Mark Scheme (Results)

October 2023

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

Question Number	Answer	Additional Guidance	Mark
1(a)(i)	An answer that makes reference to the following point: • ammonia (gas) / NH_3 ((g))	 Do not award NH_4^+ / ammonium ion	(1)

Question Number	Answer	Additional Guidance	Mark
1(a)(ii)	An answer that makes reference to the following point: • NH_4^+	 Ignore ammonium Do not award ammonia/NH_3/ NH_4	(1)

Question Number	Answer	Additional Guidance	Mark
1(b)(i)	An answer that makes reference to the following points: • (with sodium hydroxide) deprotonation / removal of a proton **(1)** • (with ammonia) ligand exchange (is taking place) **(1)**	 Allow the hydroxide precipitate is showing amphoteric (behaviour) Allow neutralisation Allow acid/base Allow ligand substitution Do not award deprotonation **and** ligand exchange Ignore any equations even if incorrect	(2)

Question Number	Answer	Additional Guidance	Mark
1(b)(ii)	An answer that makes reference to the following point: • Cr^{3+}	 Allow chromium (III) Allow $Cr(H_2O)_6^{3+}$	**(1)**

Question Number	Answer	Additional Guidance	Mark
1(c)(i)	An answer that makes reference to the following point: • SO_4^{2-}	 Ignore sulfate	**(1)**

Question Number	Answer	Additional Guidance	Mark
1(c)(ii)	An answer that makes reference to the following point: • (the hydrochloric acid) reacts with/ removes/eliminates other ions that may give a precipitate (with barium chloride)	 Allow (the hydrochloric acid) reacts with/removes/eliminates carbonate (ions) / CO_3^{2-} / hydrogencarbonate (ions) / HCO_3^- Allow sulfate(IV) / sulfite (ions) / SO_3^{2-} Allow Ignore to dissolve the barium chloride If name and formula are given both must be correct	**(1)**

Question Number	Answer	Additional Guidance	Mark
1(d)	An answer that makes reference to the following point: • $NH_4Cr(SO_4)_2$	Allow TE on (a)(ii), (b)(ii) and (c)(i) even if the ions are wrong Do not award any TE formula containing one anion and one cation Do not award any TE formula that is charged Do not award any TE formula with 2 anions and 1 cation	**(1)**

(Total for Question 1 = 8 marks)

Question Number	Answer	Additional Guidance	Mark
2(a)	An answer that makes reference to the following points: • Ketone **(1)** • carboxylic acid **(1)**	 Ignore carbonyl Ignore the type of ketone e.g. methylketone will score Allow just carboxyl Allow just carboxylic Allow near miss spellings Ignore COOH etc	**(2)**

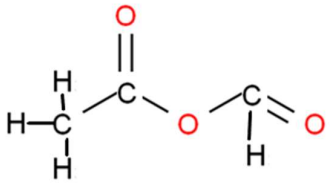
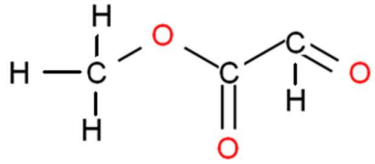
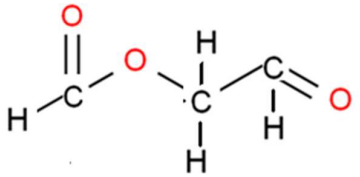
Question Number	Answer	Additional Guidance	Mark
2(b)(i)	An answer that makes reference to the following point: • bubbles / effervescence	 Allow fizzing Ignore colourless gas given off / CO_2 given off Do not award any reference to misty fumes Do not award bubbles **and** white ppt	**(1)**

Question Number	Answer	Additional Guidance	Mark
2(b)(ii)	An answer that makes reference to the following points: Observations Initial colour: orange (solution) Final colour: orange (solution)	 Allow no change for final colour Allow no observation	**(1)**

Question Number	Answer	Additional Guidance	Mark
2(b)(iii)	An answer that makes reference to the following points: • yellow / orange / red **and** precipitate	Allow ppte / ppt / solid / crystals Allow near miss spellings Do not award brick red	**(1)**

Question Number	Answer	Additional Guidance	Mark
2(b)(iv)	An answer that makes reference to the following points: Observations Initial appearance: blue (solution) Final appearance: blue (solution)	Allow no change for final appearance Allow no observation Ignore shades of colour eg deep blue Do not award blue precipitate/solid	**(1)**

