



## Mark Scheme (Results)

Summer 2019

Pearson International Advanced Level  
In Chemistry (WCH06) Paper 01 Chemistry  
Laboratory Skills II

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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.

Question Number	Acceptable Answers	Reject	Mark
1(a)(i)	<p><b>A</b> contains Na<sup>+</sup>/sodium (ions)                      IGNORE                      Na</p> <p><b>and</b></p> <p><b>B</b> contains Ca<sup>2+</sup>/calcium (ions)                      IGNORE                      Ca</p>	Ca <sup>+</sup>	(1)

Question Number	Acceptable Answers	Reject	Mark
1(a)(ii)	<p>White</p> <p>IGNORE                      Formulae even if incorrect</p>	Colourless	(1)

Question Number	Acceptable Answers	Reject	Mark
1(a)(iii)	<p><math>2\text{H}^+(\text{aq}) + \text{CO}_3^{2-}(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g})</math></p> <p><b>Correct species and balancing</b>                      ALLOW                      Multiples                      Cancelled/crossed out spectator ions (1)</p> <p>IGNORE                      Additional equations as working</p> <p><b>State symbols</b>                      Conditional on correct species (or near miss or full equation)</p> <p>ALLOW in M2  <math>\text{H}_2\text{CO}_3(\text{aq})</math> for <math>\text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g})</math> (1)</p>		(2)

Question Number	Acceptable Answers	Reject	Mark
1(a)(iv)	Silver nitrate / $\text{AgNO}_3(\text{aq})$  IGNORE Nitric acid/ $\text{HNO}_3$ Ammonia / $\text{NH}_3$ Lead nitrate / $\text{Pb}(\text{NO}_3)_2(\text{aq})$	Sodium nitrate / $\text{NaNO}_3(\text{aq})$  $\text{HCl}/\text{H}_2\text{SO}_4/\text{NaOH}$	(1)

Question Number	Acceptable Answers	Reject	Mark
1(b)(i)	Manganese(II) hydroxide / $\text{Mn}(\text{OH})_2$  ALLOW $\text{Mn}(\text{H}_2\text{O})_4(\text{OH})_2$ (1)  (Darkens as) oxidised (by oxygen in the air to oxides/hydroxides of manganese(III)/(IV))  ALLOW Reacts with oxygen (1)  IGNORE Formulae of manganese oxides/ hydroxides provided +3/+4 Mn oxidation state Colour of manganese oxides/hydroxides	$\text{Mg}(\text{OH})_2$ / magnesium hydroxide   Oxidation state higher than +4	(2)

Question Number	Acceptable Answers	Reject	Mark
1(b)(ii)	$[\text{Zn}(\text{OH})_4]^{2-}$ / $[\text{Zn}(\text{H}_2\text{O})_2(\text{OH})_4]^{2-}$  ALLOW $[\text{Zn}(\text{OH})_6]^{4-}$ $[\text{Zn}(\text{OH})_3]^-$ / $[\text{Zn}(\text{H}_2\text{O})_3(\text{OH})_3]^-$ $\text{ZnO}_2^{2-}$  IGNORE Missing square brackets  Correct charges within square brackets provided they total the charge on the complex ion  State symbols even if incorrect	$\text{Zn}(\text{OH})_2$ / $[\text{Zn}(\text{OH})_2]^-$ $\text{Zn}(\text{H}_2\text{O})_4(\text{OH})_2$ $[\text{Zn}(\text{H}_2\text{O})_4]^{2+}$ / $[\text{Zn}(\text{H}_2\text{O})_6]^{2+}$	(1)

Question Number	Acceptable Answers	Reject	Mark
1(b)(iii)	<p>(E is) iron(II) nitrate / <math>\text{Fe}(\text{NO}_3)_2</math></p> <p>ALLOW Ferrous nitrate <math>\text{Fe}(\text{NO}_3)_2 \cdot x\text{H}_2\text{O}</math> (1)</p> <p>IGNORE hydrated anhydrous</p> <p>(Brown solid is) iron(III) hydroxide / <math>\text{Fe}(\text{OH})_3</math></p> <p>ALLOW <math>\text{Fe}(\text{H}_2\text{O})_3(\text{OH})_3</math> Hydrated iron(III) oxide / <math>\text{Fe}_2\text{O}_3 \cdot x\text{H}_2\text{O}</math> <math>\text{FeO}(\text{OH})</math> (1)</p> <p>IGNORE Just iron(III) oxide / <math>\text{Fe}_2\text{O}_3</math> Just rust</p>	<p><math>\text{Fe}(\text{NO}_3)_3</math> Iron(III) nitrate Just iron nitrate</p> <p><math>\text{Fe}(\text{OH})_2</math> Iron(II) hydroxide Just iron hydroxide</p>	(2)

