | Dissolve in water<br>and test with<br>silver nitrate<br><br>Indicators<br><br>Misty / smoky<br>fumes<br><br>Just "White<br>fumes" | <b>2</b> |

**Total for Question 1 = 11 marks**

| Question Number | Acceptable answers                                                      | Reject                                            | Mark     |
|-----------------|-------------------------------------------------------------------------|---------------------------------------------------|----------|
| <b>2(a)(i)</b>  | Orange to green / blue / brown<br><br>ALLOW<br>Dark green / green-brown | Combinations of blue and green<br>Green to orange | <b>1</b> |

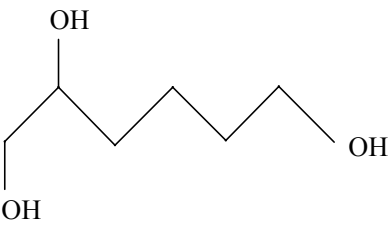
| Question Number | Acceptable answers                                                                                                                                                                                                                                                       | Reject                                                                  | Mark     |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|----------|
| <b>2(a)(ii)</b> | $\text{CH}_2=\text{CH}(\text{CH}_2)_3\text{COOH}$<br>Double bond need not be shown<br><br>ALLOW $\text{CO}_2\text{H}$ for $\text{COOH}$<br><br>ALLOW<br><br><br>ALLOW displayed formula | $\text{C}_6\text{H}_{10}\text{O}_2$<br><br>Formulae not showing H atoms | <b>1</b> |

| Question Number | Acceptable answers                                                                                                                                                                                                                                                                                                          | Reject                                                                                                                                   | Mark     |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|----------|
| <b>2(b)</b>     | Any TWO of<br><br>Bubbles / effervescence / fizzing<br><br>Sodium dissolves / disappears<br><br><b>White</b> residue / solid /<br>ALLOW<br><b>White</b> precipitate<br><br>ALLOW<br>Rise in temperature / gets hotter /<br>heat is given out<br><br>IGNORE<br>Moves / Floats / Sinks / Catches fire<br>/ Hydrogen given off | Just "Gas forms"<br>Bubbles form if incorrect gas identified.<br><br>White solid dissolves<br><br>Crystals form<br><br>Just "exothermic" | <b>2</b> |

| Question Number | Acceptable answers                                                                   | Reject                                                                                    | Mark     |
|-----------------|--------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|----------|
| <b>2(c)(i)</b>  | Brown / red-brown / orange / yellow<br>/ combinations of these colours to colourless | Red to colourless<br>Clear for colourless<br>Paler for colourless<br>White for colourless | <b>1</b> |

| Question Number | Acceptable answers                                                                                                                                                                                                                                                                                                                                  | Reject                                   | Mark |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|------|
| 2(c)(ii)        | <div> <p>Br at left hand end without a bond to it</p> </div> <p>ALLOW</p> <div> </div> <p>ALLOW</p> <div> </div> <p>IGNORE orientation of Br and OH, eg both Br pointing down<br/>IGNORE lengths of bonds</p> <p>Check that there are <b>6C</b> in formula</p> | Br at left hand end without a bond to it | 1    |

| Question Number | Acceptable answers                                                                                                | Reject                                                                                            | Mark     |
|-----------------|-------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|----------|
| <b>2(d)(i)</b>  | Purple / pink to colourless<br><br>ALLOW<br>For purple pink: pinkish-purple, dark purple<br>For colourless: brown | Clear for colourless<br>White for colourless<br>Green / orange for colourless<br>Lilac for purple | <b>1</b> |

| Question Number | Acceptable answers                                                                                                                                                                                                       | Reject                                                                | Mark     |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|----------|
| <b>2(d)(ii)</b> |  <p>IGNORE orientation of OH, eg both OH pointing down<br/>IGNORE lengths of bonds</p> <p>Check that there are <b>6C</b> in formula</p> | OH at left hand end without a bond to it<br><br>Bond to H of OH group | <b>1</b> |

| Question Number | Acceptable answers                                                                                                                                                                                                                                                                                                                                                   | Reject | Mark     |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|----------|
| <b>2(e)</b>     | <p>hex-5-en-1-ol</p> <p>Alkene/ C=C at 1669 – 1600 (cm<sup>-1</sup>)<br/>(alkene) C-H at 3100-3010 (cm<sup>-1</sup>)</p> <p>Correct identification <b>and</b> one correct piece of evidence (<b>1</b>)</p> <p>Correct identification with two pieces of evidence (<b>2</b>)</p> <p>Correct identification and correct bonds quoted without any data can score 1.</p> |        | <b>2</b> |

