



Pearson

# Mark Scheme (Results)

January 2018

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

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January 2018

Publications Code WCH06\_01\_1801\_MS

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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.

| Question Number | Acceptable Answer   | Reject  | Mark       |
|-----------------|---|---|------------|
| <b>1(a)</b>     | (Contains)<br>a transition metal (ion) /<br>a transition element<br><br>ALLOW<br>a d-block element<br>(Might contain)<br>chromate(VI) ions/ $\text{CrO}_4^{2-}$ /<br>Iron(III) (ions)/ $\text{Fe}^{3+}$ /<br>$\text{PbI}_2$ / AgI | Dichromate (ions) /<br>$\text{Cr}_2\text{O}_7^{2-}$ /<br>$\text{Cr}^{6+}$ | <b>(1)</b> |

| Question Number | Acceptable Answer   | Reject  | Mark       |
|-----------------|---|---|------------|
| <b>1(b)</b>     | $\text{Na}^+$ (ion) / sodium (cat)ion present<br><br>ALLOW<br><br>Na ion<br>$\text{Na}_2\text{CrO}_4$ | <b>Just</b> 'Na' / sodium<br><br><br>$\text{Na}_2\text{Cr}_2\text{O}_7$<br>NaCl / any other<br>sodium compounds | <b>(1)</b> |

| Question Number | Acceptable Answer  | Reject  | Mark       |
|-----------------|--|---|------------|
| <b>1(c)</b>     | $\text{Cr}_2\text{O}_7^{2-}$<br>$(\text{Cr}_2\text{O}_7)^{2-}$ | $\text{CrO}_4^{2-}$<br>$\text{Na}_2\text{Cr}_2\text{O}_7$ | <b>(1)</b> |

| Question Number | Acceptable Answer   | Reject  | Mark       |
|-----------------|---|---|------------|
| <b>1(d)</b>     | <p><b>1st mark:</b><br/> <math>\text{Cr}_2\text{O}_7^{2-}</math> / dichromate(VI) / chromium(VI) <b>reduced</b></p> <p>ALLOW</p> <p>Chromium is <b>reduced</b></p> <p>OR</p> <p>ethanol is <b>oxidised</b></p> <p>OR</p> <p>ethanol forms ethanoic acid / ethanol forms ethanal (1)</p> <p><b>2nd mark:</b><br/> <math>\text{Cr}^{3+}</math> / chromium(III) / Cr(III) (ions) formed (1)</p> <p>Mark scoring points independently</p> | <p><math>\text{Cr}^{6+}</math> is reduced</p> <p>Just 'oxidation' or 'reduction' or 'redox'</p> | <b>(2)</b> |

| Question Number | Acceptable Answer  | Reject   | Mark       |
|-----------------|--|--|------------|
| <b>1(e)</b>     | <p><b>1st mark:</b><br/>           (Green precipitate formula is)</p> <p><math>\text{Cr}(\text{OH})_3(\text{H}_2\text{O})_3</math> / <math>\text{Cr}(\text{OH})_3</math> (1)</p> <p><b>2nd mark:</b><br/>           (Ion responsible for green colour of solution)</p> <p><math>\text{Cr}(\text{OH})_6^{3-}</math></p> <p>ALLOW</p> <p><math>\text{Cr}(\text{OH})_4^-</math> / <math>\text{Cr}(\text{OH})_5^{2-}</math> / <math>\text{CrO}_2^-</math> / <math>\text{CrO}_3^{3-}</math> (1)</p> <p>IGNORE<br/>           Any number of <math>\text{H}_2\text{O}</math> ligands included with <math>\text{Cr}(\text{OH})_4^-</math> / <math>\text{Cr}(\text{OH})_5^{2-}</math></p> | <p><math>\text{Cr}_2\text{O}_3</math></p> <p><math>\text{Cr}^{3+}</math> / <math>[\text{Cr}(\text{H}_2\text{O})_6]^{3+}</math></p> | <b>(2)</b> |

