Mark Scheme (Results)

January 2019

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.

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)(i)	**Test 1 Cation:** Cr^{3+} ALLOW $[Cr(H_2O)_6]^{3+}$ **(1)** IGNORE State symbols, even if incorrect Missing square brackets Chromium(III) ions **Test 2:** White precipitate / ppt / ppte / solid **(1)** IGNORE Cloudy	Cr Off-white / pale yellow / cream	**(2)**

Question Number	Acceptable Answers	Reject	Mark
1(a)(ii)	$[Cr(OH)_6]^{3-}$ ALLOW $[Cr(OH)_4(H_2O)_2]^-$ / $[Cr(OH)_4]^-$ / CrO_2^- IGNORE Name State symbol, even if incorrect Missing square brackets OH^-		**(1)**

Question Number	Acceptable Answers	Reject	Mark
1(a)(iii)	$Ag^+(aq) + Cl^-(aq) \rightarrow AgCl(s)$ State symbols required ALLOW Multiples IGNORE Other equations as working		**(1)**

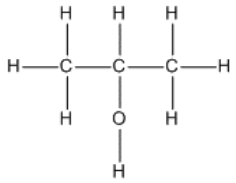
Question Number	Acceptable Answers	Reject	Mark
1(b)(i)	**Test 3 Observation:** White precipitate / ppt / ppte / solid **(1)** (Precipitate dissolves in excess to form a) colourless solution **(1)** IGNORE Just 'precipitate dissolves' / clear **Test 4 Anion:** Sulfate(VI) / SO_4^{2-} ALLOW sulfate **(1)**	Fizzing for M1 only sulfite / sulfate(IV) / SO_3^{2-}	**(3)**

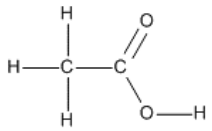
Question Number	Acceptable Answers	Reject	Mark
1(b)(ii)	(Formation of white precipitate) $Zn^{2+} + 2OH^- \rightarrow Zn(OH)_2$ OR $[Zn(H_2O)_6]^{2+} + 2OH^- \rightarrow Zn(OH)_2 + 6H_2O$ OR $[Zn(H_2O)_6]^{2+} + 2OH^- \rightarrow Zn(OH)_2(H_2O)_4 + 2H_2O$ ALLOW Other balanced equations for the reaction of zinc ions to form either of the precipitates shown **(1)** (Dissolving precipitate) **Equation must start from a precipitate** $Zn(OH)_2 + 2OH^- \rightarrow [Zn(OH)_4]^{2-}$ OR $Zn(OH)_2 + 4OH^- \rightarrow [Zn(OH)_6]^{4-}$ OR $Zn(OH)_2(H_2O)_4 + 2OH^- \rightarrow [Zn(OH)_4]^{2-} + 4H_2O$ OR $Zn(OH)_2(H_2O)_4 + 2OH^- \rightarrow [Zn(OH)_4(H_2O)_2]^{2-} + 2H_2O$ OR $Zn(OH)_2(H_2O)_4 + 4OH^- \rightarrow [Zn(OH)_6]^{4-} + 4H_2O$ ALLOW Other balanced equations for the reaction of a precipitate to form any of the complex ions shown Equation for the formation of ZnO_2^{2-} e.g. $Zn(OH)_2 + 2OH^- \rightarrow ZnO_2^{2-} + 2H_2O$ **(1)** IGNORE Missing square brackets State symbols, even if incorrect		**(2)**

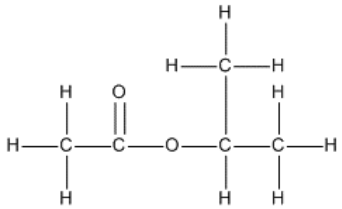
(Total for Question 1 = 9 marks)

Question Number	Acceptable Answers	Reject	Mark
2(a)	(Gas) hydrogen chloride / HCl / HCl(g) ALLOW HCl(aq) / hydrochloric acid **(1)** (Group) (−)OH / (−)O−H / hydroxy(l) OR alcohol or carboxylic acid **Both** needed for the mark **(1)**	 OH^- / hydroxide Just 'alcohol' or just 'carboxylic acid'	**(2)**