Question Number	Answer	Additional Guidance	Mark
2(b)(v)	An answer that makes reference to the following points: • (pale) yellow **and** precipitate	Allow ppte / ppt / solid / crystals Allow near miss spellings Allow just antiseptic smell	**(1)**

Question Number	Answer	Additional Guidance	Mark
2(c)	An answer that makes reference to the following points: Any non-cyclic, saturated molecule that contains • an aldehyde group **(1)** • an ester group **(1)**	Examples include    Allow skeletal / structural formulae or combination If the structure contains an obvious error e.g. a pentavalent C, max 1 If the structure is not $C_3H_4O_3$ max 1	**(2)**

(Total for Question 2 = 9 marks)

Question Number	Answer	Additional Guidance	Mark
3(a)	An explanation that makes reference to the following points: • ethanedioic acid is soluble in water **(1)** or not very soluble in hexane • because ethanedioic acid can form hydrogen bonds (in water) **(1)** or ethanedioic acid is a polar molecule **and** so it dissolves in polar solvents (such as water) or ethanedioic acid is a polar molecule **and** so is insoluble in a non-polar solvent (such as hexane)	Allow ethanedioic acid dissolves better in water Allow insoluble/does not dissolve in hexane Ignore any other types of intermolecular force If no other mark is scored allow (1) for discussion of the flammability of hexane	**(2)**

Question Number	Answer	Additional Guidance	Mark
3(b)(i)	An answer that makes reference to the following points: • (sodium hydroxide will require the indicator) phenolphthalein **(1)** • at the end-point the colour change will be from colourless to pink **(1)** • (the cerium titration is self-indicating and) at the end-point the colour change will be from colourless to yellow **(1)**	Allow other indicators eg Methyl orange from red to orange scores M1 and M2 Do not award litmus/universal indicator Both colours required Allow red M2 dependent on M1 Allow just solution becomes yellow Ignore any reference to bubbles being formed Note Allow one mark for both colour changes reversed. Phenolphthalein pink to colourless and yellow to colourless for the cerium titration scores 1 Methyl orange yellow to orange and yellow to colourless for the cerium titration scores 1	**(3)**

Question Number	Answer	Additional Guidance	Mark
3(b)(ii)	• moles of NaOH in the mean titre **(1)** • moles $(COOH)_2$ in 25.0 cm^3 of solution **(1)** • moles $(COOH)_2$ in 1000.0 cm^3 **(1)** • mass $(COOH)_2$ in 1000.0 cm^3 **(1)** • calculation of % by mass **and** answer to 2 or 3 SF **(1)**	Example of calculation $20.60 \times 0.0400 \div 1000 = 0.000824 / 8.24 \times 10^{-4}$ (mol) $8.24 \times 10^{-4} \div 2 = 4.12 \times 10^{-4} / 0.000412$ (mol) $4.12 \times 10^{-4} \times 40 = 1.648 \times 10^{-2} / 0.01648$ (mol) $0.01648 \times 90 = 1.4832$ (g) $100 \times 1.4832 \div 319 = 0.46495$ 0.46% / 0.465% Allow 0.47% TE throughout unless percentage greater than 100% Correct answer with or without working scores 5	**(5)**

Question Number	Answer	Additional Guidance	Mark
3(c)	• moles of $(COOH)_2$ **(1)** • calculation of molar mass **(1)** • calculation of **x** **(1)**	Example of calculation $500 \times 0.5 \div 1000 = 0.25$ (mol) $31.5 \div 0.25 = 126$ (g mol^{-1}) $126 - 90$ $36 \div 18 = 2$ Or $500 \times 0.5 \div 1000 = 0.25$ (mol) $0.25 \times 90 = 22.5$ and $31.5 - 22.5 = 9$ $9 \div 18 = 0.5$ and $0.25 : 0.5 = 2$ Allow TE except for wrong molar mass of water Correct answer with **some** working scores 3	**(3)**

(Total for Question 3 = 13 marks)

Question Number	Answer	Additional Guidance	Mark
4(a)(i)	An answer that makes reference to the following points: • corrosive **and** oxidising (agent)	 Ignore skin irritant Allow oxidant/ oxidizer Allow oxidising agent that causes flammability Ignore order Do not award oxidative Do not award oxidable Do not award combustion adjuvant Do not award flammable	**(1)**