(Total for Question 1 = 10 marks)

Question Number	Acceptable Answers	Reject	Mark
2(a)(i)	<p>(X is a) ketone</p> <p>ALLOW Carbonyl/C=O (1)</p> <p>IGNORE Aldehyde</p> <p>(with an) adjacent methyl (1)</p> <p>IGNORE Correct statements relating to positive or negative tests prior to final answer</p> <p>Any C<sub>6</sub>H<sub>12</sub>O structure or name if no contradiction</p> <p>Methyl ketone / methyl carbonyl / CH<sub>3</sub>C(=)O scores (2)</p> <p>Methyl secondary alcohol / CH<sub>3</sub>CH(OH) scores (0)</p>	<p>Alcohol</p> <p>Ethanal / CH<sub>3</sub>CHO</p> <p>Methyl aldehyde</p> <p>Methyl alcohol / CH<sub>3</sub>CH(OH)</p> <p>Any additional functional group</p>	(2)

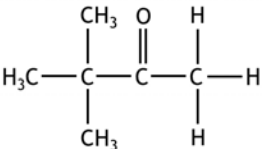
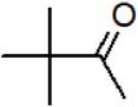
Question Number	Acceptable Answers	Reject	Mark
2(a)(ii)	<p>IGNORE Structures throughout Alkane throughout</p> <p><b>Alkene</b> ALLOW C=C Carbon-carbon double bond (1) IGNORE Just unsaturated/double bond</p> <p><b>Alcohol</b> ALLOW Hydroxyl / hydroxy OH/-OH/C-OH (1) IGNORE Primary and/or secondary</p>	<p>Phenyl/benzene</p> <p>C=O</p> <p>Saturated</p> <p>Phenol</p> <p>Hydroxide / OH<sup>-</sup></p> <p>Carboxylic acid COOH</p> <p>Tertiary</p>	(2)



Question Number	Acceptable Answers	Reject	Mark
2(a)(iii)	$C_6H_{12}O + Na \rightarrow C_6H_{11}O^{(-)}Na^{(+)} + \frac{1}{2}H_2$  ALLOW Multiples $C_6H_{11}Na^{(+)}O^{(-)}$  IGNORE State symbols, even if incorrect	O-Na $O^{(+)}Na^{(-)}$ H / $H^+$	(1)

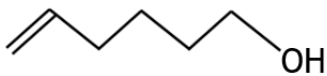
Question Number	Acceptable Answers	Reject	Mark
2(b)(i)	2 proton environments  ALLOW Hydrogen/H for proton Types/kinds for environment  IGNORE $H^+$ for proton References to symmetry References to just number of protons		(1)

Question Number	Acceptable Answers	Reject	Mark
2(b)(ii)	Each proton environment has no adjacent protons  ALLOW No neighbouring protons Hydrogen/H for proton  IGNORE $H^+$ for proton Protons are isolated Reference to n+1 rule Reference to O-H protons Reference to number of proton environments		(1)

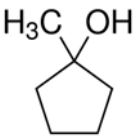
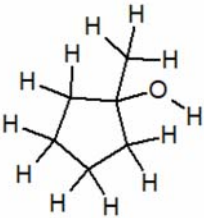
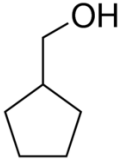
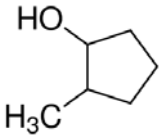
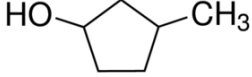
Question Number	Acceptable Answers	Reject	Mark
2(b)(iii)	<p>Allow displayed, structural or skeletal formula, or any correct combination of these</p> <p>eg</p> $(CH_3)_3CCOCH_3$   <p>IGNORE Bond lengths and bond angles Name, even if incorrect</p>	Any other answer	(1)

