Mark Scheme (Final)

Summer 2023

Pearson Edexcel International Advanced Subsidiary Level In Chemistry (WCH13)
Paper 01
Unit 3: Practical Skills in Chemistry I

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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.

Quality of Written Communication

Questions which involve the writing of continuous prose will expect candidates to:
- write legibly, with accurate use of spelling, grammar and punctuation in order to make the meaning clear
- select and use a form and style of writing appropriate to purpose and to complex subject matter
- organise information clearly and coherently, using specialist vocabulary when appropriate.

Full marks will be awarded if the candidate has demonstrated the above abilities. Questions where QWC is likely to be particularly important are indicated (QWC) in the mark scheme, but this does not preclude others.

Question	Answer	Additional Guidance	Mark
1(a)(i)	An answer that makes reference to the following point: • barium (ion) / Ba^{2+} / Ba^{+2}	Do not award Ba/ Ba^{+} Do not award Cu^{2+} If name and formula are given both must be correct	**(1)**

Question	Answer	Additional Guidance	Mark
1(a)(ii)	An answer that makes reference to the following point: • iodide (ion) / I^{-}	Do not award just iodine / I / I_2^{-}	**(1)**

Question	Answer	Additional Guidance	Mark
1(a)(iii)	An answer that makes reference to the following point: • BaI_2	Allow TE on incorrect ions in (a)(i) and (a)(i) Ignore barium iodide	**(1)**

Question	Answer	Additional Guidance	Mark
1(a)(iv)	An answer that makes reference to the following points: • test for iodide ion **(1)** • result of test for iodide ion **(1)**	Add **conc** sulfuric acid / H_2SO_4 Bad egg smell / purple vapour/ purple fumes / yellow solid/ black solid Ignore misty fumes (of HI) Or (To a solution of A) add chlorine water / $Cl_2(aq)$ Solution turns yellow / orange / brown / darker / gives a purple colour with an organic solvent Do not award black Or (To a solution of A) add bromine water / $Br_2(aq)$ Solution turns darker / more orange / gives a purple colour with an organic solvent Do not award black Allow TE for bromide ion and chloride ion	**(2)**

Question	Answer	Additional Guidance	Mark
1(b)(i)	An answer that makes reference to the following points: • test for ammonium ions **(1)** • result of test on ammonium ions **(1)**	Sodium hydroxide (solution) / NaOH ((aq)) (and heat) Allow any named alkali Gas/ vapour evolved turns (damp red) litmus blue/UI blue/indicator Allow turns indicator paper blue Ignore pungent gas evolved Do not award if the indicator is being added to the mixture Or Gas evolved forms white smoke with HCl Allow white fumes with HCl Do not award steamy/misty fumes	**(2)**

Question	Answer	Additional Guidance	Mark
1b(ii)	An answer that makes reference to the following points: • addition of suitable barium compound **(1)** • addition of suitable acid **(1)** • result of test for sulfate ions **(1)**	(to a solution of ammonium sulfate add) barium chloride (solution) / $BaCl_2$ ((aq)) / barium nitrate (solution) / $Ba(NO_3)_2$ ((aq)) hydrochloric acid/ nitric acid Allow HCl/ HNO_3 without (aq) M2 is dependent on M1 or near miss white and precipitate / ppt / ppte / solid M3 is not a stand-alone mark	**(3)**

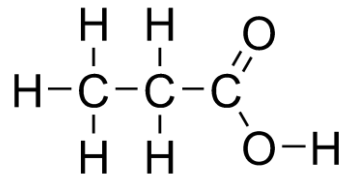
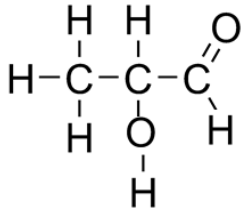
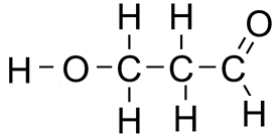
Question	Answer	Additional Guidance	Mark
1(b)(iii)	An answer that makes reference to the following points: • balanced equation **and** correct state symbols	$Ba^{2+}(aq) + SO_4^{2-}(aq) \longrightarrow BaSO_4(s)$	**(1)**

(Total for Question 1 = 11 marks)

Question	Answer	Additional Guidance	Mark
2(a)	An answer that makes reference to the following point: • hydrogen chloride / HCl/ HCl (gas)	Allow hydrochloric acid / HCl (aq) If name and formula given both must be correct	**(1)**

Question	Answer	Additional Guidance	Mark
2(b)	An answer that makes reference to the following point: • carbon dioxide / CO_2 / CO_2 (gas)	If name and formula given both must be correct	**(1)**

Question	Answer	Additional Guidance	Mark
2(c)	An answer that makes reference to the following points: • blue (solution) **(1)** • (produces) (brick) red / orange/ brown **and** precipitate/solid / ppt / ppte / **(1)**	Do not award blue solid or ppt Allow cloudy red/orange/brown solution If formula given (of ppt), Cu_2O it must be correct	**(2)**

