



Mark Scheme (Results)

January 2018

Pearson Edexcel 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.

Question Number	Acceptable Answer	Reject	Mark
1(a)	(Contains) a transition metal (ion) / a transition element ALLOW a d-block element (Might contain) chromate(VI) ions/ CrO_4^{2-} / Iron(III) (ions)/ Fe^{3+} / PbI_2 / AgI	Dichromate (ions) / $\text{Cr}_2\text{O}_7^{2-}$ / Cr^{6+}	(1)

Question Number	Acceptable Answer	Reject	Mark
1(b)	Na^+ (ion) / sodium (cat)ion present ALLOW Na ion Na_2CrO_4	Just 'Na' / sodium $\text{Na}_2\text{Cr}_2\text{O}_7$ NaCl / any other sodium compounds	(1)

Question Number	Acceptable Answer	Reject	Mark
1(c)	$\text{Cr}_2\text{O}_7^{2-}$ $(\text{Cr}_2\text{O}_7)^{2-}$	CrO_4^{2-} $\text{Na}_2\text{Cr}_2\text{O}_7$	(1)

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

Question Number	Acceptable Answer	Reject	Mark
1(e)	<p>1st mark: (Green precipitate formula is)</p> <p>$\text{Cr}(\text{OH})_3(\text{H}_2\text{O})_3$ / $\text{Cr}(\text{OH})_3$ (1)</p> <p>2nd mark: (Ion responsible for green colour of solution)</p> <p>$\text{Cr}(\text{OH})_6^{3-}$</p> <p>ALLOW</p> <p>$\text{Cr}(\text{OH})_4^-$ / $\text{Cr}(\text{OH})_5^{2-}$ / CrO_2^- / CrO_3^{3-} (1)</p> <p>IGNORE Any number of H_2O ligands included with $\text{Cr}(\text{OH})_4^-$ / $\text{Cr}(\text{OH})_5^{2-}$</p>	<p>Cr_2O_3</p> <p>Cr^{3+} / $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$</p>	(2)

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

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

(Total for Question 1 = 11 marks)

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

Question Number	Acceptable Answer	Reject	Mark
2(a)(iii)	<p>(Y contains a) $\text{CH}_3\text{CH}(\text{OH})$ group / (Y is a) secondary methyl alcohol / 2° alcohol with methyl group next to C-OH</p> <p>ALLOW</p> <p>Secondary alcohol with methyl group next to the functional group</p> <p>OR</p> <p>(Y is) propan-2-ol</p> <p>IGNORE</p> <p>References to methyl ketone / ethanol / just 'secondary alcohol' / just 'CHOH group'</p>		(1)

Question Number	Acceptable Answer	Reject	Mark
2(a)(iv)	<p>(Y is) propan-2-ol / $\text{CH}_3\text{CH}(\text{OH})\text{CH}_3$</p> <p>ALLOW</p> <p>Skeletal / displayed formula</p>	<p>propanol</p> <p>Just $\text{C}_3\text{H}_8\text{O}$</p>	(1)

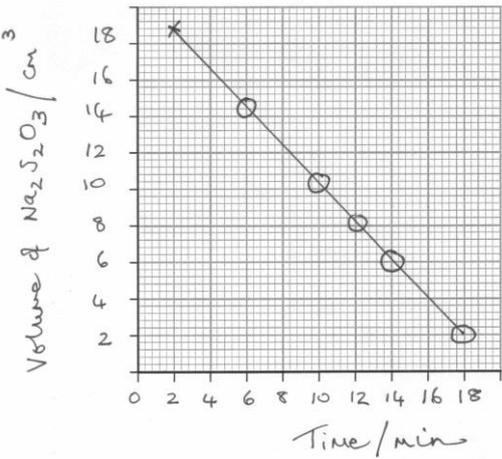
Question Number	Acceptable Answer	Reject	Mark
2(a)(v)	<p>1st mark: (Peak caused by)</p> <p>CH_3CHOH^+ / $\text{C}_2\text{H}_5\text{O}^+$</p> <p>ALLOW</p> <p>TE on structure in (iv) e.g. $\text{CH}_2\text{CH}_2\text{OH}^+$ if propan-1-ol given in (iv) (1)</p> <p>2nd mark: (Species is formed by) (Fragmentation of molecular ion by) loss of a CH_3 group / $\bullet\text{CH}_3$ / CH_3 radical / methyl group / methyl radical</p> <p>ALLOW</p> <p>Breaking a single carbon to carbon bond</p> <p>Loss of CH_3^+ (1)</p>	<p>MP1 if + sign missing</p> <p>$\text{CH}_3\text{CH}_2\text{O}^+$</p> <p>Loss of CH_3^-</p>	(2)