Question Number	Acceptable Answers	Reject	Mark
2(c)(i)	<p><b>Y</b> is a 1-ene</p> <p>ALLOW The C=C bond is at the end of the chain</p> <p>OR</p> <p>One of the carbon atoms in the C=C has two hydrogens / two identical groups/atoms attached</p> <p>ALLOW Both carbon atoms of the C=C have the same group/atom attached</p> <p>IGNORE References to restricted rotation</p>	<p>...two molecules ...functional groups</p> <p>'similar' for 'same'</p>	(1)

Question Number	Acceptable Answers	Reject	Mark
2(c)(ii)	<p>No carbon/atom with four different groups attached</p> <p>ALLOW 'functional groups' or 'atoms' for groups OR No chiral carbon/centre OR No asymmetric carbon/centre OR Is a primary alcohol / not a secondary alcohol</p> <p>IGNORE Achiral/not chiral Is symmetric No effect on plane polarised light Does not have enantiomers Is not non-superimposable</p>	<p>molecules</p> <p>bonds</p>	<p><b>1 exp</b></p>

Question Number	Acceptable Answers	Reject	Mark
2(c)(iii)	<p>Allow displayed, structural or skeletal formula, or any correct combination of these</p> <p>eg</p> <p>CH<sub>2</sub>CHCH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>OH</p> $  \begin{array}{c}  \text{H} \quad \text{CH}_2(\text{CH}_2)_2\text{CH}_2\text{OH} \\    \quad   \\  \text{C} = \text{C} \\    \quad   \\  \text{H} \quad \text{H}  \end{array}  $  <p>IGNORE Connectivity of OH group Name, even if incorrect</p>	<p>Any other answer</p> <p>C-H-O</p>	<p><b>(1)</b></p>

Question Number	Acceptable Answers	Reject	Mark
2(d)(i)	Tertiary alcohol  ALLOW Tertiary hydroxy(l)/OH group 3° for tertiary		(1)

Question Number	Acceptable Answers	Reject	Mark
2(d)(ii)	<p>Allow displayed, structural or skeletal formula, or any correct combination of these eg</p>   <p>Mark independently of (d)(i) except ALLOW</p>  <p>if answer to (d)(i) is <b>primary</b> alcohol</p>  <p>OR</p>  <p>if answer to (d)(i) is <b>secondary</b> alcohol</p> <p>IGNORE Connectivity of OH group Name, even if incorrect</p>		(1)

C-H-O

(Total for Question 2 = 13 marks)

Question Number	Acceptable Answers	Reject	Mark
3(a)(i)	Self-indicating ALLOW Colour changes at the end of the reaction / end-point  OR  Manganate(VII)/MnO <sub>4</sub> <sup>-</sup> ions are purple <b>and</b> manganese(II)/Mn <sup>2+</sup> ions are colourless  OR  Colour changes as MnO <sub>4</sub> <sup>-</sup> reduced/converted to Mn <sup>2+</sup>  IGNORE Colours due to Fe <sup>2+</sup> and Fe <sup>3+</sup>		(1)

Question Number	Acceptable Answers	Reject	Mark
3(a)(ii)	(From) colourless to (permanent pale) pink  ALLOW (pale) green to pink	(Pale) purple	(1)

Question Number	Acceptable Answers	Reject	Mark
3(b)	<b>Mark M1 and M2 independently</b>  Titre value will not be affected/remain the same/be unchanged <b>(1)</b>  (as titre is) difference between two readings ALLOW Both/all/two/initial and final readings taken from the top of the liquid/in the same way <b>(1)</b>  IGNORE Error cancels out  If no other mark awarded <b>and</b> effect on titre not stated then 'titre value is inaccurate due to increased uncertainty/parallax error (in reading from the top of the meniscus)' scores (1)		(2)