Question Number	Acceptable Answers	Reject	Mark
2(b)	Primary or secondary alcohol **Both** needed for the mark ALLOW 1˚ or 2˚ alcohol Not tertiary alcohol IGNORE Just 'alcohol' / not a carboxylic acid		**(1)**

Question Number	Acceptable Answers	Reject	Mark
2(c)	 IGNORE Connectivity of OH unless OH−C on left OR $CH_3CH(OH)CH_3$ IGNORE Missing brackets ALLOW Any combination of structural and displayed formula /skeletal formula 3 carbon atoms with OH group **(1)** Rest of structure of propan-2-ol **(1)** IGNORE Name, even if incorrect		**(2)**
Question Number	Acceptable Answers	Reject	Mark
2(d)	(Gas) carbon dioxide / CO_2 **(1)** (Functional group) Carboxylic acid / COOH / CO_2H /carboxyl / carboxylic **(1)**	Just acid Just carbonyl /C=O COO^- / COO	**(2)**

Question Number	Acceptable Answers	Reject	Mark
2(e)	 OR CH_3COOH ALLOW Any combination of structural and displayed formula / skeletal formula IGNORE Name, even if incorrect		**(1)**

Question Number	Acceptable Answers	Reject	Mark
2(f)	 OR $CH_3COOCH(CH_3)_2$ ALLOW Any combination of structural and displayed formula / skeletal formula IGNORE Name, even if incorrect TE on (c) and (e) provided (c) and (e) are an alcohol and a carboxylic acid e.g. propylethanoate from propan-1-ol		**(1)**

(Total for Question 2 = 9 marks)

Question Number	Acceptable Answers	Reject	Mark
3(a)	**First mark** White /off-white / beige / buff / pale brown / light brown **and** precipitate / ppte / ppt / solid **(1)** **Note:** Colour **and** state are needed for the mark IGNORE Colourless or pale pink solution Gelatinous **Second mark** Darkens / turns brown (on standing) ALLOW Turns black **(1)**	Cream ppt Pink ppt Brown ppt Fizzing / bubbles / effervescence Reference to precipitate dissolving	**(2)**

Question Number	Acceptable Answers	Reject	Mark
3(b)(i)	$E^{\ominus}_{cell}$ = (0.56 – 2.26 =) −1.7(0) (V) **(1)** (Reaction is not thermodynamically feasible as) $E^{\ominus}_{cell}$ is (large and) negative / <0 ALLOW MnO_4^{2-} disproportionates in acid solution **(1)**		**(2)**

Question Number	Acceptable Answers	Reject	Mark
3(b)(ii)	**First mark** (Higher concentration of OH^- ions) Reduces the $E^\ominus$ value / $E^\ominus$ becomes less positive / shifts the equilibrium to the left **and** linked to second equation / reference to equation with OH^- ALLOW Becomes 'more negative' for 'less positive' **(1)** **Second mark** So $E^\ominus_{cell}$ **becomes** positive (and the reaction is feasible) OR $E^\ominus_{cell}$ (of original reaction)= −0.03 (V) ALLOW $E^\ominus_{cell}$ (of original reaction) is slightly negative **(1)** IGNORE Reference to non-standard conditions Activation energy Just '$E^\ominus_{cell}$ is positive (so reaction is feasible)'		**(2)**

