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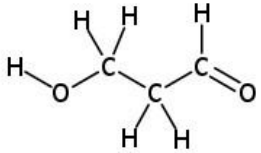
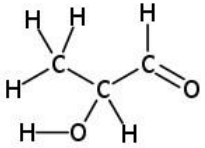
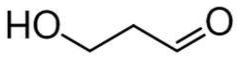
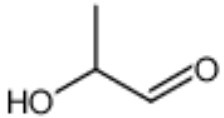
Mark Scheme (Results)

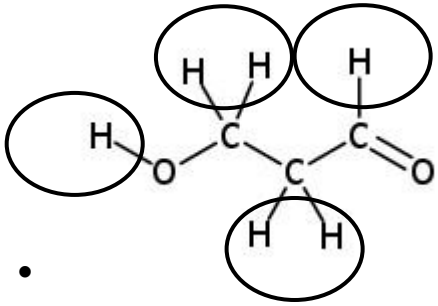
Summer 2024

Pearson Edexcel International Advanced Level in Chemistry (WCH16)
Paper 01 Practical Skills in Chemistry II

Question Number	Answer	Additional Guidance	Mark
1(a)	An answer that makes reference to the following points: • -OH **and** because misty fumes/HCl (with PCl_5) **(1)** • not a carboxylic acid (as it does not react with sodium hydrogencarbonate/ $NaHCO_3$) **(1)** .	Allow OH because positive result (in test 1) Allow hydroxy(l) Allow alcohol or carboxylic acid present Allow COOH/ for carboxylic acid Allow just alcohol Do not award OH^- Allow not an acid Allow not carboxylic Allow this is the test for a carboxylic acid and it is negative/no visible reaction Ignore carboxy(l)	**(2)**

Question Number	Answer	Additional Guidance	Mark
1(b)	An answer that makes reference to the following point: • aldehyde/CHO/ 	Ignore carbonyl/ C=O Do not award COH If both a name and structure are given both must be correct.	**(1)**

Question Number	Answer	Additional Guidance	Mark
1(c)(i)	An answer that makes reference to the following points: •  **(1)** •  **(1)**	  Allow skeletal / structural formulae or a combination Ignore connectivity of OH unless horizontal	**(2)**

Question Number	Answer	Additional Guidance	Mark
1(c)(ii)	An answer that makes reference to the following point:  •	Allow skeletal / structural formula Annotations may be shown in ci Allow numbers/ letters instead of circles Allow other atoms to be included with the Hs if circled. Ignore names even if incorrect	**(1)**

(Total for Question 1 = 6 marks)

Question Number	Answer	Additional Guidance	Mark
2(a)(i)	An answer that makes reference to the following points: • <table><tr><th>Observation on adding a few drops of sodium hydroxide</th></tr><tr><td>(grey)green precipitate</td></tr></table> **(1)** • <table><tr><th>Observation on adding an excess of sodium hydroxide</th></tr><tr><td>(dark/ deep) green solution/sol/soln</td></tr></table> **(1)**	Allow ppt / ppte /solid Ignore any reference to shade of green e.g. pale Do not award just grey Allow green (aq) Ignore green ppt dissolves Do not award pale green If answers are reversed score 1 No TE on wrong colour ppt.	**(2)**

Question Number	Answer	Additional Guidance	Mark
2(a)(ii)	An answer that makes reference to the following point: • (chromium(III) hydroxide is) amphoteric	Allow it reacts with (an acid and) a base Allow it can behave as an acid (and a base) Ignore anything about ligands, solubility, complex ions, variable oxidation states, deprotonation, transition metal	**(1)**