Question	Answer	Additional Guidance	Mark
2(d)(i)	An answer that makes reference to the following structures: • structure of C **(1)** • possible structure of D **(1)** • possible structure of D **(1)** Ignore connectivity of the OH unless horizontal Accept displayed / structural / skeletal formula or any combination Do not award COH for the CHO of the aldehydes but only penalise once in parts (d)(i) and (d)(iii)	Structure of **C**  **(1)** Possible structure of **D**  **(1)** Possible structure of **D**  **(1)**	**(3)**

	Answer	Additional Guidance	Mark
2(d)(ii)	An answer that makes reference to the following points • 2962 - 2853 (cm^{-1}) **and** C-H (stretching in alkanes)	No TE on wrong structures	**(1)**

Question	Answer	Additional Guidance	Mark
2(d)(iii)	An explanation that makes reference to the following points: • (peak at *m/z* = 15 is due to) $CH_3^{(+)}$ **(1)** This is a stand-alone mark • (only formed) from 2-hydroxypropanal. **(1)**	Do not award CH_3 • Allow any reference to the correct structure e.g., the first one	**(2)**

(Total for Question 2 = 10 marks)

Question	Answer	Additional Guidance	Mark
3(a)(i)	An explanation that makes reference to the following points: • **distillation** takes place **(1)** • before complete oxidation can occur **(1)**	Allow **distillation** apparatus (not reflux) Allow incomplete reaction/ incomplete oxidation/ only oxidised to the aldehyde/ butanal is formed Allow complete oxidation is needed to get butanoic acid Allow reflux is required to ensure complete oxidation Allow reflux is required to ensure butanoic acid is formed Ignore just low yield of butanoic acid	**(2)**

Question	Answer	Additional Guidance	Mark
3(a)(ii)	An answer that makes reference to the following point: • reactants and / or products would evaporate	Allow (the vessel is open so) reactants /products/gas/ would escape Allow alcohols are flammable Ignore not safe/toxic/no condenser Ignore reference to volatile reactants/products Do not award the (butanoic) acid would escape/evaporate	**(1)**

Question	Answer	Additional Guidance	Mark
3 (a)(iii)	An explanation that makes reference to the following points: • condenser is full of water/ prevents air bubbles from forming **(1)** • (more) efficient condensation/ (ensuring) **all/ more/most** of the vapour/ gas is condensed/no or less vapour is lost **(1)**	Allow better contact between the water and the glass wall of the condenser. Allow just (more) efficient cooling Allow reverse argument Ignore speed of condensation	**(2)**

Question	Answer	Additional Guidance	Mark
3(a)(iv)	An answer that makes reference to the following points: • potassium dichromate((VI)) / $K_2Cr_2O_7$ **and** sulfuric acid (ignore concentration)	Allow acidified potassium dichromate((VI)) Or $Cr_2O_7^{2-}$ and H^+ Do not award hydrochloric acid / HCl/nitric acid/HNO_3 Do not award acidified potassium manganate(VII) / potassium permanganate If name, formula and oxidation numbers are given all must be correct	**(1)**

Question	Answer	Additional Guidance	Mark
3(a)(v)	An answer that makes reference to the following point: • from orange to green	Allow from orange to blue	**(1)**

Question	Answer	Additional Guidance	Mark
3(b)(i)	An answer that makes reference to the following points: • (concentrated)phosphoric ((V)) acid/ H_3PO_4 Or concentrated sulfuric acid H_2SO_4	Allow ⩾ 50% Allow passing vapour over suitable solid catalyst such as aluminium oxide / porous pot If name, formula and oxidation numbers are given all must be correct Do not award phosphorus acid	**(1)**

Question	Answer	Additional Guidance	Mark
3(b)(ii)	An answer that makes reference to one of the following pairs of points: • bromine water / aqueous bromine / bromine solution / bromine in organic solvent / Br_2 (aq) **(1)** • orange / yellow / brown/ red brown to colourless **(1)** Or • potassium manganate(VII) / $KMnO_4$ and sulfuric acid / H_2SO_4 **(1)** • purple to colourless **(1)**	Allow bromine / Br_2((l)) Allow just decolourises Ignore clear Allow potassium permanganate and sulfuric acid Allow acidified potassium manganate(VII) Allow just decolourises Ignore clear If name, formula and oxidation numbers are given all must be correct M2 dependent on M1 or near miss	**(2)**

(Total for Question 3 = 10 marks)

Question	Answer	Additional Guidance	Mark
4(a)(i)	An explanation that makes reference to two of the following points: bubbles / effervescence **(1)** goes cloudy / white precipitate / white solid **(1)** calcium/solid disappears **(1)**	Allow the gas syringe filled up/(barrel) moved Ignore gas/ hydrogen given off Ignore goes milky Ignores forms a colourless solution Allow calcium/solid dissolves Ignore Ca floats Mention of any coloured product (max 1) Confusion with sodium e.g. whizzing round (max 1)	**(2)**