| Question Number | Acceptable Answer   | Reject           | Mark       |
|-----------------|---|------------------|------------|
| <b>1(f)</b>     | <p><b>1st mark:</b><br/>(Ion responsible for pale blue colour of solution)<br/><math>\text{Cr}(\text{H}_2\text{O})_6^{2+} / \text{Cr}^{2+}</math> (1)</p> <p><b>2nd mark:</b><br/>(Role of the Zn)</p> <p>Reducing agent / reduces / reduction / loses electrons / donates electrons (1)</p> <p>IGNORE<br/>References to redox<br/>Mark independently</p> | $\text{Cu}^{2+}$ | <b>(2)</b> |

| Question Number | Acceptable Answer   | Reject   | Mark       |
|-----------------|---|--|------------|
| <b>1(g)</b>     | <p><b>1st mark:</b><br/>(Ion responsible for green colour of the solution)</p> <p><math>\text{Cr}(\text{H}_2\text{O})_6^{3+} ((\text{aq})) / \text{Cr}^{3+} ((\text{aq}))</math> (1)</p> <p><b>2nd mark:</b><br/>(Type of reaction)</p> <p>Oxidation</p> <p>ALLOW<br/>'redox' (1)</p> <p>Mark independently</p> | <p>Other numbers of water ligands</p> <p>Reduction<br/>Ligand exchange</p> | <b>(2)</b> |

**(Total for Question 1 = 11 marks)**

| Question Number | Acceptable Answer  | Reject                               | Mark       |
|-----------------|--|--------------------------------------|------------|
| <b>2(a)(i)</b>  | <p>EITHER</p> <p>(<b>Y</b> contains an)</p> <p>OH (group) / hydroxy(l) (group)</p> <p>OR</p> <p>(<b>Y</b> is an) alcohol <b>or</b> a carboxylic acid</p> <p>OR</p> <p>(<b>Y</b> contains) an OH <b>or</b> a COOH (group)</p> <p>OR</p> <p>(<b>Y</b> is) propanol <b>or</b> propanoic acid / propan-1-ol <b>or</b> propan-2-ol <b>or</b> propanoic acid</p> <p>Note<br/>The significance of '<b>or</b>'</p> | "hydroxide/ OH <sup>-</sup> "        | <b>(1)</b> |
| <b>2(a)(ii)</b> | <p>(<b>Y</b> is) NOT a (carboxylic) acid / does not contain a carboxyl group</p> <p>ALLOW</p> <p>(<b>Y</b> is) an alcohol</p>  | Does not contain a carboxylate group | <b>(1)</b> |

| Question Number  | Acceptable Answer   | Reject | Mark       |
|------------------|---|--------|------------|
| <b>2(a)(iii)</b> | <p>(Y contains a)<br/>CH<sub>3</sub>CH(OH) group /<br/>(Y is a) secondary methyl alcohol /<br/>2° alcohol with methyl group next to<br/>C-OH</p> <p>ALLOW</p> <p>Secondary alcohol with methyl group<br/>next to the functional group</p> <p>OR<br/>(Y is) propan-2-ol</p> <p>IGNORE<br/>References to methyl ketone /<br/>ethanol / just 'secondary alcohol' /<br/>just 'CHOH group'</p> |        | <b>(1)</b> |

| Question Number | Acceptable Answer  | Reject   | Mark       |
|-----------------|--|--|------------|
| <b>2(a)(iv)</b> | <p>(Y is) propan-2-ol / CH<sub>3</sub>CH(OH)CH<sub>3</sub></p> <p>ALLOW<br/>Skeletal / displayed formula</p> | <p>propanol<br/>Just C<sub>3</sub>H<sub>8</sub>O</p> | <b>(1)</b> |