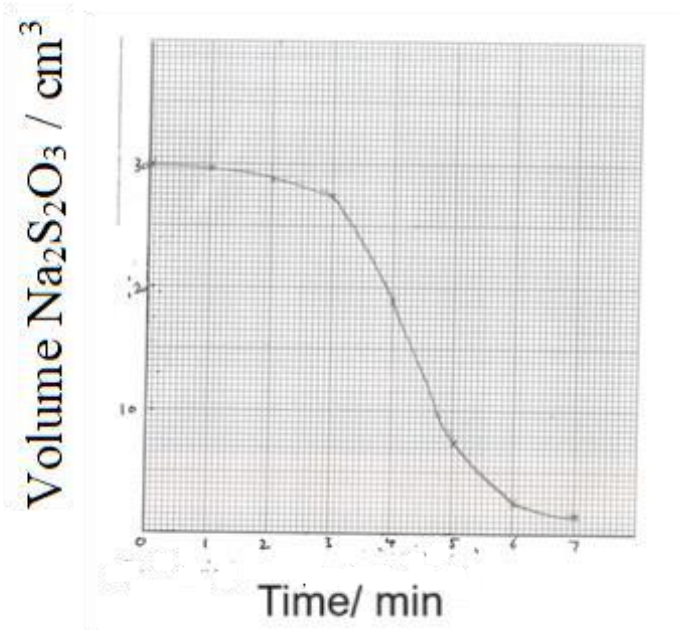
Question Number	Answer	Additional Guidance	Mark
2(b)	An answer that makes reference to the following points: • Hydrogen peroxide is an oxidising agent **(1)** • Cr (oxidation number changes from) +3 to +6 **(1)**	 Allow oxidant Allow it is an oxidising agent Allow oxidising agent Allow it oxidises the Cr Ignore it is a catalyst Do not award if there is a contradiction i.e. it is an oxidising agent and reduces the Cr Allow III/VI $3^+/6^+$	**(2)**

Question Number	Answer	Additional Guidance	Mark
2(c)	An answer that makes reference to the following point: • $2CrO_4^{2-} + 2H^+ \rightleftharpoons Cr_2O_7^{2-} + H_2O$	 Allow multiples Allow $^{-2}$ Ignore state symbols even if incorrect Do not award if electrons included	**(1)**

(Total for Question 2 = 6 marks)

Question Number	Answer	Additional Guidance	Mark
3(a)(i)	An answer that makes reference to the following points: • KI/I^-/iodide reacts with the MnO_4^- /manganate ((VII)) (rapidly) **(1)** • MnO_4^- /manganate ((VII)) is **all** used up (so the reaction will stop) **(1)**	Allow the MnO_4^- gets reduced Allow the I^-/iodide gets oxidised by the MnO_4^- If oxidation numbers given, they must be correct Do not award the KI/I^-/iodide reacts with ethanedioate ions Allow so the MnO_4^- /manganate ((VII)) can no longer react (with the ethanedioate ions) Allow the manganate ((VII)) is the limiting reagent (with the KI) (so the reaction stops) KI/I^-/iodide reacts with **all** the MnO_4^- /manganate ((VII)) score 2 Ignore any reference to quenching	**(2)**

Question Number	Answer	Additional Guidance	Mark
3(a)(ii)	An answer that makes reference to the following point: • when the solution turns pale yellow/ straw coloured	Ignore towards the end of the titration Allow just yellow Allow yellow-brown Allow straw brown Do not award just brown/ pale brown/orange brown Do not award any reference to a ppt forming	**(1)**

Question Number	Answer	Additional Guidance	Mark
3(b)(i)	• suitable axes and labels with units Allow V/v/vol for volume **and** cm^3 $Na_2S_2O_3$ does not need to be seen Allow T/t for time **and** min The points plotted must cover at least half the grid in both directions **(1)** • points plotted correctly within one small square **(1)** • curved line of best fit **(1)** If graph is reversed penalise M1 only so max 2	Example of graph  	**(3)**

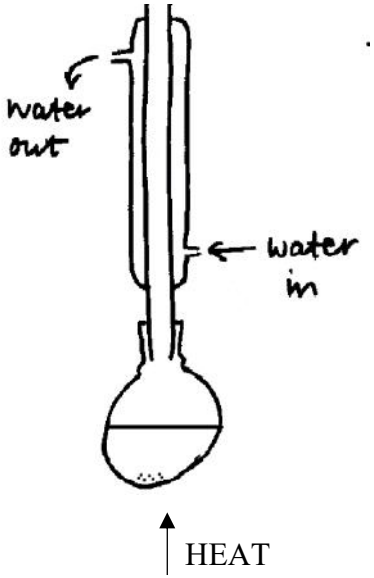
Question Number	Answer	Additional Guidance	Mark
3(b)(ii)	An answer that makes reference to the following point: • slow at the start, speeds up and then slows down	Allow just slow, fast, slow Allow low for slow Ignore any comment about the gradient and time	**(1)**

