



Mark Scheme (Results)

Summer 2023

Pearson Edexcel International Advanced
Subsidiary Level In Chemistry (WCH16)

Paper 01

Unit 6: Practical Skills in Chemistry 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	Answer	Additional Guidance	Mark
1(a)(i)	An answer that makes reference to the following point: <ul style="list-style-type: none"> green precipitate 	Allow solid / crystals for precipitate Allow ppte / ppt	(1)

Question Number	Answer	Additional Guidance	Mark
1(a)(ii)	An answer that makes reference to the following point: <ul style="list-style-type: none"> precipitate dissolves / forms a (green) solution 	Allow solid / crystals for precipitate Allow ppte / ppt Allow TE of colour from a(i) Ignore colour of precipitate / solid	(1)

Question Number	Answer	Additional Guidance	Mark
1(a)(iii)	An answer that makes reference to the following point: <ul style="list-style-type: none"> Cl⁻ 	Allow Cl ⁻¹ , Cl ¹⁻ Ignore chloride	(1)

Question Number	Answer	Additional Guidance	Mark
1(b)	<p>An explanation that makes reference to the following points:</p> <ul style="list-style-type: none"> the nitric acid removes interfering anions / negative ions (1) naming of any interfering anions or chromium(III) carbonate is not soluble so would not produce a green solution (hence is not present) (1) 	<p>Allow to remove / dissolve / destroy anions</p> <p>Anions such as carbonate (CO_3^{2-})/hydrogencarbonate (HCO_3^-)</p> <p>Allow chromium(III) ions are already acidic (and so acid is not required)</p> <p>Ignore hydroxide (OH^-)</p>	(2)

Question Number	Answer	Additional Guidance	Mark
1(c)(i)	<p>An explanation that makes reference to the following points:</p> <ul style="list-style-type: none"> (precipitate) turns brown (1) (due to formation of) Fe^{3+} / iron(III) (1) 	<p>Ignore orange</p> <p>Allow correct formula / complex formula</p>	(2)

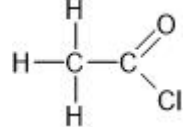
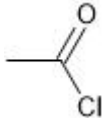
Question Number	Answer	Additional Guidance	Mark
1(c)(ii)	<p>A description that makes reference to the following points:</p> <ul style="list-style-type: none"> • add barium ions / barium chloride (BaCl_2) / barium nitrate ($\text{Ba}(\text{NO}_3)_2$) (solution) (1) • the formation of a white precipitate (confirms sulfate ions) (1) 	<p>M2 is dependent on M1 or near miss (eg $\text{Ba}^+(\text{aq})$)</p> <p>Ignore addition of HCl / HNO_3 Do not award sulfuric acid is added (0 overall)</p> <p>Allow solid / crystals / ppte / ppt (barium sulfate) for precipitate</p>	(2)

Question Number	Answer	Additional Guidance	Mark
1(d)	<p>An answer that makes reference to the following point:</p> <ul style="list-style-type: none"> • Ni^{2+} OR • V^{3+} 	<p>Charge or oxidation number is required.</p> <p>nickel(II) / nickel^{2+}</p> <p>V(III) / vanadium$^{3+}$</p> <p>Do not award $\text{Ni}(\text{NO}_3)_2$</p>	(1)

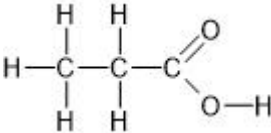
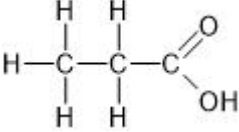
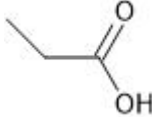
(Total for Question 1 = 10 marks)

Question Number	Answer	Additional Guidance	Mark
2(a)(i)	<p>An explanation that makes reference to the following points:</p> <p>(functional group)</p> <ul style="list-style-type: none"> acyl chloride / COCl / $-\text{COCl}$ <p>(justification)</p> <ul style="list-style-type: none"> (because it is hydrolysed by water to give misty fumes of) hydrogen chloride which produces (a white smoke of) ammonium chloride/ NH_4Cl (when in contact with ammonia) 	<p>Penalise mix up of white smoke/misty fumes or combination of these words once only</p> <p>(1) Allow acid chloride / RCOCl Ignore -anoyl chloride Do not award $-\text{COCl}-$ / $^+\text{COCl}$ / $\text{O}-\text{C}-\text{Cl}$</p> <p>(1) Allow hydrochloric acid Do not award white smoke is HCl</p> <p>(1) Do not award misty fumes are NH_4Cl</p>	(3)