| Question Number | Acceptable Answer   | Reject  | Mark       |
|-----------------|---|---|------------|
| <b>2(a)(v)</b>  | <p><b>1st mark:</b><br/>(Peak caused by)</p> <p>CH<sub>3</sub>CHOH<sup>+</sup> / C<sub>2</sub>H<sub>5</sub>O<sup>+</sup></p> <p>ALLOW<br/>TE on structure in (iv) e.g.<br/>CH<sub>2</sub>CH<sub>2</sub>OH<sup>+</sup> if propan-1-ol given in<br/>(iv) (1)</p> <p><b>2nd mark:</b><br/>(Species is formed by)<br/>(Fragmentation of molecular ion by)<br/>loss of a CH<sub>3</sub> group / •CH<sub>3</sub> /<br/>CH<sub>3</sub> radical / methyl group / methyl<br/>radical</p> <p>ALLOW<br/>Breaking a single carbon to carbon<br/>bond<br/>Loss of CH<sub>3</sub><sup>+</sup> (1)</p> | <p>MP1 if + sign<br/>missing</p> <p>CH<sub>3</sub>CH<sub>2</sub>O<sup>+</sup></p> <p>Loss of CH<sub>3</sub><sup>-</sup></p> | <b>(2)</b> |



| Question Number | Acceptable Answer  | Reject | Mark       |
|-----------------|--|--------|------------|
| <b>2(b)(i)</b>  | Hydrogen chloride / HCl / HCl(g) / HCl(gas)<br><br>ALLOW<br>Hydrochloric acid/ HCl(aq) |        | <b>(1)</b> |

| Question Number | Acceptable Answer  | Reject        | Mark       |
|-----------------|--|---------------|------------|
| <b>2(b)(ii)</b> | ( <b>Z</b> contains the functional group)<br>Carboxylic acid / (-)COOH / (-)CO <sub>2</sub> H<br><br>ALLOW<br><br>Carboxylic group / carboxyl group<br><br>IGNORE<br>Just 'acid'<br>Carbon dioxide is produced | 'Carboxylate' | <b>(1)</b> |

| Question Number  | Acceptable Answer  | Reject | Mark       |
|------------------|--|--------|------------|
| <b>2(b)(iii)</b> | ( <b>Z</b> is)<br>Propanoic acid / CH <sub>3</sub> CH <sub>2</sub> COOH / CH <sub>3</sub> CH <sub>2</sub> CO <sub>2</sub> H / C <sub>2</sub> H <sub>5</sub> COOH / C <sub>2</sub> H <sub>5</sub> CO <sub>2</sub> H<br><br>ALLOW<br>Skeletal or displayed formula |        | <b>(1)</b> |

**(Total for Question 2 = 9 marks)**

| Question Number | Acceptable Answer  | Reject   | Mark       |
|-----------------|--|--|------------|
| <b>3(a)(i)</b>  | <p><b>1st mark:</b></p> <p>Both axes labelled, with units<br/>ALLOW<br/>units in brackets (1)</p> <p><b>2nd mark:</b></p> <p>'Sensible' scale, covering more than half the grid in each direction (1)</p> <p><b>3rd mark:</b></p> <p>All six points plotted correctly (1)</p> <p><b>4th mark:</b></p> <p><b>Straight line</b> of best fit<br/>ALLOW<br/>If a non-uniform scale is used (1)</p> | <p>If units missing, no MP1</p> <p>Non-uniform scale</p> <p>Reject if a non-uniform scale is used in MP2</p> <p>point-to-point' if misplot/<br/>curve of any description</p> | <b>(4)</b> |

| Question Number | Acceptable Answer  | Reject | Mark       |
|-----------------|--|--------|------------|
| <b>3(a)(ii)</b> | <p>The iodine concentration is proportional to the titre / volume of thiosulfate</p> <p>IGNORE</p> <p>Use of 1:2 ratio</p> |        | <b>(1)</b> |

| Question Number  | Acceptable Answer   | Reject | Mark       |
|------------------|---|--------|------------|
| <b>3(a)(iii)</b> | <p>The concentrations of the propanone and hydrochloric acid are (effectively) constant (during the reaction) (1)</p> <p>(So that) <b>only</b> the iodine concentration changes (during the reaction)</p> <p>ALLOW<br/>Iodine concentration is the <b>only</b> variable</p> <p>(So) the order is that with respect to iodine <b>alone</b> (1)</p> |        | <b>(2)</b> |