Question Number	Acceptable Answers	Reject	Mark																				
3(c)(i)	<p><b>First mark</b> – three titre values correctly recorded to <b>2DP</b> in table</p> <table border="1" data-bbox="462 331 1107 575"> <thead> <tr> <th data-bbox="462 331 716 394">Titration numbers</th> <th data-bbox="716 331 813 394">1</th> <th data-bbox="813 331 911 394">2</th> <th data-bbox="911 331 1008 394">3</th> <th data-bbox="1008 331 1107 394">4</th> </tr> </thead> <tbody> <tr> <td data-bbox="462 394 716 457">Burette reading (final) / cm<sup>3</sup></td> <td data-bbox="716 394 813 457">10.85</td> <td data-bbox="813 394 911 457">21.40</td> <td data-bbox="911 394 1008 457">31.60</td> <td data-bbox="1008 394 1107 457">42.40</td> </tr> <tr> <td data-bbox="462 457 716 520">Burette reading (initial) / cm<sup>3</sup></td> <td data-bbox="716 457 813 520">0.00</td> <td data-bbox="813 457 911 520">10.85</td> <td data-bbox="911 457 1008 520">21.40</td> <td data-bbox="1008 457 1107 520">32.10</td> </tr> <tr> <td data-bbox="462 520 716 575">Titre / cm<sup>3</sup></td> <td data-bbox="716 520 813 575">10.85</td> <td data-bbox="813 520 911 575"><u>10.55</u></td> <td data-bbox="911 520 1008 575"><u>10.20</u></td> <td data-bbox="1008 520 1107 575"><u>10.30</u></td> </tr> </tbody> </table> <p><b>(1)</b></p> <p><b>Second mark</b> – calculating mean titre from concordant results</p> <p>Mean titre = <math>(10.2(0) + 10.3(0))/2</math>  <math>= 10.25 \text{ (cm}^3\text{)}</math></p> <p>TE on averaging of concordant results from incorrect subtraction in table</p> <p>ALLOW            3DP for mean titre if average = X.XX5 <b>(1)</b></p>	Titration numbers	1	2	3	4	Burette reading (final) / cm <sup>3</sup>	10.85	21.40	31.60	42.40	Burette reading (initial) / cm <sup>3</sup>	0.00	10.85	21.40	32.10	Titre / cm <sup>3</sup>	10.85	<u>10.55</u>	<u>10.20</u>	<u>10.30</u>		<b>(2)</b>
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Titre / cm <sup>3</sup>	10.85	<u>10.55</u>	<u>10.20</u>	<u>10.30</u>																			

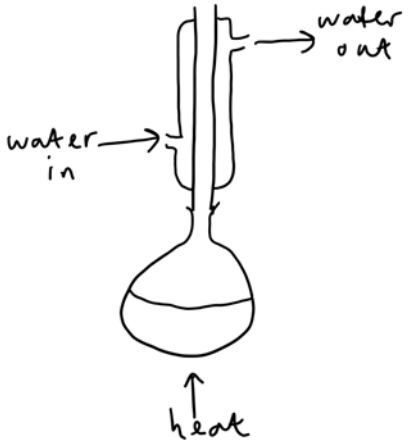
Question Number	Acceptable Answers	Reject	Mark
3(c)(ii)	<p>Correct answer with correct units to 3SF or 2SF and no working scores <b>(5)</b></p> <p>Mol <math>\text{MnO}_4^-</math> used  <math>= 0.00500 \times 10.25/1000</math>  <math>= 0.00005125 / 5.125 \times 10^{-5}</math>                      TE on mean titre <b>(1)</b></p> <p>Mol <math>\text{Fe}^{2+}</math> in <math>10.0 \text{ cm}^3</math>  <math>= 0.00005125 \times 5</math>  <math>= 0.00025625 / 2.5625 \times 10^{-4}</math>                      TE on mol <math>\text{MnO}_4^-</math> used <b>(1)</b></p> <p>Mol <math>\text{Fe}^{2+}</math> in <math>100.0 \text{ cm}^3</math>  <math>= 0.00025625 \times 100.0/10.0</math>  <math>= 0.0025625 / 2.5625 \times 10^{-3}</math>                      TE on mol <math>\text{Fe}^{2+}</math> in <math>10.0 \text{ cm}^3</math> <b>(1)</b></p> <p>Mass <math>\text{FeSO}_4 \cdot 7\text{H}_2\text{O}</math> in <math>100.0 \text{ cm}^3</math>/two tablets  <math>= 0.0025625 \times 277.9</math>  <math>= 0.712119 \text{ (g)}</math>                      TE on mol <math>\text{Fe}^{2+}</math> in <math>100.0 \text{ cm}^3</math> <b>(1)</b></p> <p>Mass <math>\text{FeSO}_4 \cdot 7\text{H}_2\text{O}</math> in one tablet to 3SF/2SF  <math>= 0.712119/2</math>  <math>= 0.356 \text{ g} / 356 \text{ mg}</math>                      TE on mass <math>\text{FeSO}_4 \cdot 7\text{H}_2\text{O}</math> in <math>100.0 \text{ cm}^3</math>/two tablets                      TE on <math>M_r \text{ FeSO}_4 \cdot 7\text{H}_2\text{O}</math> <b>(1)</b></p>	<p>Incorrect/ missing units</p>	<b>(5)</b>