Question Number	Answer	Additional Guidance	Mark
2(a)(ii)	<p>An answer that makes reference to the following point:</p> <ul style="list-style-type: none"> use a fume cupboard / fume hood 	<p>Ignore well-ventilated lab Ignore mask</p>	(1)

Question Number	Answer	Additional Guidance	Mark
2(b)	<p>An answer that makes reference to the following point:</p> <ul style="list-style-type: none">  	<p>Note if two formulae given both must be correct</p> <p>Allow skeletal / structural / or any combination thereof</p> <p>Allow CH₃COCl</p> <p>Allow </p> <p>Do not award molecular formula</p>	(1)

Question Number	Answer	Additional Guidance	Mark
2(c)(i)	<p>An answer that makes reference to the following point:</p> <ul style="list-style-type: none"> suitable ion structure 	<p>Accept skeletal / displayed / or any combination thereof</p> <p>COOH⁺ / CO₂H⁺ Ignore position of charge</p> <p>Do not award -COOH⁺ / COOH</p>	(1)

Question Number	Answer	Additional Guidance	Mark
2(c)(ii)	An answer that makes reference to the following point: <ul style="list-style-type: none"> • C_2H_5COOH / CH_3CH_2COOH 	Allow $C_2H_5CO_2H$ / $CH_3CH_2CO_2H$ Allow skeletal / displayed Allow  Allow  Allow  Ignore vertical connectivity to OH group Do not award C-HO	(1)

Question Number	Answer	Additional Guidance	Mark
2(d)(i)	An answer that makes reference to the following point: <ul style="list-style-type: none"> • ethanol 	Allow ethyl alcohol / ethan-1-ol Ignore C_2H_5OH / CH_3CH_2OH Ignore just alcohol	(1)

Question Number	Answer	Additional Guidance	Mark
2(d)(ii)	An answer that makes reference to the following points: <ul style="list-style-type: none"> the smell of the acid masks the smell of the ester sodium hydrogencarbonate neutralises the acid (removing the smell) 	<p>Mark independently</p> <p>Allow (esters/sample have a) sweet or fruity smell/odour/aroma</p> <p>Accept 'removes' or 'reacts with' for neutralises. Accept allows ester to float (on aqueous layer)</p> <p>Ignore quench or stop the reaction between X and an alcohol</p> <p>Ignore NaHCO₃ reacts with ester</p>	(2)

