Mark Scheme (Results)

October 2017

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

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November 2017
Publications Code WCH06_01_1710_MS

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.
- Mark schemes will indicate within the table where, and which strands of QWC, are being assessed. The strands are as follows:

  i) ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear
  ii) select and use a form and style of writing appropriate to purpose and to complex subject matter
  iii) organise information clearly and coherently, using specialist vocabulary when appropriate

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 Number	Acceptable Answers	Reject	Mark
1(a)	Any **two** from: Fe^{2+} / $[Fe(H_2O)_6]^{2+}$ **(1)** Ni^{2+} / $[Ni(H_2O)_6]^{2+}$ **(1)** Cr^{3+} **(1)** ALLOW (1) for $[Cr(H_2O)_6]^{3+}$ / V^{3+} / $[V(H_2O)_6]^{3+}$ / Cu^{2+} IGNORE names / state symbols / missing square brackets If no other mark is awarded: ALLOW (1) for two names with oxidation numbers	 Fe^{3+} Cr^{2+}	**(2)**

Question Number	Acceptable Answers	Reject	Mark
1(b)(i)	Cr^{3+} / $[Cr(H_2O)_6]^{3+}$ IGNORE names / state symbols/ missing square brackets		**(1)**

Question Number	Acceptable Answers	Reject	Mark
1(b)(ii)	$[Cr(OH)_6]^{3-}$ ALLOW $[Cr(H_2O)_2(OH)_4]^-$ / $[Cr(OH)_4]^-$ / CrO_2^- IGNORE name / state symbol	OH^-	**(1)**

Question Number	Acceptable Answers	Reject	Mark
1(c)(i)	Chromate **and** (VI) / VI / +6 / 6+ ALLOW CrO_4^{2-} **and** (VI) / VI / +6 / 6+	Incorrect formula e.g. $Cr_2O_7^{2-}$	**(1)**

Question Number	Acceptable Answers	Reject	Mark
1(c)(ii)	Gas: ammonia / NH_3 **(1)** Ionic equation: $NH_4^+ + OH^- \rightarrow NH_3 + H_2O$ **(1)** IGNORE state symbols, even if incorrect / non-ionic equation	ammonium / NH_4 / NH_4^+	**(2)**

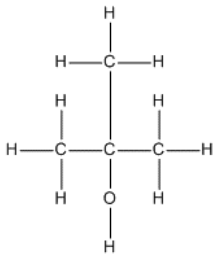
Question Number	Acceptable Answers	Reject	Mark
1(d)	Barium sulfate / $BaSO_4$		**(1)**

Question Number	Acceptable Answers	Reject	Mark
1(e)	$NH_4Cr(SO_4)_2$ / $(NH_4)_2SO_4.Cr_2(SO_4)_3$ ALLOW Correct neutral formulae with any Cr^{3+} : NH_4^+ ratio e.g. $Cr(NH_4)_3(SO_4)_3$ / $(NH_4)_2Cr_2(SO_4)_4$ ALLOW species in any order ALLOW species with charges e.g. $NH_4^+Cr^{3+}(SO_4^{2-})_2$ IGNORE Missing dot / water of crystallisation TE on (b)(i) (c)(ii) and (d) e.g. $(NH_4)_2SO_4.FeSO_4$	Species with charges giving a net charge	**(1)**

(Total for Question 1 = 9 marks)

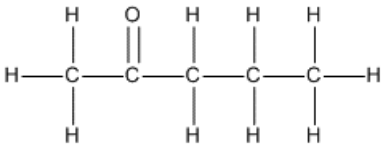
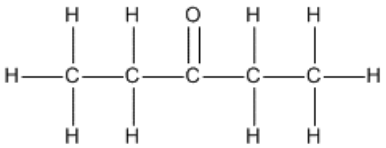
Question Number	Acceptable Answers	Reject	Mark
2(a)(i)	(Gas) hydrogen chloride / HCl / HCl(g) ALLOW HCl(aq) / hydrochloric acid **(1)** (Group) OH / –OH / alcohol / hydroxy / hydroxyl **(1)**	 OH^- / hydroxide / carboxylic acid	**(2)**

Question Number	Acceptable Answers	Reject	Mark
2(a)(ii)	Tertiary / 3° alcohol ALLOW Not primary **and** not secondary alcohol IGNORE **D** cannot be oxidised / not aldehyde / just '-OH'	Carboxylic acid	**(1)**

