Pearson Edexcel

# Mark Scheme (Results)

## October 2021

Pearson Edexcel International Advanced Level In Chemistry (WCH16)
Paper 01: Practical Skills in Chemistry 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.

**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 |
|---|---|---|---|
| **1(a)(i)** | A description that makes reference to the following point:<br><br>• blue precipitate (forms) | Accept light / pale blue<br>Allow ppt / ppte / solid for precipitate<br><br>Ignore formulae even if incorrect<br><br>Do not award mixed colours e.g. blue / green<br>Do not award dark blue / royal blue / navy blue | **(1)** |

| Question Number | Answer | Additional Guidance | Mark |
|---|---|---|---|
| **1(a)(ii)** | • (the initial blue solution goes) green **(1)**<br><br>• (this changes to a) yellow (solution) **(1)** | Allow any shades of colours e.g. bright<br>Ignore formulae even if incorrect<br>Penalise green precipitate or yellow precipitate once only<br><br>Ignore mention of blue precipitate<br><br>If no other mark is awarded, allow (1) for green-yellow / yellow-green (solution) | **(2)** |

| Question Number | Answer | Additional Guidance | Mark |
|---|---|---|---|
| 1(b) | A description that makes reference to the following points:<br><br>• addition of (dilute) hydrochloric acid / HCl(aq) **and** barium chloride (solution) / $BaCl_2$(aq) **(1)**<br><br>• white precipitate (forms) **(1)** | Allow names or formulae of reagents but if both are given, both must be correct<br><br>Allow HCl / acidified / $H^+$ / dilute nitric acid / $HNO_3$(aq) for hydrochloric acid<br>Allow barium nitrate solution / $Ba(NO_3)_2$(aq) for barium chloride (solution)<br>Ignore concentration of acid<br>Do not award sulfuric acid<br><br>Conditional on use of barium chloride or barium nitrate with or without any acid<br>Allow ppt / ppte / solid for precipitate<br>Ignore cloudy<br>Ignore incorrect name / formula of precipitate<br>Do not award just 'turns white' | **(2)** |

| Question Number | Answer | Additional Guidance | Mark |
|---|---|---|---|
| 1(c)(i) | • calculation of $E^{\ominus}_{cell}$ | Example of calculation:<br>0.77 – 0.34<br>= (+)0.43 (V)<br><br>Correct answer with no working scores (1)<br><br>Do not award −0.43 (V) | **(1)** |

| Question Number | Answer | Additional Guidance | Mark |
|---|---|---|---|
| 1(c)(ii) | • low voltage supply **and** replace with (high resistance) voltmeter **(1)**<br>• (platinum) wire **and** replace with salt bridge **(1)**<br>• iron (electrode) **and** replace with platinum **(1)** | Penalise **additional** incorrect changes<br>The mistakes can be in any order<br><br>Allow potentiometer / Wheatstone bridge<br>Do not award voltameter<br><br>Allow a description of a salt bridge containing potassium / sodium / ammonium with nitrate / chloride | **(3)** |

| Question Number | Answer | Additional Guidance | Mark |
|---|---|---|---|
| 1(d)(i) | • balanced equation | Example of equation:<br>$Zn + 4HNO_3 \rightarrow Zn(NO_3)_2 + 2NO_2 + 2H_2O$<br>Allow<br>$Zn + 4H^+ + 2NO_3^- \rightarrow Zn^{2+} + 2NO_2 + 2H_2O$<br><br>Allow multiples<br><br>Ignore state symbols, even if incorrect<br><br>Do not award equation with copper | **(1)** |

| Question Number | Answer | Additional Guidance | Mark |
|---|---|---|---|
| **1(d)(ii)** | • (10 $cm^3$) measuring cylinder | Allow 25 $cm^3$ measuring cylinder but no bigger size specified<br>Allow measurement on the side of a beaker<br><br>Do not award burette / pipette / volumetric flask | **(1)** |