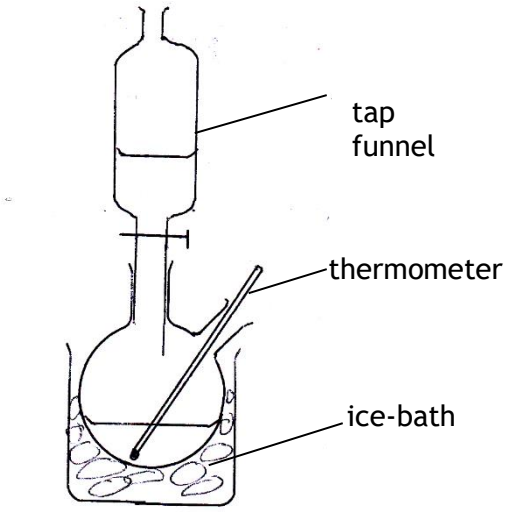
Question Number	Acceptable Answers	Reject	Mark
3(c)(i)	(Indicator) starch (solution) **(1)** (Colour change from) blue or black or blue-black **and** (to) colourless ALLOW Any shade of blue e.g. deep blue **(1)** IGNORE Clear	Purple / green	**(2)**

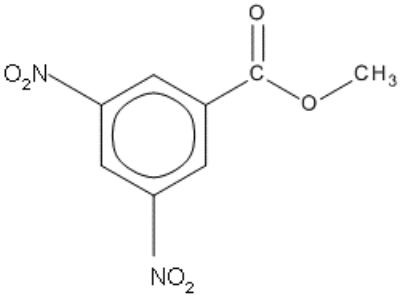
Question Number	Acceptable Answers	**Reject**	Mark
3(c)(ii)	Correct answer, with or without working, scores (4) Mol $S_2O_3^{2-}$ used = $\frac{16.2 \times 0.0100}{1000}$ = 0.000162 / 1.62×10^{-4} **(1)** (Mol I_2 = $\frac{1.62 \times 10^{-4}}{2}$ = 0.000081 / 8.1×10^{-5}) Mol Mn(II)/Mn(III) = ($8.1 \times 10^{-5} \times 2$) = 0.000162 / 1.62×10^{-4} TE on mol $S_2O_3^{2-}$ / I_2 **(1)** Mol O_2 = $\frac{0.000162}{4}$ = 4.05×10^{-5} / 0.0000405 TE on mol Mn(II)/Mn(III) **(1)** Volume O_2 = $4.05 \times 10^{-5} \times 24\,000$ = 0.972 / 0.97 / 1(cm^3) TE on mol O_2 ALLOW 9.72×10^{-4} **dm^3** **(1)**		**(4)**

(Total for Question 3 = 12 marks)

Question Number	Acceptable Answers	Reject	Mark
4(a)	Benzene is carcinogenic / causes cancer ALLOW Benzene is toxic / poisonous / causes cells to mutate IGNORE References to flammability / volatility / corrosive / dangerous / hazardous / reactivity / harmful	Explosive	**(1)**

Question Number	Acceptable Answers	Reject	Mark
4(b)	Reactions (with concentrated sulfuric acid) are (very)exothermic / produce (a lot of) heat ALLOW To prevent hydrolysis of the ester IGNORE Vigorous / violent / to prevent decomposition / to prevent further nitration / flammable / prevent evaporation	Explosive	**(1)**

Question Number	Acceptable Answers	Reject	Mark
4(c)	 **Note:** Apparatus does not need to be labelled, the marks are for recognisable drawing **First mark - funnel** Dropping funnel with tap and open top ALLOW Funnel with vertical sides that does not narrow at top **(1)** IGNORE Missing liquid line **Second mark - thermometer** Thermometer in side neck **and** immersed in liquid **and** apparatus not sealed **(1)** **Note** – thermometer and tap funnel in wrong necks loses second mark only **Third mark – ice-bath** Flask in container of ice or ice-water mixture **(1)**	Normal filter funnel with tap in stem	**(3)**

Question Number	Acceptable Answers	Reject	Mark
4(d)	**First mark** Structure of any methyl dinitrobenzoate ALLOW Skeletal / displayed formula for side chain **(1)** **I**GNORE Connectivity of NO_2 groups **Second mark** – conditional on M1 Name of the methyl dinitrobenzoate drawn e.g.  methyl 3,5-dinitrobenzoate ALLOW 3,5-dinitromethylbenzoate **(1)** IGNORE Extra / missing hyphen from name Missing comma	Nitration of methyl group Just methyldinitro benzoate / dinitromethyl benzoate	**(2)**