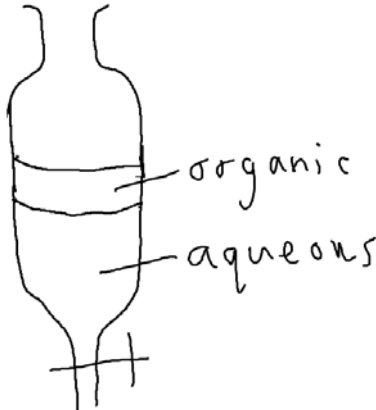
Question Number	Acceptable Answers	Reject	Mark
3(d)	<p><b>First mark</b> – % uncertainty in mean titre</p> <p><math>(0.05 \times 2)/10.25 \times 100 = 0.9756/0.976/0.98/1.0/1\%</math> TE on mean titre from (c)(i) <b>(1)</b></p> <p><b>Second mark</b> – % uncertainty in pipette</p> <p><math>0.06/10.0 \times 100 = 0.6\%</math> <b>(1)</b> (so burette has greater percentage uncertainty)</p> <p>Both uncertainties calculated correctly but labelled incorrectly scores (1)</p> <p><math>\pm 0.05</math> for pipette gives % uncertainty 0.5% <b>and</b> <math>\pm 0.06</math> for burette gives % uncertainty 1.17% scores (1)</p> <p>mean titre for pipette volume (with TE) gives % uncertainty = <math>0.06/(\text{mean titre}) \times 100</math> <b>and</b> <math>10 \text{ cm}^3</math> for burette volume gives % uncertainty = 1% scores (1)</p>		<b>(2)</b>

**(Total for Question 3 = 13 marks)**



Question Number	Acceptable Answers	Reject	Mark
4(a)	<p><b>(Concentrated sulfuric acid)</b> Catalyst</p> <p>ALLOW To speed up the reaction To shift the equilibrium to the right <b>(1)</b></p> <p>IGNORE To initiate reaction To provide H<sup>+</sup> As a solvent</p> <p><b>(Anti-bumping granules)</b> For smooth boiling / heating ALLOW 'uniform/even/gentle' for 'smooth' To promote formation of small bubbles To provide nucleation sites</p> <p>OR</p> <p>To prevent superheating / violent/flash boiling ALLOW 'vigorous/uneven/localised/sudden' for 'violent/flash' To prevent formation of large bubbles <b>(1)</b></p> <p>IGNORE To prevent bumping To prevent splashing/spitting/spillage</p>	<p>Just gentle heating</p> <p>Explosion</p>	<b>(2)</b>

Question Number	Acceptable Answers	Reject	Mark
4(b)	 <p><b>First mark</b> Heat/arrow (may be directed to any part of the liquid in the flask) / heating mantle / electric heater</p> <p><b>and</b></p> <p>Round-bottom/pear-shaped flask</p> <p><b>and</b></p> <p>Vertical condenser/tube <b>(1)</b></p> <p>IGNORE No reaction mixture in flask</p> <p><b>Second mark</b> Condenser jacket <b>and</b> correct water direction (water in must be below water out) ALLOW Correct unlabelled arrows or just water in/out <b>(1)</b></p>	<p>Water bath</p> <p>Sealed apparatus or accidental lines sealing apparatus <b>unless qualified</b></p> <p>Gaps at apparatus joints</p> <p>Conical flask</p> <p>Lack of joint between flask and condenser</p> <p>Thermometer in condenser</p>	(2)

Question Number	Acceptable Answers	Reject	Mark
4(c)	 <p><b>First mark</b> Diagram of separating funnel (with or without stopper/bung)</p> <p>ALLOW Any shape separating funnel with tap at the bottom (no label required) if capable of being sealed with a bung <b>(1)</b></p> <p><b>Second mark</b> Aqueous and organic layers labelled in correct order</p> <p>ALLOW Just one labelled layer if two layers shown</p> <p>3-methylbutyl ethanoate/ester for organic layer</p> <p>Water/ethanoic acid for aqueous layer <b>(1)</b></p> <p>IGNORE 3-methylbutan-1-ol/ alcohol/ product for organic layer</p> <p>IGNORE 3-methylbutan-1-ol/alcohol/ reactant for aqueous layer</p>	<p>Sealed apparatus (if stopper/bung unclear)</p> <p>Burette</p> <p>More than two layers</p>	<b>(2)</b>