Question Number	Answer	Additional Guidance	Mark
4(a)(ii)	An answer that makes reference to the following point: • (wear) gloves	 Allow keep away from flammable substances Ignore use it in a fume cupboard/open space Ignore use a small quantity Ignore use tongs	**(1)**

Question Number	Answer	Additional Guidance	Mark
4(b)	An answer that makes reference to the following points: • the reaction is (highly) **exothermic** **(1)** • (if the temperature gets too hot) other reactions may take place / multiple substitutions may take place / multiple nitration may take place/the ester may be hydrolysed **(1)**	Ignore mixture gets hot/ (heat) energy given off/ heat is produced Comment: the question implies that the reaction gets hot so M1 is only for exothermic Allow mixture will boil **and** reactants will be lost Allow reactants will evaporate Allow other products may be formed Ignore products will evaporate Ignore splash / spray /spill/spit Ignore to keep the temperature below 7°C/ low Ignore prevents decomposition Ignore violent reaction Do not award phenol may be formed	**(2)**

Question Number	Answer	Additional Guidance	Mark
4(c)(i)	An answer that makes reference to the following point: • solid / methyl 3-nitrobenzoate is (very) soluble at high temperatures (in methanol) but less soluble / insoluble at low temperatures	Allow the solubility of methyl 3-nitrobenzoate (in methanol) varies with temperature Ignore any reference to water	**(1)**

Question Number	Answer	Additional Guidance	Mark
4(c)(ii)	An answer that makes reference to the following points: • the first/hot filtration removes/ separates the insoluble impurities **(1)** • the second/cooled filtration removes/separates the soluble impurities **(1)**	Ignore removes solid impurities Remove the insoluble and soluble impurities scores 2 as this is the order the filtrations are done in Remove the soluble and insoluble impurities scores 1 as this is not the order the filtrations are done in Just removes impurities score 0	**(2)**

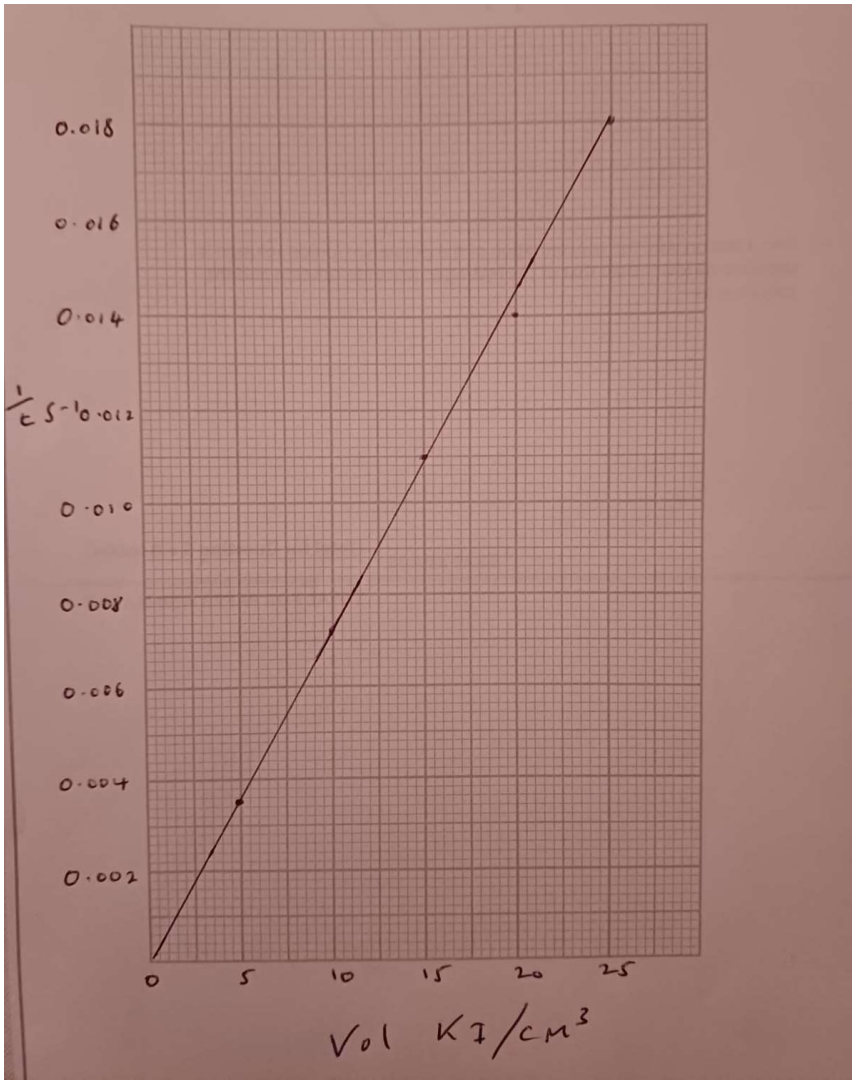
Question Number	Answer	Additional Guidance	Mark
4(c)(iii)	An answer that makes reference to the following points: • to wash off (soluble) impurities (on the crystals of methyl 3-nitrobenzoate) **(1)** • ice-cold so that the crystals do not dissolve **(1)**	Allow to wash so there are no other compounds on the crystals Allow to remove (soluble) impurities (on the crystals of methyl 3-nitrobenzoate) Ignore just to clean the crystal Ignore so the crystals are pure Do not award to remove the insoluble impurities Ignore to obtain more crystals/increase yield	**(2)**