Question Number	Acceptable Answers	Reject	Mark
4(e)	(Filtration under reduced pressure is) Fast(er) / filtration speeds up OR The methyl 3-nitrobenzoate / crystals / product is drier ALLOW Filtrate / soluble impurities / solvent is removed **and** more completely / efficiently ALLOW Dries the methyl 3-nitrobenzoate / crystals / product IGNORE Reference to yield	Reacts faster	**(1)**

Question Number	Acceptable Answers	Reject	Mark
4(f)(i)	**First mark** It should be the **minimum** amount of hot methanol / solvent ALLOW a description of minimum e.g. just enough to dissolve the solid **(1)** **Second mark** To minimise / reduce the amount of solid left in solution (when it crystallises) OR To ensure that (some) crystals / solid form on cooling OR If there is too much solvent, crystals will not form OR So the solution is saturated / concentrated **(1)** IGNORE Just 'to increase the yield'	Incorrect named solvent e.g. water / ethanol	**(2)**

Question Number	Acceptable Answers	Reject	Mark
4(f)(ii)	**First mark** Filter (the hot mixture) **(1)** IGNORE Stir / use of fluted filter paper **Second mark -** Conditional on filter To remove insoluble / undissolved / solid impurities ALLOW Use a pre-heated funnel to prevent crystals forming (in the stem of the funnel) **(1)**	Use of a tap funnel or separating funnel	**(2)**

Question Number	Acceptable Answers	Reject	Mark
4(f)(iii)	**First mark** The methyl 3-nitrobenzoate would need to be separated from the (anhydrous) sodium sulfate ALLOW (Anhydrous) sodium sulfate will mix with the crystals OR Both are in the solid state OR (Anhydrous) sodium sulfate only removes water (and not methanol) OR (Anhydrous) sodium sulfate would not remove (excess) methanol OR (Anhydrous) sodium sulfate is used to dry liquids **(1)** **Second mark** Dry the crystals on filter paper / on tissue paper / use of an oven / leave to dry / place in a desiccator (with anhydrous sodium sulfate) / leave in an unstoppered boiling tube (for the methanol to evaporate) ALLOW Other suitable methods of drying crystals **(1)** IGNORE Reference to removing water	(Anhydrous) sodium sulfate reacts with the crystals Hot oven / Use of any other drying agent e.g. $CaCl_2$	**(2)**

Question Number	Acceptable Answers	Reject	Mark
4(g)	Correct answer, with or without working, scores (3) **First mark** Mass of methyl benzoate = 3.0 x 1.09 = 3.27 (g) **and** moles of methyl benzoate = $\frac{3.27}{136}$ = 0.024044 / 2.4044 x 10^{-2} **(1)** **Second mark** EITHER Theoretical mass methyl 3-nitrobenzoate = 0.024044 x 181 = 4.3520 (g) TE on moles of methyl 3-nitrobenzoate OR Moles methyl 3-nitrobenzoate produced = $\frac{2.28}{181}$ = 0.012597 / 1.2597 x 10^{-2} **(1)** **Third mark** EITHER % yield = $\frac{2.28}{4.35199}$ x 100 = 52.390 / 52.4 / 52(%) TE on theoretical mass benzoic acid provided it is less than 100% OR % yield = $\frac{0.012597}{0.024044}$ x 100 = 52.390 / 52.4 / 52 (%) TE on moles methyl 3-nitrobenzoate provided it is less than 100% **(1)** IGNORE SF except 1SF		**(3)**

Question Number	Acceptable Answers	Reject	Mark
4(h)	**Technique** Heat the water gently OR Stir the water (to distribute the heat evenly) **(1)** **Melting starts** Note the temperature at which methyl 3-nitrobenzoate / crystals / solid starts to melt **(1)** **Melting ends** Note the temperature at which methyl 3-nitrobenzoate / crystals / solid has completely melted **(1)**	Heat to any temperature above 73°C Penalise dissolve for melts once only in M2 and M3	**(3)**

(Total for Question 4 = 20 marks)

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