**Total for Question 2 = 10 marks**

| Question Number | Acceptable answers                                                                                                                                                                                                                                                                   | Reject                                                                                                                                                                                                                                                                                           | Mark     |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| <b>3(a)(i)</b>  | <p>No sharp colour change / colour change gradual / difficult to see end-point/ end-point not clear / end-point not obvious / no specific colour change at end-point / colour change hard to distinguish</p> <p>many different colours during the vertical section of a pH curve</p> | <p>Colour changes slowly<br/>Does not give accurate results<br/>No significant colour change<br/>end-point not visible<br/>Colour does not change in vertical section of pH curve</p> <p>Forms various colours with acid and alkali</p> <p>Comments about suitability for weak/ strong acids</p> | <b>1</b> |

| Question Number | Acceptable answers                                                                                                                                                                                                                                                                                                                                                                          | Reject                                                                                          | Mark     |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|----------|
| <b>3(a)(ii)</b> | <p>Suitable acid-base indicator (1)</p> <p>correct colours (1)</p> <p>Likely answers:<br/>methyl orange (1)<br/>red in acid, yellow in alkali (1)</p> <p>Phenolphthalein (1)<br/>colourless in acid, pink / purple / red in alkali (1)</p> <p>ALLOW<br/>Bromothymol blue (1)<br/>Yellow in acid, blue in alkali (1)</p> <p>No TE on colours for litmus<br/>Second mark depends on first</p> | <p>Litmus</p> <p>Orange for red</p> <p>Spelling is not a reasonable match for pronunciation</p> | <b>2</b> |

| Question Number | Acceptable answers                                                                        | Reject             | Mark     |
|-----------------|-------------------------------------------------------------------------------------------|--------------------|----------|
| <b>3(b)(i)</b>  | $\frac{(22.80 \times 0.250)}{1000} =$ $5.70 \times 10^{-3} / 5.7 \times 10^{-3} / 0.0057$ | $6 \times 10^{-3}$ | <b>1</b> |

| Question Number | Acceptable answers                                                       | Reject | Mark     |
|-----------------|--------------------------------------------------------------------------|--------|----------|
| <b>3(b)(ii)</b> | $5.70 \times 10^{-3} / 5.7 \times 10^{-3} / 0.0057$<br>TE: Same as 3b(i) |        | <b>1</b> |

| Question Number  | Acceptable answers                                                                                                                                                                  | Reject                                             | Mark     |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|----------|
| <b>3(b)(iii)</b> | $(2.00 \times 10^{-2} - 5.70 \times 10^{-3})$ $= 1.43 \times 10^{-2} / 14.30 \times 10^{-3} / 0.0143$ TE<br>$2.00 \times 10^{-2} - \text{answer from 3b(ii)}$<br>IGNORE SF except 1 | Numbers obtained without having done a subtraction | <b>1</b> |

| Question Number | Acceptable answers                                                                                                                                                                                                                                                                                                                                | Reject                                               | Mark     |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|----------|
| <b>3(b)(iv)</b> | $\text{Mol Mg(OH)}_2 = \text{answer to 3b(iii)} / 2$ $= 7.15 \times 10^{-3} / 0.00715$ $\text{mass} = 58.3 \times \text{number of mol}$ $= 0.416845$ $= 0.417 \text{ (g)}$ TE for second mark based on number of moles calculated for first mark.<br>ALLOW use of 58 instead of 58.3 (giving 0.415(g))<br>Correct answer with no working scores 2 | Answers with more or less than 3 significant figures | <b>2</b> |