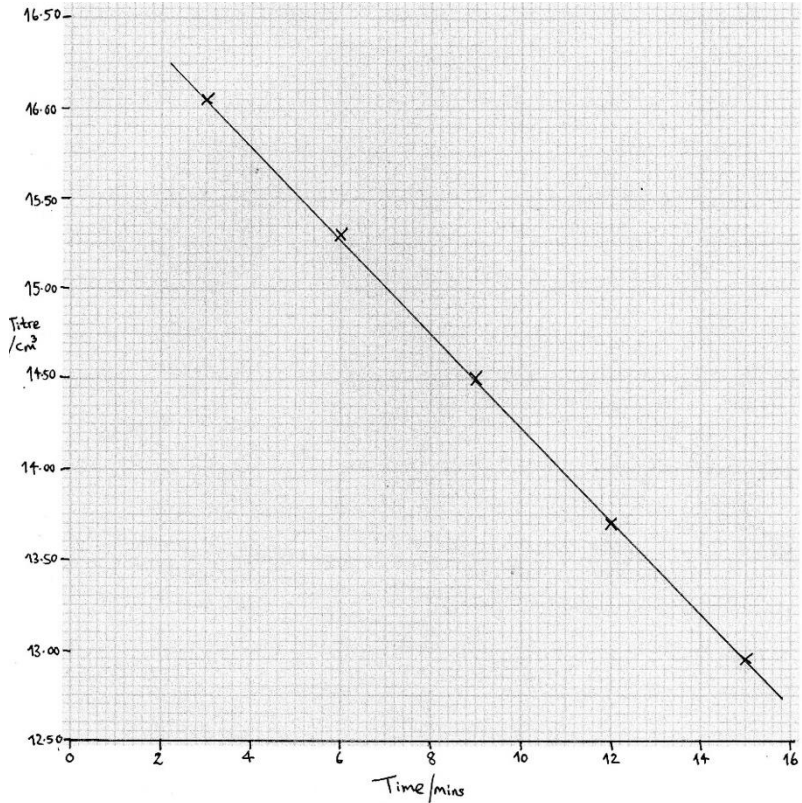
Question Number	Answer	Additional Guidance	Mark
2(e)	An answer that makes reference to the following points: <ul style="list-style-type: none"> (Product with X) CH₃CONH₂ / ethanamide (Product with Y) C₂H₅COONH₄ / ammonium propanoate 	<p>Allow displayed / skeletal / structural or combination thereof</p> <p>Allow ethyl amide Ignore + NH₄Cl or + HCl</p> <p>Accept inclusion of charges C₂H₅COO⁻NH₄⁺ Ignore + H₂O</p>	(2)

(Total for Question 2 = 12 marks)

Question Number	Answer	Additional Guidance	Mark
3(a)	<p>An answer that makes reference to the following point:</p> <ul style="list-style-type: none"> only the iodine concentration affects the rate <p>OR</p> <p>so the concentrations of sulfuric acid and propanone do not affect the rate</p>	<p>Allow so only the iodine concentration changes (significantly)</p> <p>Allow $[H^+]$ and $[CH_3COCH_3]$ do not change (significantly) / (effectively) zero order (wrt $[H^+]$ and $[CH_3COCH_3]$)</p> <p>Ignore just concentrations of H_2SO_4 and CH_3COCH_3 are in excess</p> <p>Ignore comments on limiting reagents</p>	(1)

Question Number	Answer	Additional Guidance	Mark
3(b)	<p>An answer that makes reference to the following point:</p> <ul style="list-style-type: none"> to stop / quench the reaction 	<p>Allow neutralise/remove the (sulfuric) acid/H^+ (catalyst)</p> <p>Ignore slow the reaction</p> <p>Do not award to remove OH^-</p>	(1)

Question Number	Answer	Additional Guidance	Mark
3(c)	<p>An answer that makes reference to the following points:</p> <ul style="list-style-type: none"> (indicator) starch (solution) (1) (colour change) blue-black/(dark)blue/black to colourless (1) 	<p>M2 is dependent on M1</p> <p>Ignore colour before addition of starch</p>	(2)

Question Number	Answer	Additional Guidance	Mark
3(d)(i)	<ul style="list-style-type: none"> • axes labelled correctly with units and suitable scale • all points plotted correctly • best fit straight line 	<p>Example of graph:</p>  <p>(1) Points plotted must cover at least 50% of the graph in both directions</p> <p>(1) Allow ± 1 small square</p> <p>(1) Ignore extrapolation</p>	(3)

Question Number	Answer	Additional Guidance	Mark
3(d)(ii)	An answer that makes reference to the following point: <ul style="list-style-type: none"> the volume of (sodium) thiosulfate / titre is (directly) proportional to the concentration of iodine 	Allow they are (directly) proportional Ignore any comments on correlation	(1)