| Question Number | Answer | Additional Guidance | Mark |
|---|---|---|---|
| **1(d)(iii)** | • (when the solution is) straw coloured / pale yellow | Allow near / approaching / just before the end point<br><br>Ignore at the end point / before the end point<br><br>Do not award just yellow / pale brown | **(1)** |

| Question Number | Answer | | Additional Guidance | Mark |
|---|---|---|---|---|
| 1(d)(iv) | • calculation of mol $S_2O_3^{2-}$ | **(1)** | Example of calculation:<br>Mol $S_2O_3^{2-}$ used = $\frac{28.60 \times 0.100}{1000}$<br>$= 0.00286 / 2.86 \times 10^{-3}$ | **(5)** |
| | • calculation of mol of $Cu^{2+}$ in 25.0 $cm^3$ | **(1)** | (Mol $I_2$ formed = 0.00143)<br>Mol of $Cu^{2+}$ in 25.0 $cm^3$ = $0.00286 / 2.86 \times 10^{-3}$<br>TE on mol $S_2O_3^{2-}$ | |
| | • calculation of mol $Cu^{2+}$ in 250 $cm^3$ | **(1)** | Mol $Cu^{2+}$ in 250 $cm^3$ = $0.00286 \times 10$<br>$= 0.0286 / 2.86 \times 10^{-2}$<br>TE on mol $Cu^{2+}$ in 25.0 $cm^3$ | |
| | • calculation of mass of Cu | **(1)** | Mass of Cu = $0.0286 \times 63.5$<br>= 1.8161 (g)<br>TE on mol $Cu^{2+}$ in 250 $cm^3$ | |
| | • calculation of percentage of copper in brass<br>**and**<br>answer to 2 / 3 SF | **(1)** | Percentage of copper = $\frac{1.8161}{3.90} \times 100 = 46.567$<br>= 46.6 / 47 (%)<br>TE on mass Cu unless percentage >100%<br><br>Allow answer to 2 / 3 SF from earlier correct rounding<br>1.82 g gives 46.7 / 47(%)<br>1.8 g gives 46.2 / 46(%)<br>Correct answer with no or some working scores (5) | |

**(Total for Question 1 = 17 marks)**

| Question Number | Answer | Additional Guidance | Mark |
|---|---|---|---|
| **2(a)(i)** | • **Test 1**: aldehyde or ketone / −CHO or C=O **(1)**<br><br>• **Test 2**: aldehyde / −CHO **(1)** | Allow structural / displayed / skeletal formulae<br>Ignore COH / C=O for aldehyde in M1 and M2<br><br>Both needed for the mark<br>Allow carbonyl (compound)<br>Do not award methyl ketone / specific aldehydes and ketones for M1 only | **(2)** |

| Question Number | Answer | Additional Guidance | Mark |
|---|---|---|---|
| **2(a)(ii)** | • copper(I) oxide / $Cu_2O$ | If name and formula given, both must be correct<br>Ignore copper oxide / $Cu^+$ | **(1)** |

| Question Number | Answer | Additional Guidance | Mark |
|---|---|---|---|
| **2(b)(i)** | • $C_2H_5^+$ / $CH_3CH_2^+$<br>**or**<br>$CHO^+$ | Penalise additional incorrect formulae<br><br>Accept brackets around the formulae<br>Allow charge anywhere on the ion<br>Allow symbols in any order e.g. $H_5C_2^+$ / $COH^+$<br><br>Do not award bond from formula e.g. − $C_2H_5^+$<br><br>Symbols and the charge are needed | **(1)** |

| Question Number | Answer | Additional Guidance | Mark |
|---|---|---|---|
| **2(b)(ii)** | • *m* / *z* value = 58<br>**and**<br>structure of propanal | Example of structure:<br><br>$CH_3CH_2CHO$<br><br>Allow any combination of structural and displayed formula / skeletal formula<br>Ignore $CH_3CH_2COH$ | **(1)** |

| Question Number | Answer | Additional Guidance | Mark |
|---|---|---|---|
| **2(c)(i)** | • **Test 3**: blue **(1)**<br><br>• **Test 4**: amine **(1)** | Allow blue-green / dark green / purple<br>Ignore indigo / violet / mauve<br><br>Allow amino<br><br>Ignore classification of amine<br>Do not award ammine / amide | **(2)** |