Question Number	Acceptable Answers	Reject	Mark
2(b)	 ALLOW OH / CH_3 IGNORE connectivity to vertical OH but penalise OH-C on left ALLOW displayed formula of propanoic acid		**(1)**

Question Number	Acceptable Answers	Reject	Mark
2(c)(i)	Penalise methyl ketone for ketone once only in (c)(i) and (c)(ii) Aldehyde / CHO /  /  or ketone /  / $R_2C=O$ / Both aldehyde and ketone needed for the mark ALLOW Carbonyl IGNORE Just C=O	Carboxyl	**(1)**

Question Number	Acceptable Answers	Reject	Mark
2(c)(ii)	Ketone		**(1)**

Question Number	Acceptable Answers	Reject	Mark
2(d)(i)	 **(1)**  **(1)** ALLOW Isomers in either order Structural / skeletal / displayed formulae or any combination of these TE if aldehyde identified in (c)(ii) for (1) mark	Incorrect names in addition to formulae once only Minor errors once only e.g. H missing / bond missing Pentavalent carbons in each structure	**(2)**

Question Number	Acceptable Answers	Reject	Mark
2(d)(ii)	**Reagents** – standalone mark Iodine / I_2 (in potassium iodide / KI) / KI_3 **and** sodium hydroxide / NaOH (solutions) OR Potassium iodide / KI **and** sodium chlorate(I) / NaOCl (solutions) ALLOW Iodine and alkali **(1)** **Observations** – conditional on at least one ketone in (d)(i) (Observation for pentan-2-one) (Pale) yellow precipitate /ppt /ppte / solid (with antiseptic smell) **(1)** IGNORE yellow colour (Observation for pentan-3-one) No change / no precipitate /no ppt/ no ppte / no solid ALLOW No reaction No change in colour / remains colourless / remains (pale) yellow **(1)** No TE on structures in (d)(i) IGNORE References to spectroscopy	NH_3 as alkali White ppt Other colours e.g. brown	**(3)**

(Total for Question 2 = 11 marks)

Question Number	Acceptable Answers	Reject	Mark
3(a)	Correct answer, with or without working, scores (3) **First mark** - calculating moles of O_2 Mol O_2 = 20/24000 or 0.02/24 = 0.00083333 / 8.3333 x 10^{-4} ALLOW 1/1200 OR Mol O_2 = 20/24 = 0.833 **(1)** **Second mark -** using mole ratio Mol H_2O_2 (in 1 cm^3) = 2 x 0.00083333 = 0.00167 / 1.67 x 10^{-3} ALLOW 1/600 OR Mol H_2O_2 (in 1 dm^3) = 2 x 0.833 = 1.67 TE on mol O_2 **(1)** **Third mark** – calculating concentration of H_2O_2 This is dependent on a mole ratio being used in the calculation Concentration H_2O_2 = 0.00167 x 1000 = 1.67 (mol dm^{-3}) OR Recognition that there are 1.67 mol H_2O_2 in 1 dm^3 so concentration = 1.67 mol dm^{-3} TE on mol H_2O_2 ALLOW 5/3 and $1^2/_3$ **(1)** IGNORE SF except 1 SF Do not penalise final answer from correct rounding of intermediate answers e.g. 1.6 / 1.66 (mol dm^{-3}) from 0.83 / 0.000833		**(3)**

Question Number	Acceptable Answers	Reject	Mark
3(b)(i)	(Rinse it with distilled water followed by) rinse it with the hydrogen peroxide / solution (it will be filled with) ALLOW rinse with water and hydrogen peroxide IGNORE just clean / rinse / dry	Rinse with hydrogen peroxide and water Rinse with hydrogen peroxide then water	**(1)**

Question Number	Acceptable Answers	Reject	Mark
3(b)(ii)	Shake / invert the solution ALLOW any indication of mixing e.g.stir		**(1)**

Question Number	Acceptable Answers	Reject	Mark
3(b)(iii)	The nozzle / jet of the burette is full / has no air bubbles ALLOW The part below the tap is full (of solution) OR The gap is full (of solution) / the bottom part is full (of solution) OR There are no (air) bubbles / check for air gaps OR The funnel has been removed IGNORE References to reading from the bottom of the meniscus / reading at eye level Check that the tap is closed		**(1)**