Question	Answer	Additional Guidance	Mark
4(a)(ii)	• calculation of mass of Ca **(1)** • calculation of moles of Ca **(1)** • calculation of volume of one mole of hydrogen gas **(1)** • correct units and answer to 2 or 3 SF **(1)**	Example of calculation 1.783 g – 1.657 g = 0.126 (g) 0.126/40.1 = 0.0031421 / 3.1421×10^{-3} (mol) 72.0/0.0031421 = 22914 / 2.2914×10^{4} (cm^3) Or 0.072/0.0031421 = 22.914 / (dm^3) 23 / 22.9 dm^3 (mol^{-1}) / 23 000 / 22 900 cm^3 (mol^{-1}) Allow TE throughout Correct answer with or without working scores (4)	**(4)**

Question	Answer	Additional Guidance	Mark
4(b)(i)	• percentage error	Example of calculation 100 × (23.9 – 21.8) ÷ 23.9 = 8.7866 (%) Ignore SF except 1SF Ignore +/- Do not award 9%, 8.7% or 8.78% Correct answer with no working scores (1)	**(1)**

Question	Answer	Additional Guidance	Mark
4(b)(ii)	An answer that makes reference to the following points: • some (hydrogen) gas escapes before the bung is attached OR reaction starts before the bung is placed in the conical flask **(1)** • some of the calcium had already formed calcium oxide **(1)**	Allow there was a delay (after dropping in the Ca) before the bung could be placed on the conical flask/connecting the apparatus Ignore hydrogen dissolves in water Ignore just the gas escaped/ bung didn't fit properly Allow the Ca/it was not pure Allow the Ca/it did not fully react Allow the Ca/it did not fully dissolve Ignore just the reaction was incomplete Ignore any measurement errors eg some Ca left in the weighing boat Ignore non-standard conditions etc Do not award the water was limiting	**(2)**

Question	Answer	Additional Guidance	Mark
4(c)(i)	An answer that makes reference to the following points: • (from) yellow **(1)** • (to) orange **(1)**	Ignore shades of colours eg pale Colours reversed scores (1)	**(2)**

Question	Answer	Additional Guidance	Mark
4(c)(ii)			**(2)**

Titration	1	2	3	4
Final burette reading / cm^3	26.85	31.25	34.55	27.15
Final burette reading / cm^3	0.00	5.00	8.00	1.00
Titre / cm^3	**26.85**	**26.25**	**26.55**	**26.15**
Concordant results (✓)		✓		✓

- all 6 correct **(1)**

- calculation of mean titre **(1)**

$\frac{26.25 + 26.15}{2}$

$= 26.20\ (cm^3)$

Allow 26.2

Allow TE for the mean titre on ticked boxes

Question	Answer	Additional Guidance	Mark
4(c)(iii)	• calculation of moles of hydrochloric acid **(1)** • calculation of moles of calcium hydroxide in 25 cm^3 **(1)** • calculation of moles of calcium hydroxide in 1 dm^3 **(1)** • calculation of concentration in g dm^{-3} **(1)**	Example of calculation $26.2 \times 0.0400 / 1000 = 0.001048$ (mol)/ 1.048×10^{-3} (mol) TE on (c)(ii) $1.048 \times 10^{-3} \div 2 = 0.000524 / 5.24 \times 10^{-4}$ (mol) $5.24 \times 10^{-4} \times 1000 \div 25 = 0.02096$ (mol) $= 0.02096 \times 74.1 = 1.5531$ (g dm^{-3}) Allow $= 0.02096 \times 74 = 1.5510$ (g dm^{-3}) Ignore SF except 1SF Ignore units TE throughout Correct answer with no working score (4)	**(4)**

Question	Answer	Additional Guidance	Mark
4(d)	An explanation that makes reference to the following points: • goes cloudy / white precipitate / white solid (of calcium hydroxide) **(1)** • (increasing temp) moves the equilibrium in the endothermic direction so: calcium hydroxide solubility decreases/ less calcium hydroxide dissolves/ more (solid) calcium hydroxide forms Or • (increasing temp) favours the reverse direction so: calcium hydroxide solubility decreases / less calcium hydroxide dissolves/ more (solid) calcium hydroxide forms **(1)**	Do not award any other white ppt eg CaO, $CaCl_2$ Do not award white anhydrous calcium hydroxide Do not award any other colour or extra observations e.g. effervesces Do not award any reference to water evaporating/ crystallisation Allow (increasing temp) means: calcium hydroxide solubility decreases / less calcium hydroxide dissolves/calcium hydroxide forms Ignore any reference rates of dissolving	**(2)**

(Total for Question 4 = 19 marks)

(Total for Paper = 50 marks)

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