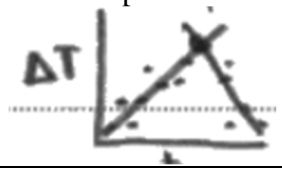
| Question Number | Answer | Additional Guidance | Mark |
|---|---|---|---|
| **2(c)(ii)** | • structure of **B** | Example of structure:<br>$CH_3CH_2CH_2NH_2$ / $CH_3CH_2NHCH_3$ / $(CH_3)_2CHNH_2$ / $(CH_3)_3N$<br><br>Allow any combination of structural and displayed formula / skeletal formula | **(1)** |

**(Total for Question 2 = 8 marks)**

| Question Number | Answer | Additional Guidance | Mark |
|---|---|---|---|
| 3(a) | • polystyrene / it is a better / good insulator<br>**or**<br>reduces / minimises heat loss (to the surroundings )<br>**or**<br>cup has a low heat capacity | Allow description of insulation<br>Allow glass is a poor insulator<br>Ignore reference to polystyrene does not break<br>Ignore prevents / no heat loss<br>Do not award low specific heat capacity | **(1)** |

| Question Number | Answer | | Additional Guidance | Mark |
|---|---|---|---|---|
| 3(b) | • calculation of heat produced | **(1)** | Example of calculation:<br>Heat produced = 25.0 x 4.18 x 12.5<br>= 1306.25 (J) / 1.30625 (kJ)<br>Ignore sign | **(3)** |
| | • calculation of moles of LiCl | **(1)** | Moles of LiCl = $\frac{2.12}{6.9 + 35.5}$ = 0.0500 / 5.00 x $10^{-2}$ (mol)<br>Allow 0.05 / 0.04988 (from 7 for Li) | |
| | • calculation of enthalpy change<br>**and** sign<br>**and** units | **(1)** | Enthalpy change = $-\frac{1306.25}{0.0500}$ = −26125 J $mol^{-1}$<br>Or $-\frac{1.30625}{0.0500}$ = −26.125 kJ $mol^{-1}$<br>TE on heat produced and moles LiCl<br>Ignore SF except 1 SF<br><br>Allow answer from earlier correct rounding to at least 2 SF<br>e.g. −26.2 kJ $mol^{-1}$ from 1.31 kJ<br>Correct answer with sign and units and no working scores (3) | |

| Question Number | Answer | Additional Guidance | Mark |
|---|---|---|---|
| **3(c)** | • calculation of percentage uncertainty | Example of calculation:<br><br>$\frac{2 \times 0.25}{12.5} \times 100 = (\pm)4\ (\%)$<br><br>Correct answer with no working scores (1) | **(1)** |

| Question Number | Answer | Additional Guidance | Mark |
|---|---|---|---|
| **3(d)** | A description that makes reference to the following points:<br><br>• (start a stop watch / clock and) measure the temperature of the water every 30 s for 2½ minutes **(1)**<br><br>• add the lithium chloride at exactly 3 min **(1)**<br><br>• (stir and) record the temperature every 30 s for another 5 minutes **(1)**<br><br>• plot a graph of temperature against time **(1)**<br><br>• (join the two sets of points with 2 best fit straight lines and) extrapolate the lines to the time of mixing<br>**and**<br>determine the maximum temperature change / rise at that time **(1)** | Allow any reasonable specified times / time intervals in M1, M2 and M3<br>Ignore any other changes to the apparatus<br><br>Allow idea of more than one reading to stabilise temperature<br>Allow use of a lid / additional insulation<br><br>Allow start stop watch when LiCl is added<br><br>Stand alone mark for idea of record / measure temperature at regular time intervals<br><br>Do not award if time is on y axis<br>Allow an annotated sketch graph for M4 and M5<br><br>Do not award graph that shows extrapolated lines with temperature increasing then decreasing e.g.<br>  | **(5)** |