Question Number	Acceptable Answers	Reject	Mark
3(b)(iv)	(25 cm^3) measuring cylinder ALLOW Beaker with 25 cm^3 graduation mark / 50 cm^3 beaker / 100 cm^3 beaker / 100 cm^3 or 50 cm^3 conical flask with graduation mark / syringe IGNORE just 'beaker' / 'conical flask'	pipette burette volumetric flask	**(1)**

Question Number	Acceptable Answers	Reject	Mark
3(b)(v)	(From) colourless (to permanent pale) pink Both colours needed for the mark IGNORE clear	Colourless to purple / mauve / red Pink / purple / mauve to colourless	**(1)**

Question Number	Acceptable Answers	Reject	Mark
3(b)(vi)	Results that are within 0.1 / 0.2 (cm^3 of each other) ALLOW Results that are similar **and** a specific example within 0.1 / 0.2 e.g. 25.00 and 25.20 (cm^3) Results that are within ±0.1 / ±0.2 (cm^3 of each other) IGNORE Just 'results that are (almost) the same' / results that are close together / results within a stated % of each other		**(1)**

Question Number	Acceptable Answers	Reject	Mark
3(b)(vii)	Correct answer, with or without working, scores (4) Mol MnO_4^- used = $\frac{15.80 \times 0.0200}{1000}$ = 0.000316 / 3.16×10^{-4} **(1)** Mol H_2O_2 in 25.0 cm^3 = $\frac{0.000316 \times 5}{2}$ = 0.000790 / 7.90×10^{-4} TE on mol MnO_4^- **(1)** Concentration diluted H_2O_2 = $\frac{0.000790 \times 1000}{25.0}$ = 0.0316 (mol dm^{-3}) TE on mol H_2O_2 in 25.0 cm^3 **(1)** Concentration original H_2O_2 = $\frac{0.0316 \times 250.0}{10.0}$ = 0.790 / 0.79 (mol dm^{-3}) TE on concentration diluted H_2O_2 **(1)** **Alternative method for 3rd and 4th marks** Mol H_2O_2 in 250.0 cm^3 / (original) 10.0 cm^3 = 0.000790 x 10 or 0.000790 x $\frac{250.0}{25.0}$ = 0.00790 TE on mol H_2O_2 in 25.0 cm^3 **(1)** Concentration original H_2O_2 = 0.00790 x $\frac{1000}{10.0}$ = 0.790 / 0.79 (mol dm^{-3}) TE on mol H_2O_2 in 250.0 cm^3 / (original) 10.0 cm **(1)** IGNORE SF except 1SF		**(4)**

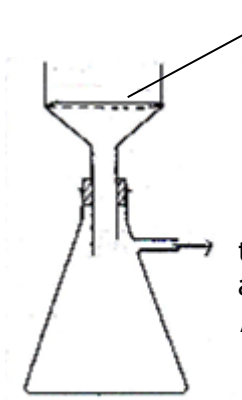
Question Number	Acceptable Answers	Reject	Mark
3(c)	$\frac{2 \times 0.05}{15.80} \times 100 =$ (±)0.63291 / 0.6329 /0.633 / 0.63 / 0.6(%)	0.31646 (%)	**(1)**

Question Number	Acceptable Answers	Reject	Mark
3(d)	(Some of) the hydrogen peroxide had already decomposed (slowly, to form water and oxygen) OR (Some of) the hydrogen peroxide had formed / reacted to form oxygen / water OR (Some of) the hydrogen peroxide had undergone disproportionation / oxidation and reduction IGNORE Just oxidation / just reduction Hydrogen peroxide has low boiling / melting temperature Water formed dilutes the hydrogen peroxide	Any references to a reaction with MnO_4^- Water /hydrogen peroxide evaporates Hydrogen is formed	**(1)**

(Total for Question 3 = 15 marks)