| Question Number | Acceptable answers                                                                                                                                                                   | Reject                                                                                                                                                   | Mark     |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| <b>3(c)(i)</b>  | <p>Split sample into two / several portions (so that titration can be repeated)</p> <p>OR make solution to a standard volume (e.g. 100cm<sup>3</sup>) and take measured aliquots</p> | <p>Just "repeat the titration"</p> <p>Just " use more concentrated acid " or "Use more acid".</p> <p>Use more accurate burettes / pipettes / balance</p> | <b>1</b> |

| Question Number | Acceptable answers                                                                                                                                                                        | Reject                              | Mark     |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|----------|
| <b>3(c)(ii)</b> | <p><math>\frac{100 \times (2 \times 0.05)}{40.00} = (\pm) 0.250 / 0.25\%</math></p> <p>Doubling error in each reading (1)</p> <p>Final answer (1)</p> <p>0.125% / 0.13% scores 1 mark</p> | <p>0.3 / 0.30%</p> <p>0.12, 0.1</p> | <b>2</b> |

| Question Number | Acceptable answers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Reject                                                                                                                                                     | Mark     |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| <b>3(d)</b>     | <p>Any two from</p> <p>Use (finely) powdered magnesium hydroxide</p> <p>Use moderately concentrated acid / acid which is not very dilute/ acid of higher concentration / keep excess acid to minimum possible volume.</p> <p>Ensure good mixing / stir mixture</p> <p>ALLOW</p> <p>Measure temperature before adding magnesium hydroxide and for some time after; plot temperatures against time and extrapolate (cooling) line (to where reagents are mixed, to allow for cooling)</p> <p>IGNORE</p> <p>Put a lid on the container/ other comments on insulation</p> | <p>Break magnesium hydroxide into smaller pieces</p> <p>Use a more accurate thermometer</p> <p>Just "plot temperatures against time and extrapolating"</p> | <b>2</b> |

**Total for Question 3 = 13 marks**

| Question Number | Acceptable answers                                                                                                                                                            | Reject                           | Mark     |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|----------|
| <b>4(a)(i)</b>  | Dehydrating agent / dehydration/<br>removes (elements of) water /<br>removes H <sub>2</sub> O / eliminates water /<br>eliminates H and OH<br><br>IGNORE reference to catalyst | Drying agent<br>Just elimination | <b>1</b> |

| Question Number | Acceptable answers                                                                                                                               | Reject                                                                                | Mark     |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|----------|
| <b>4(a)(ii)</b> | Corrosive / burns skin (1)<br><br>Wear gloves (1)<br><br>Second mark depends on first being<br>corrosive <b>or</b> harms skin <b>or</b> irritant | Just "harms skin"<br>Toxic<br><br>Use tongs<br>Avoid spillage<br>Use fume<br>cupboard | <b>2</b> |

| Question Number | Acceptable answers                                                                                                                                                                                                                                                                                                                                                                                                              | Reject                                                                                                | Mark     |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|----------|
| <b>4(b)</b>     | <b>First mark</b><br>Apparatus should not be completely<br>sealed / put vent in apparatus /<br>leave gap between condenser and<br>receiving flask / insert gas outlet /<br>use receiving flask with opening (1)<br><br>ALLOW<br>"Open end of apparatus for pressure<br>release"<br><br><b>Second mark</b><br>Move (bulb of) thermometer to<br>opposite opening to condenser (1)<br><br>These points may be shown on<br>diagram. | Just "Move<br>thermometer up"/<br>"position in neck<br>of flask" /<br>"position in mouth<br>of flask" | <b>2</b> |

| Question Number | Acceptable answers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Reject                                                                                                                                         | Mark     |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| <b>4(c)(i)</b>  | <p>EITHER</p> <p>Cyclohexene only forms London forces / cyclohexene only forms van der Waals forces / cyclohexene can only form weak forces / cyclohexene is non-polar AND water is polar (1)</p> <p>Hydrogen bonds would be broken if cyclohexene mixed with water / cyclohexene cannot form hydrogen bonds with water / cyclohexene cannot replace hydrogen bonds with a strong bond / cyclohexene cannot form bonds with water of comparable strength (to original ones) (1)</p> <p>OR (alternative approach)</p> <p>Hydrogen bonds would be broken if cyclohexene mixes with water (1)</p> <p>Only weaker London forces would replace them (1)</p> <p>IGNORE comments on ionic bonding in sodium chloride</p> | <p>Just "cyclohexene is non-polar"</p> <p>Cyclohexene forms permanent dipole-dipole forces</p> <p>Just "there are hydrogen bonds in water"</p> | <b>2</b> |