**(Total for Question 3 = 10 marks)**

| Question Number | Answer | Additional Guidance | Mark |
|---|---|---|---|
| **4(a)** | • error: (conical) flask<br>correction: change to pear-shaped flask **(1)**<br><br>• error: thermometer should not be in the reaction mixture / liquid / flask<br>correction: thermometer (bulb) should be level with entrance / opening to condenser **(1)**<br><br>• error: apparatus should not be sealed / there would be a build-up of pressure<br>correction:<br>EITHER<br>remove stopper from boiling tube / test tube<br>OR<br>use a bend with a vent / collection tube with side arm **(1)** | If the error is omitted but the correction clearly indicates the error, then award the mark e.g removing the stopper implies what the error was<br>Allow errors and corrections shown on diagram<br>Penalise **additional** incorrect errors e.g. water wrong way in condenser once only<br><br>Allow change to round-bottomed flask<br><br>Allow move thermometer bulb until level with entrance to condenser<br>Ignore just' thermometer should be higher' / 'near to the top' unless shown where on diagram<br>Do not award thermometer at neck of flask<br><br>Allow replace sealed test tube with beaker / measuring cylinder/ unstoppered container<br><br>Ignore just 'change test tube to flask' unless mention of open / no bung | **(3)** |

<table>
<tr><th>Question Number</th><th>Answer</th><th>Additional Guidance</th><th>Mark</th></tr>
<tr>
<td>4(b)</td>
<td>A description that makes reference to the following points:<br><br>• test (1)<br><br>• observation with alcohol (1)</td>
<td>Examples of tests:
<table>
<tr><th>Test</th><th>Observation with alcohol</th></tr>
<tr><td>$PCl_5$ / phosphorus(V) chloride / phosphorus pentachloride</td><td>Steamy fumes<br>Allow white / misty fumes<br>Allow gas turns blue litmus red<br>Do not award white smoke</td></tr>
<tr><td>Ethanoic acid / any carboxylic acid and sulfuric / hydrochloric acid (and heat)</td><td>Fruity smell</td></tr>
<tr><td>Allow<br>Na / sodium</td><td>Effervescence / fizzing / bubbles</td></tr>
</table>
Allow name or formula for reagent but if both are given both must be correct<br><br>Observation conditional on correct or ‘near miss’ reagent e.g. acid missing in ester test<br><br>Ignore acidified potassium / sodium dichromate(VI)<br>Ignore additional conditions e,g, heat<br>Ignore names of gases in observation</td>
<td>(2)</td>
</tr>
</table>

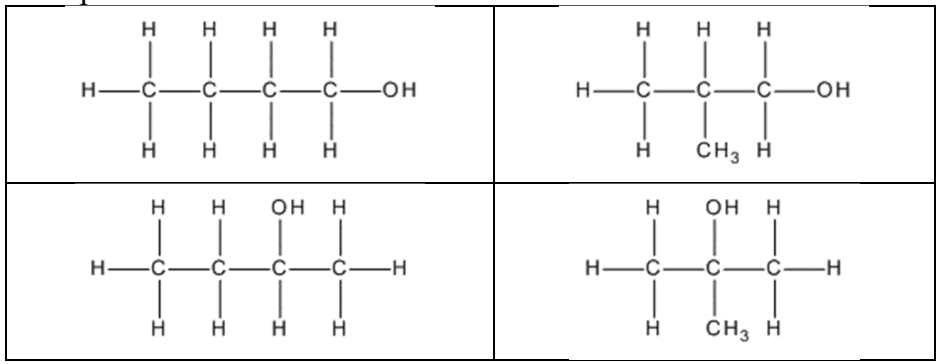
| Question Number | Answer | Additional Guidance | Mark |
|---|---|---|---|
| 4(c)(i) | • balanced equation | Examples of equation:<br><br>$C_6H_5COONa + HCl \rightarrow C_6H_5COOH + NaCl$<br>Or<br>$C_6H_5COONa + H^+ \rightarrow C_6H_5COOH + Na^+$<br>Or<br>$C_6H_5COO^- + H^+ \rightarrow C_6H_5COOH$<br>Or<br>$C_6H_5COO^- + HCl \rightarrow C_6H_5COOH + Cl^-$<br><br>Allow multiples<br>Allow displayed / skeletal formulae / combination of structural, displayed and skeletal formulae for organic reactant / product<br><br>Ignore molecular formulae for organic reactant / product<br>Ignore state symbols even if incorrect<br>Ignore reversible arrow<br>Do not award −O−Na in reactant | **(1)** |