| Question Number | Acceptable Answer   | Reject                              | Mark       |
|-----------------|---|-------------------------------------|------------|
| <b>3(a)(iv)</b> | <p>Zero (order) / 0 (order) / <math>c = 0</math> (1)</p> <p>(The straight line graph shows) rate is independent of <math>I_2</math> concentration / rate (of decrease of <math>I_2</math> concentration) is constant / gradient is constant (1)</p> | Just 'the graph is a straight line' | <b>(2)</b> |

| Question Number | Acceptable Answer  | Reject                         | Mark       |
|-----------------|--|--------------------------------|------------|
| <b>3(b)(i)</b>  | <p>Starch (solution) (1)</p> <p>From blue-black / from blue / from black to colourless (1)</p> <p>IGNORE<br/>'Clear'</p> <p>Colour <b>change</b> is needed for this mark</p> | Purple /Pale blue<br>Off white | <b>(2)</b> |

| Question Number | Acceptable Answer   | Reject                            | Mark       |
|-----------------|---|-----------------------------------|------------|
| <b>3(b)(ii)</b> | (When solution/reaction mixture is)<br>pale-yellow /<br>'straw' coloured (1)<br><br>IGNORE<br>'Near end-point'<br><br>To prevent the formation of an<br><b>insoluble</b> complex/ <b>insoluble</b><br>compound /<br><b>insoluble</b> substance /<br><b>insoluble</b> starch-iodine complex<br>(1) | Just 'yellow'<br>Just 'goes pale' | <b>(2)</b> |

| Question Number | Acceptable Answer   | Reject | Mark       |
|-----------------|---|--------|------------|
| <b>3(c)</b>     | Titre is small(est) (so the (relative)<br>uncertainty/(relative) error is greatest) |        | <b>(1)</b> |

| Question Number | Acceptable Answer   | Reject                     | Mark       |
|-----------------|---|----------------------------|------------|
| <b>3(d)</b>     | (Order is) first / 1st / 1 (1)<br><br>Doubling the concentration (of the acid)<br>doubles the <b>rate</b> (1) | 'Speed'<br>instead of rate | <b>(2)</b> |

| Question Number | Acceptable Answer  | Reject         | Mark       |
|-----------------|--|----------------|------------|
| <b>3(e)</b>     | Any ONE of the following matching pairs:   |                | <b>(2)</b> |
|                 | Colorimetry (1)<br><b>I<sub>2</sub></b> colour decreases / changes<br>ALLOW<br>Iodine / I <sub>2</sub> is coloured |                |            |
|                 | Brown to colourless (1)<br>ALLOW   |                |            |
|                 | Conductivity (1)<br>Increase in <b>ion / H<sup>+</sup> / I<sup>-</sup></b> concentration (1)                       |                |            |
|                 | OR   |                |            |
|                 | pH (1)<br>Increase in H <sup>+</sup> concentration (1)   | Increase in pH |            |
|                 | OR   |                |            |
|                 | Acid-base titration (1)<br>Increase in H <sup>+</sup> concentration (1)  |                |            |
|                 | OR   |                |            |
|                 | AgNO <sub>3</sub> titration (1)<br>Increase in I <sup>-</sup> concentration (1)                                    |                |            |

**(Total for Question 3 = 18 Marks)**

| Question Number | Acceptable Answer  | Reject | Mark       |
|-----------------|--|--------|------------|
| <b>4(a)</b>     | <p><b>1st mark:</b></p> <p>(As liquid boils / vaporises),<br/>it / vapour is cooled and condensed<br/>(back to liquid) (1)</p> <p><b>2nd and 3rd marks:</b></p> <p>Any TWO from</p> <ul style="list-style-type: none"> <li>Prevents escape of reactants / products / flammable liquids / flammable vapours / volatile liquids</li> <li>Enables (in)flammable / harmful liquids to be heated safely</li> <li>Allows time for reaction / allows for a complete reaction / increases rate of reaction / increases yield (of product) / overcome the activation energy (for the reaction) (2)</li> </ul> |        | <b>(3)</b> |