Question Number	Acceptable Answers	Reject	Mark
4(d)	<p>To react with/neutralise any (remaining sulfuric) acid</p> <p>ALLOW</p> <p>To remove the (sulfuric/ethanoic) acid / H<sup>+</sup></p> <p>To neutralise the organic layer (1)</p> <p>(Aqueous layer) turns damp red litmus blue</p> <p>ALLOW</p> <p>Test with (red) litmus paper</p> <p>Test with universal indicator paper</p> <p>Remove sample and test with any named indicator</p> <p>IGNORE</p> <p>Just test with any named indicator</p> <p>ALLOW</p> <p>(Confirm alkalinity) with pH meter</p> <p>ALLOW</p> <p>Add sodium hydrogencarbonate and no effervescence is observed (1)</p>	<p>Mention of NaOH</p> <p>HCl (or other acids)</p> <p>Addition of any named indicator to the funnel</p>	(2)

Question Number	Acceptable Answers	Reject	Mark
4(e)	<p>To avoid contamination (of the distillate) with 3-methylbutan-1-ol / unreacted alcohol <b>(1)</b> IGNORE Ethanoic acid Water</p> <p>(Because) the boiling temperature of 3-methylbutan-1-ol is lower (than that of 3-methylbutyl ethanoate) ALLOW 131°C for lower</p> <p>OR</p> <p>(The distillate) would contain a lower yield of 3-methylbutyl ethanoate as its boiling temperature is 142°C/higher than 140°C <b>(1)</b> IGNORE 3-methylbutyl ethanoate will not be collected below 140°C</p> <p>If no other mark awarded, 'to obtain a pure product' or 'to avoid contamination with impurities' scores (1)</p>		<b>(2)</b>

Question Number	Acceptable Answers	Reject	Mark
4(f)(i)	<p>Correct answer with no working scores <b>(3)</b></p> <p><b>First mark</b> – calculating mass of 3-methylbutan-1-ol</p> <p>Mass 3-methylbutan-1-ol  <math>= 0.81 \times 7.5 (= 6.075 \text{ (g)})</math> <b>(1)</b></p> <p><b>Second mark</b> – calculating moles of 3-methylbutan-1-ol</p> <p>Moles 3-methylbutan-1-ol  <math>= 6.075/88.0 (= 0.069034)</math>                      TE on mass <b>(1)</b></p> <p><b>Third mark</b> – calculating moles / theoretical mass of product and % yield</p> <p>EITHER</p> <p>Moles 3-methylbutyl ethanoate  <math>= 4.75/130.0 = 0.036538</math>  <b>and</b>  <math>\% \text{ yield} = 0.036538/0.069034 \times 100</math>  <math>= 52.928</math>  <math>= 53</math>                      TE on moles 3-methylbutan-1-ol</p> <p>OR</p> <p>Theoretical mass 3-methylbutyl ethanoate  <math>= 0.069034 \times 130.0</math>  <math>= 8.9744 \text{ (g)}</math>                      TE on moles 3-methylbutan-1-ol  <b>and</b>  <math>\% \text{ yield} = 4.75/8.9744 \times 100</math>  <math>= 52.928</math>  <math>= 53</math> <b>(1)</b></p> <p>IGNORE SF except 1 SF throughout</p>	<p>&gt;100%</p> <p>&gt;100%</p>	<p><b>(3)</b></p>

Question Number	Acceptable Answers	Reject	Mark
4(f)(ii)	(The reaction/esterification is) equilibrium/reversible  ALLOW (The reaction) does not go to completion The ester product is (partially) hydrolysed  IGNORE Any reference to side reactions/additional products/impurities  IGNORE Any correct reason relating to the method of preparation/transfer losses	by NaHCO <sub>3</sub>  Water is a by-product	(1)

(Total for Question 4 = 14 marks)

TOTAL FOR PAPER = 50 MARKS