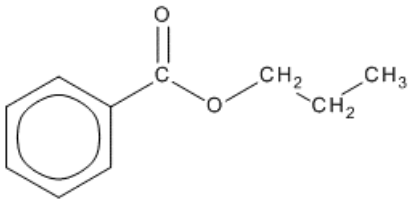
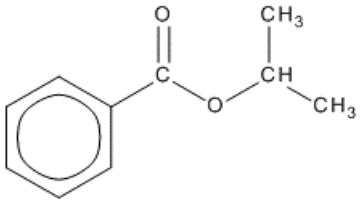
Question Number	Acceptable Answers	Reject	Mark
4(a)(i)	As a (mutual/co) solvent (for the ester and sodium hydroxide solution) OR Dissolves ester and sodium hydroxide / both substances / the mixture OR To allow the ester and sodium hydroxide (solution) to mix / dissolve / become miscible ALLOW Dissolves the ester IGNORE To allow the ester and sodium hydroxide to react / References to the product dissolving	Catalyst	**(1)**

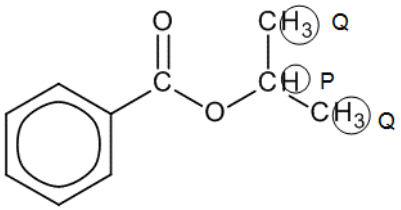
Question Number	Acceptable Answers	Reject	Mark
4(a)(ii)	**First mark** Heating to increase / speed up the rate of reaction /make the reaction faster ALLOW To overcome / provide the (high) activation energy / reaction is slow at room temperature **(1)** IGNORE Just 'to provide energy for the reaction' **Second mark** Refluxing to prevent loss of (volatile) reactants / products OR So that (volatile) reactants / products return to the flask ALLOW To condense the gases / vapours formed To prevent gas / vapour escaping So that reaction goes to completion **(1)** IGNORE To condense the mixture / any reference to flammable gases	Just 'to prevent evaporation'	**(2)**

Question Number	Acceptable Answers	Reject	Mark
4(a)(iii)	 (Top label) Filter paper ALLOW Sintered glass **(1)** IGNORE Porous filter / Buchner funnel (Lower label) To (vacuum) pump / aspirator/ (water)tap /suction ALLOW To vacuum (apparatus) / reduced pressure **(1)** (Reason) Faster /speeds up (filtration) OR (Product / benzoic acid is) drier ALLOW Filtrate / soluble impurities / solvent is removed **and** more completely / efficiently OR Dries the benzoic acid **(1)**	Fluted filter paper Waste gas / gas out /pressure out Reference to removing insoluble impurities	**(3)**

Question Number	Acceptable Answers	Reject	Mark
4(a)(iv)	Dissolve/ add the benzoic acid / (impure) solid / crystals in the minimum (volume / amount) of boiling / hot water ALLOW use of solvent for water	Incorrect solvent	**(1)**

Question Number	Acceptable Answers	Reject	Mark
4(a)(v)	Correct answer, with or without working scores (4) **First mark** Mass of ester/**X** = 3.0 x 1.02 = 3.06 (g) **(1)** **Second mark** moles of ester/**X** = $\frac{3.06}{164}$ = 0.018659 **(1)** **Third mark** **EITHER** Theoretical mass benzoic acid = 0.018659 x 122 = 2.2763 (g) TE on moles of ester/**X** **OR** Moles of benzoic acid produced = 1.45/122 = 0.011885 TE on moles of ester/**X** **(1)** **Fourth mark** **EITHER** % yield = $\frac{1.45}{2.2763}$ x 100 = 63.6987(%) TE on theoretical mass benzoic acid **OR** % yield = $\frac{0.011885}{0.018659}$ x 100 = 63.6987(%) TE on moles benzoic acid produced **(1)** IGNORE SF except 1 SF		**(4)**

Question Number	Acceptable Answers	Reject	Mark
4(b)	 **(1)**  **(1)** Structures can be in either order ALLOW displayed, skeletal, structural formulae or any combination of these	Any missing H from non-skeletal formulae once only	**(2)**

Question Number	Acceptable Answers	Reject	Mark
4(c)	 **First mark** Identification of **X** as isopropylbenzoate **(1)** **Second mark** Identification of proton responsible for peak P **and** Identification of **both** sets of protons responsible for peak Q ALLOW carbon atoms / CH and CH_3 groups labelled ALLOW just 1 proton in each CH_3 group labelled **(1)** IGNORE Missing benzoate group / circle in benzene	Incorrect ester scores (0) Additional protons circled e.g. in benzene ring	**(2)**

(Total for Question 4 = 15 marks)