| Question Number | Acceptable Answer  | Reject                                    | Mark       |
|-----------------|--|---|------------|
| <b>4(b)(i)</b>  | <p>To remove / react with the<br/>(excess/unreacted) <b>ethanoyl chloride</b></p> <p>ALLOW</p> <p>Hydrolysis of the <b>ethanoyl chloride</b></p> | Cool down / dilute the mixture / solution | <b>(1)</b> |

| Question Number | Acceptable Answer  | Reject | Mark       |
|-----------------|--|--------|------------|
| <b>4(b)(ii)</b> | <p>The reaction (with water) is (very) exothermic / gives out heat / is violent / is vigorous</p> <p>IGNORE</p> <p>explosive</p> |        | <b>(1)</b> |

| Question Number | Acceptable Answer  | Reject | Mark       |
|-----------------|--|--------|------------|
| <b>4(c)</b>     | (Filtration is) faster / quicker (1)<br><br>Dries the solid / dries the precipitate / dries the crystals<br>OR<br>Removes the maximum amount of solution<br><br>IGNORE<br>References to 'higher yield' / 'less product lost' / fewer 'transfer losses' (1) |        | <b>(2)</b> |

| Question Number | Acceptable Answer   | Reject  | Mark       |
|-----------------|---|---|------------|
| <b>4(d)</b>     | 'Sharp' melting temperature / melts over a 1-2°C range / melts over a 'narrow' temp range (1)<br><br>Value (of melting temperature is) consistent with literature value / Internet value<br><br>ALLOW<br>'Correct value' (obtained) (1) | Shar <b>per</b> melting temperature<br>narrow <b>er</b> | <b>(2)</b> |

| Question Number | Acceptable Answer   | Reject  | Mark     |
|-----------------|---|---|----------|
| <b>4(e)</b>     | <p>SCROLL DOWN TO CHECK WHOLE SPACE</p> <p>TE is allowed at each stage</p> <p><u>Correct answer with no working scores 3</u></p> <p>IGNORE</p> <p>SF except 1 SF</p> <p>Moles of <math>C_7H_7NO_2</math><br/> <math>(= \frac{3.70}{137}) = 0.027007299</math><br/> <math>= 0.0270 \text{ (mol)}</math> (1)</p> <p>Actual moles of product, <math>C_9H_9NO_3</math><br/> <math>(= \frac{2.42}{179}) = 0.013519553</math><br/> <math>= 0.0135 \text{ (mol)}</math> (1)</p> <p>% yield <math>(= \frac{0.0135}{0.0270} \times 100\%)</math><br/> <math>= 50\%</math> (1)</p> <p>OR</p> <p>Alternative route for MP2 and MP3</p> <p>Expected mass of product, <math>C_9H_9NO_3</math><br/> <math>(= 0.0270 \times 179) = 4.833 \text{ (g)}</math> (1)</p> <p>% yield <math>(= \frac{2.42}{4.833} \times 100\%)</math><br/> <math>= 50.07241879\%</math><br/> <math>= 50.1\%</math> (1)</p> | <p>Just<br/> <math>\frac{2.42}{3.70} \times 100</math><br/> <math>= 65.4\%</math></p> | <b>3</b> |



|  |  |  |  |
|--|--|--|--|
|  | <p>OR FURTHER ALTERNATIVE ROUTE</p> <p>Expected moles of product, <math>C_9H_9NO_3</math><br/> <math>\frac{3.70}{137} = 0.027007299</math> (1)</p> <p>Expected mass of product, <math>C_9H_9NO_3</math><br/> <math>0.027007299 \times 179 = 4.834(g)</math> (1)</p> <p>% yield (<math>= \frac{2.42}{4.834} \times 100\%</math>)<br/> <math>= 50.06206041\%</math><br/> <math>= 50.1\%</math> (1)</p> <p>NOTE<br/> Final answer will depend on figures held in calculator by candidate – all working must be checked<br/> e.g if all numbers held in calculator, value equals<br/> 50.0588857 %</p> |  |  |
|--|--|--|--|

**(Total for Question 4 = 12 Marks)**

**TOTAL FOR PAPER = 50 MARKS**