Question Number	Answer	Additional Guidance	Mark
3(b)(iii)	An answer that makes reference to the following points: • **Mn^{2+}** is a catalyst **(1)** • formed during the reaction (so the rate increases) **(1)** • reaction slows down as the reactants/ managanate ions/ethanedioate ions get used up **(1)**	product is a catalyst / autocatalytic Do not award the reaction slows down as the catalyst/ thiosulfate/iodide gets used up.	**(3)**

(Total for Question 3 = 10 marks)

Question Number	Answer	Additional Guidance	Mark
4(a)	• moles of salicylic acid **(1)** • mass of methanol **(1)** • moles of methanol **(1)** **and** 2.4719 (mol) > 0.14493 (mol)/ 2.32697 mol in excess Alternative solution using masses instead of moles for M3 0.14493 (mol) × 32 = 4.64 (g) of methanol **and** 79.1(g) > 4.64(g) / the methanol is 74.46 g in excess	Example of calculation: Ignore early and incorrect rounding or truncating 20.0/138.0 = 0.14493 (mol) 100 x 0.791 = 79.1 (g) 79.1/32.0 = 2.4719 (mol) Allow just methanol is in excess if both mol have been calculated Ignore SF except 1 SF TE for wrong moles in M3 as long as methanol moles are greater than salicylic acid moles A ratio of 17:1 will score 3 marks	**(3)**

Question Number	Answer	Additional Guidance	Mark
4(b)	An answer that makes reference to the following point: • acts as a catalyst	Allow it catalyses the reaction Ignore just speeds up the reaction Ignore supplies hydrogen ions/acidifies the reaction Ignore dehydrates Ignore any reference as to how it acts as a catalyst even if wrong.	**(1)**

Question Number	Answer		Additional Guidance	Mark
4(c)			Example of diagram  	(3)
	• round-bottomed / pear-shaped flask containing mixture and heat	(1)	Allow any indication of heat including an arrow or water bath or electrical heater or Bunsen burner Ignore missing anti-bumping granules Do not award conical flask or flask with no liquid	
	• vertical condenser with water jacket and water flowing in the correct direction	(1)	Ignore thermometer	
	• no gaps and open condenser and apparatus would work	(1)	Do not award if the condenser and flask are one piece of apparatus **unless both are labelled** Allow just M1 for distillation apparatus	

Question Number	Answer	Additional Guidance	Mark
4(d)	An answer that makes reference to the following points: • add sodium carbonate (solution) to the separating funnel (stopper it) **and** invert/shake/ swirl/agitate/mix **(1)** • open the stopcock/tap to release the pressure/gas/ carbon dioxide **(1)**	Allow add sodium carbonate (solution) to the funnel **and** invert/shake/ swirl/agitate/mix Allow add **it** to the separating funnel **and** invert/shake/ swirl/ agitate/mix Ignore any reference to layers Allow remove the stopper to release the pressure/gas/carbon dioxide Allow opening the funnel to release the pressure/gas/carbon dioxide Ignore subsequent steps	**(2)**

Question Number	Answer	Additional Guidance	Mark
4(e)	• moles of salicylic acid (no mark as already awarded in (a)) • M_r methyl salicylate **(1)** • maximum mass of methyl salicylate **(1)** • percentage yield calculation **and** answer to 2 or 3 SF **(1)** Common wrong answers Using a *Mr* of 153 gives an answer of 63.587% and will score 2 if 2-3 SF Using a *Mr* of 140 gives an answer of 69.492% and will score 2 if 2-3 SF	<u>Example of calculation:</u> Ignore intermediate rounding and truncating 20.0/138.0 = 0.14493 (mol) 152 (g mol^{-1}) 152 x 0.14493 = 22.029 (g) 14.1÷ 22.029 x 100 = 64.007 64 (%)/64.0 (%) Correct answer with some working scores 3 TE on wrong molar mass for M2 but only allow M3 if percentage is less than 100%. If no attempt has been made at calculating the M_r of methyl salicylate score 0.	**(3)**