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

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

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

(Total for Question 2 = 9 marks)

Question Number	Acceptable Answer	Reject	Mark
3(a)(i)	 <p>1st mark:</p> <p>Both axes labelled, with units ALLOW units in brackets (1)</p> <p>2nd mark:</p> <p>'Sensible' scale, covering more than half the grid in each direction (1)</p> <p>3rd mark:</p> <p>All six points plotted correctly (1)</p> <p>4th mark:</p> <p>Straight line of best fit ALLOW 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/ curve of any description</p>	(4)

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

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

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

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

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

Question Number	Acceptable Answer	Reject	Mark
3(c)	Titre is small(est) (so the (relative) uncertainty/(relative) error is greatest)		(1)

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

Question Number	Acceptable Answer	Reject	Mark
3(e)	Any ONE of the following matching pairs:		(2)
	Colorimetry (1) I₂ colour decreases / changes ALLOW Iodine / I ₂ is coloured		
	Brown to colourless (1) ALLOW		
	Conductivity (1) Increase in ion / H⁺ / I⁻ concentration (1)		
	OR		
	pH (1) Increase in H ⁺ concentration (1)	Increase in pH	
	OR		
	Acid-base titration (1) Increase in H ⁺ concentration (1)		
	OR		
	AgNO ₃ titration (1) Increase in I ⁻ concentration (1)		

(Total for Question 3 = 18 Marks)

Question Number	Acceptable Answer	Reject	Mark
4(a)	<p>1st mark:</p> <p>(As liquid boils / vaporises), it / vapour is cooled and condensed (back to liquid) (1)</p> <p>2nd and 3rd marks:</p> <p>Any TWO from</p> <ul style="list-style-type: none"> • Prevents escape of reactants / products / flammable liquids / flammable vapours / volatile liquids • Enables (in)flammable / harmful liquids to be heated safely • 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) 		(3)

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

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

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

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

Question Number	Acceptable Answer	Reject	Mark
4(e)	<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 $C_7H_7NO_2$ $(= \frac{3.70}{137}) = 0.027007299$ $= 0.0270 \text{ (mol)}$ (1)</p> <p>Actual moles of product, $C_9H_9NO_3$ $(= \frac{2.42}{179}) = 0.013519553$ $= 0.0135 \text{ (mol)}$ (1)</p> <p>% yield $(= \frac{0.0135}{0.0270} \times 100\%)$ $= 50\%$ (1)</p> <p>OR</p> <p>Alternative route for MP2 and MP3</p> <p>Expected mass of product, $C_9H_9NO_3$ $(= 0.0270 \times 179) = 4.833 \text{ (g)}$ (1)</p> <p>% yield $(= \frac{2.42}{4.833} \times 100\%)$ $= 50.07241879\%$ $= 50.1\%$ (1)</p>	<p>Just $\frac{2.42}{3.70} \times 100$ $= 65.4\%$</p>	3

	<p>OR FURTHER ALTERNATIVE ROUTE</p> <p>Expected moles of product, C₉H₉NO₃ $\frac{3.70}{137} = 0.027007299$ (1)</p> <p>Expected mass of product, C₉H₉NO₃ $0.027007299 \times 179 = 4.834(\text{g})$ (1)</p> <p>% yield (= $\frac{2.42}{4.834} \times 100\%$) $= 50.06206041\%$ $= 50.1\%$ (1)</p> <p>NOTE Final answer will depend on figures held in calculator by candidate – all working must be checked e.g if all numbers held in calculator, value equals 50.0588857 %</p>		
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(Total for Question 4 = 12 Marks)

TOTAL FOR PAPER = 50 MARKS