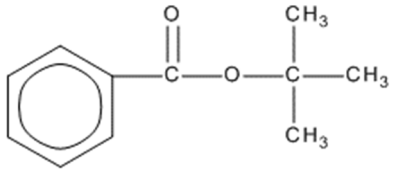
| Question Number | Answer | Additional Guidance | Mark |
|---|---|---|---|
| 4(c)(ii) | • filter (under reduced pressure) | Penalise mention of hot filtration<br><br>Allow any other type of filtration e.g. suction filtration<br>Allow description of filtration using any type of funnel (except separating funnel) and filter paper<br>Allow diagram of filtration<br><br>Ignore decanting / rinsing / drying | **(1)** |

| Question Number | Answer | Additional Guidance | Mark |
|---|---|---|---|
| **4(d)** | • dissolve the benzoic acid / solid / crystals<br>**and**<br>in the minimum amount / volume<br>**and**<br>of boiling / hot water | Allow mix / add / form a (saturated) solution for dissolve<br>Allow solvent for water<br>Allow small amount / volume<br><br>Ignore missing amount / volume<br><br>Do not award incorrect solvent e.g. ethanol | **(1)** |

| Question Number | Answer | Additional Guidance | Mark |
|---|---|---|---|
| **4(e)** | An answer that makes reference to the following points:<br><br>• (melting temperature / it) is lower **(1)**<br><br>• (it melts over) a range of temperatures / (the melting temperature / it) is not sharp **(1)** | Penalise mention of boiling temperature / distillation once only | **(2)** |

| Question Number | Answer | Additional Guidance | Mark |
|---|---|---|---|
| 4(f)(i) | • (alkyl group is) $C_4H_9$ | Allow structural / displayed formula for any $C_4H_9$ group<br>Ignore working<br>Do not award $C_4H_9^+$ | (1) |

| Question Number | Answer | Additional Guidance | Mark |
|---|---|---|---|
| 4(f)(ii) | • four alcohols with formula $C_4H_9OH$ (2) | Examples of alcohols:<br>  <br>Alcohols can be in any order<br>Allow any combination of structural / displayed formulae / skeletal formulae<br><br>Allow (1) for any two or three alcohols correct<br><br>Allow (1) for at least two alcohols as TE from R group in (f)(i)<br><br>Penalise missing H once only<br><br>Penalise incorrect connectivity of horizontal OH groups once only e.g. OH-C on left<br><br>Penalise omission of OH once only i.e. 4 correct carbon skeletons for R scores (1) | (2) |

| Question Number | Answer | Additional Guidance | Mark |
|---|---|---|---|
| **4(f)(iii)** | • structure of any butyl benzoate **(1)**<br>• tertiary butyl R group **(1)** | Example of structure:<br>  <br>Allow any combination of structural / displayed formulae / skeletal formula<br><br>Allow (1) for structure as TE from R group in (f)(i)<br>Allow another mark if the R group would give 2 peaks on $^{13}C$ NMR spectrum | **(2)** |

**(Total for Question 4 = 15 marks)**

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