(Total for Question 4 = 12 marks)

Question Number	Answer	Additional Guidance	Mark
5(a)(i)	An answer that makes reference to the following points: • (hold damp) red litmus paper (over the mouth of the flask and it) will turn blue **(1)** • repeat until the litmus paper remains red/no colour change **(1)** Allow testing with **concentrated** HCl producing white smoke/ solid for M1 and no longer producing white smoke for M2	Allow UI/full range paper and a change to blue/purple Allow just litmus turns blue Allow until the test is negative Allow damp red litmus no longer turns blue OWTTE score 2 Ignore until it no longer smells Do not award placing the litmus into the conical flask. Score 0.	**(2)**

Question Number	Answer	Additional Guidance	Mark
5(a)(ii)	An answer that makes reference to the following point: • corrosive **and** toxic	Allow poisonous for toxic	**(1)**

Question Number	Answer	Additional Guidance	Mark
5(a)(iii)	An answer that makes reference to one of the following points: • carry out in a fume cupboard or wear gloves (when testing the vapours)	 Allow carry out in a well-ventilated laboratory Ignore wearing a gas mask Ignore use tongs etc	**(1)**

Question Number	Answer	Additional Guidance	Mark
5(b)(i)	• moles of NaOH at the start **(1)** • moles of HCl equals moles of NaOH at the end **(1)** • moles of NaOH used up/moles of NH_4X **(1)** • molar mass of NH_4X	<u>Example of calculation</u> $50.0 \times 1.00 \div 1000 = 0.05$ (mol) $26.80 \times 1.00 \div 1000 = 0.0268$ (mol) $0.05 - 0.0268 = 0.0232$ (mol) $2.27 \div 0.0232 = 97.845$ ($g\ mol^{-1}$) Correct answer with or without working scores 4 TE throughout Ignore SF except 1 SF	**(4)**

Question Number	Answer	Additional Guidance	Mark
5(b)(ii)	• mass of NH_4 and deduction from 97.845 (g mol^{-1}) **(1)** • selection of Br / Br^- / bromide/ bromine (79.9) (as the M_r is closest) **(1)**	<u>Example of calculation:</u> 14.0 + 4.0 = 18.0 and 97.8 – 18.0 = 79.8 The subtraction calculation does not have to be seen as long as the correct number is noted i.e. 18 deducted. TE on closest halide as long as 18 has been subtraction Note this answer may be in bi Do not award Br_2	**(2)**

Question Number	Answer	Additional Guidance	Mark
5(b)(iii)	An answer that makes reference to the following points: • (to a solution of NH_4X add) silver nitrate (solution) **and** (dilute) nitric acid **(1)** • cream ppt/solid **(1)**	Allow TE on the halide from bii Ignore just acidified Allow off-white / pale yellow Ignore any reference to adding ammonia solution to the ppt M2 is dependent on M1 or a near miss such as a wrong acid or no acid.	**(2)**

Question Number	Answer	Additional Guidance	Mark
5(c)	An answer that makes reference to the following points: Advantage • you can do more titrations/ 4 titrations OR you can do a range finder titration OR you can calculate a mean titre **(1)** • any anomalies or range finder titration can be discarded OR you can get concordant results **(1)** Disadvantage • titre will be smaller / smaller volume of acid required **(1)** • will have a greater (%) uncertainty/ percentage error **(1)**	Ignore any references to accuracy/ reliability for both the advantages and disadvantages Allow just smaller volume Ignore any reference to an inaccurate molar mass	**(4)**

(Total for Question 5 = 16 marks)
(Total for Paper = 50 marks)