Question Number	Answer	Additional Guidance	Mark
4(d)(i)	• moles of methyl benzoate and mass of methyl 3-nitrobenzoate **(1)** • % yield calculation **(1)** Or • moles of methyl benzoate and moles of methyl 3-nitrobenzoate **(1)** • % yield calculation **(1)**	Example of calculation 1.95 ÷ 136 = 0.014338 (mol) 0.01434 × 181 = 2.5952 (g) 100 × 1.51 ÷ 2.595 = 58.184 % 1.95 ÷ 136 = 0.014338 (mol) 1.51÷181 = 0.0083425 100 × 0.0083425 ÷ 0.014338 = 58.184 % Ignore SF except 1SF in final answer Ignore rounding/ truncating errors except in the final answer Correct answer with or without workings scores 2	**(2)**

Question Number	Answer	Additional Guidance	Mark
4(d)(ii)	An answer that makes reference to one of the following points: • side reactions • dinitration / multiple nitrations/ substitutions • incomplete reaction • loss when transferring from the conical flask to the beaker • loss during recrystallisation • some product remains in solution	Ignore just transfer loss Ignore impure methyl benzoate/starting material may not be pure Do not award crystals are not dry	**(1)**

(Total for Question 4 = 12 marks)

Question Number	Answer	Additional Guidance	Mark
5(a)	An answer that makes reference to the following points: • to react with the iodine formed **(1)** • so a colour change occurs when a certain amount of reaction has taken place **(1)**	Allow to remove the iodine Allow to reduce the iodine (to iodide ions) Allow balanced equation Allow to delay the colour change / solution turning blue-black Allow so the solution does not immediately change colour Allow when all the sodium thiosulfate is used up the iodine reacts with the starch/ there is a colour change (2) Do not award to slow down the reaction	**(2)**

Question Number	Answer	Additional Guidance	Mark
5(b)(i)	• suitable axes and labels with units **(1)** Axes wrong way round lose M1 • points plotted correctly within half a square **(1)** • points joined with a straight line through the origin/would hit the origin if the line was extended. **(1)** Allow +/- two squares	The points plotted must cover at least half the grid in both directions  	**(3)**

Question Number	Answer	Additional Guidance	Mark
5(b)(ii)	An answer that makes reference to the following points: • first order with respect to iodide ions **(1)** • because graph is a straight line through the origin **(1)**	Allow the graph (of rate and concentration) is a straight line/ linear Allow rate is proportional to concentration/volume Allow 1/t is proportional to concentration /volume Allow the relationship between two points Allow constant gradient	**(2)**

Question Number	Answer	Additional Guidance	Mark
5(c)	An answer that makes reference to the following point: • (the concentrations of hydrogen peroxide and sulfuric acid are effectively constant) so the rate is only dependent on the iodide ions/KI	Allow they (hydrogen peroxide and sulfuric acid) do not affect the rate Ignore iodide ions are the only variable/only the concentration of iodide ions is changing	**(1)**

(Total for Question 5 = 8 marks)

(Total for Paper = 50 marks)