| Question Number | Acceptable answers                                                                                                                                                                                                                                                            | Reject                                                                                                         | Mark     |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|----------|
| <b>4(c)(ii)</b> | <p>Separating funnel with tap (and stopper)</p> <p>ALLOW</p> <p>Any shaped tube with opening at top which can be stoppered and tap at bottom (1)</p> <p>Cyclohexene in upper layer (1)</p> <p>Don't penalise if labelled cyclohexane, not -ene.</p> <p>Mark independently</p> | <p>Filter funnel</p> <p>Buchner funnel</p> <p>Very large opening at the top of the funnel.</p> <p>3 layers</p> | <b>2</b> |

| Question Number | Acceptable answers                                                                                                                                           | Reject                                                                                | Mark     |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|----------|
| <b>4(d)(i)</b>  | (anhydrous) calcium chloride / $\text{CaCl}_2$ / magnesium sulfate / $\text{MgSO}_4$ / sodium sulphate / $\text{Na}_2\text{SO}_4$<br><br>ALLOW<br>silica gel | Other compounds, even if anhydrous<br>Incorrect formulae (concentrated) sulfuric acid | <b>1</b> |

| Question Number | Acceptable answers                                         | Reject                                                          | Mark     |
|-----------------|------------------------------------------------------------|-----------------------------------------------------------------|----------|
| <b>4(d)(ii)</b> | (cloudy) liquid would go clear/ liquid becomes less cloudy | Volume decreases<br>Water layer disappears<br>Viscosity changes | <b>1</b> |

| Question Number | Acceptable answers                                                                                                                                               | Reject                                                                         | Mark     |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|----------|
| <b>4(e)</b>     | (re)distillation (collecting liquid close to its boiling point)<br><br>ALLOW<br>Simple distillation<br>Fractional distillation<br>Correct description of process | collecting liquid more than $5^\circ$ from its boiling point)<br><br>Filtering | <b>1</b> |

| Question Number | Acceptable answers                                                                                                                                                                                                             | Reject                     | Mark     |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|----------|
| <b>4(f)(i)</b>  | Mass cyclohexanol = $(0.100 \times 100)$<br>= 10.0/ 10 g <b>(1)</b><br><br>Volume = $\frac{10.0}{0.962}$<br><br>= 10.395 / 10.40/ 10.4 ( $\text{cm}^3$ ) <b>(1)</b><br><br>Second mark TE from mass of cyclohexanol calculated | 10/ 10.39( $\text{cm}^3$ ) | <b>2</b> |

| Question Number | Acceptable answers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Reject                                      | Mark            |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|-----------------|
| <b>4(f)(ii)</b> | <p>EITHER</p> <p>Max yield = <math>(0.100 \times 82)</math><br/> <math>= 8.20 / 8.2\text{g}</math> (1)</p> <p>% yield = <math>\frac{(5.50 \times 100)}{8.20} =</math></p> <p>67.073/ 67.1/ 67% (1)</p> <p>Second mark TE from mass of cyclohexene, but NOT if max yield = 10.4 or 10 (ie from volume of cyclohexanol or molar mass of cyclohexanol).</p> <p>OR</p> <p>Mol cyclohexene = <math>\frac{5.5}{82}</math></p> <p>= 0.067073 (1)</p> <p>Ignore sf except 1 sf</p> <p>% yield = <math>\frac{(0.067073 \times 100)}{0.1} =</math></p> <p>67.073/ 67.1/ 67% (1)</p> <p>Correct answer with no working scores 2<br/>         Use of 84 as molar mass cyclohexene scores max 1</p> <p>Ignore SF except 1</p> | <p>0 overall if yield greater than 100%</p> | <p><b>2</b></p> |

**Total for Question 4 = 16 marks**