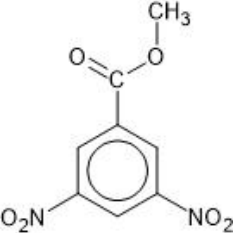
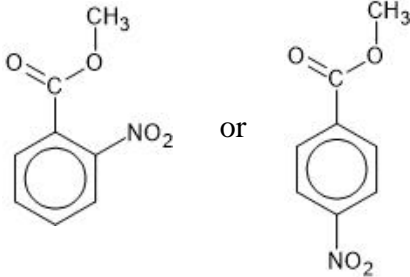
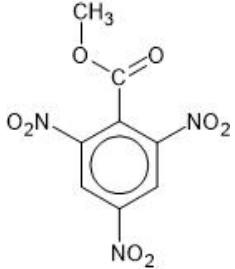
Question Number	Answer	Additional Guidance	Mark
3(d)(iii)	An answer that makes reference to the following point: <ul style="list-style-type: none"> zero (order) / 0 and straight line (with a negative gradient) graph 	Accept rate is proportional to 1/time Accept changes to iodine concentration have no affect on rate Accept zero order and gradient is constant Ignore reference to sign of gradient NOTE: the order wrt iodine must be used in (e)(ii) COMMENT: allow linear for straight line	(1)

Question Number	Answer	Additional Guidance	Mark
3(e)(i)	An answer that makes reference to the following points: <ul style="list-style-type: none"> working shown on graph for two half lives (1) two half-lives of 7 and 8 (seconds) (1) 	Allow a range of 6 – 9 (seconds) Ignore references to constant half life Do not award minutes / min	(2)

Question Number	Answer	Additional Guidance	Mark
3(e)(ii)	<p>An answer that makes reference to the following point:</p> <ul style="list-style-type: none"> rate = $k[\text{CH}_3\text{COCH}_3][\text{H}^+]$ 	<p>Allow r for rate Allow H₂SO₄ / acid for H⁺ Allow names for formulae Accept inclusion of '1' for powers Allow TE from diii Ignore inclusion of [I₂]⁰ NOTE: The order wrt to iodine must be consistent with the answer in 3(d)(iii)</p> <p>Ignore state symbols even if incorrect</p>	(1)

(Total for Question 3 = 12 marks)

Question Number	Answer	Additional Guidance	Mark
4(a)	<p>An answer that makes reference to the following point:</p> <ul style="list-style-type: none"> more effective cooling because greater (surface area) contact 	<p>Allow more quickly / more efficiently for effective</p> <p>Allow reverse argument</p> <p>Do not award reduced risk of explosion</p>	(1)

Question Number	Answer	Additional Guidance	Mark
4(b)	<p>An answer that makes reference to the following point:</p> <ul style="list-style-type: none"> suitable nitrated methyl benzoate structure 	<p>Accept displayed / structural / skeletal or any combination of</p> <p>Allow the 2-nitro or the 4-nitro isomer such as</p>  <p>Allow any di-nitrated isomer</p> <p>Allow any tri-nitrated isomer such as</p>  <p>Ignore structure of methyl 3-nitrobenzoate</p> <p>Ignore water</p>	(1)

Question Number	Answer	Additional Guidance	Mark
4(c)	An answer that makes reference to the following points: <ul style="list-style-type: none"> no / needs filter paper (in the Buchner funnel) no / needs side arm on the flask no / needs pump (to reduce the pressure) 	<p>May be shown on diagram</p> <p>(1) Ignore just no solid on filter paper Ignore just filter paper should be flat</p> <p>(1) Allow needs a Buchner flask / no outlet on the flask Ignore just not connected (to pump) Do not award round bottom flask</p> <p>(1) Allow vacuum / Venturi tube / tap vacuum</p> <p>Ignore flask should be extra thick to withstand vacuum</p>	(3)

Question Number	Answer	Additional Guidance	Mark
4(d)	A description that makes reference to the following points: <ul style="list-style-type: none"> dissolve (solid) in the minimum (volume) of hot ethanol (hot) (gravity) filtration to remove insoluble impurities cool (solution) to precipitate the solid / methyl 3-nitrobenzoate (suction) filtration to remove the soluble impurities 	<p>(1) Allow solvent for ethanol Ignore warm</p> <p>(1) Allow crystallise</p> <p>(1) Ignore any washing comments</p>	(4)

Question Number	Answer	Additional Guidance	Mark
4(e)(i)	An answer that makes reference to the following point: <ul style="list-style-type: none"> • difficult to separate the solid drying agent from the product 	Allow difficult to dry a solid with another solid Allow would contaminate or make product impure Ignore they are both solids Do not award reacts with the product	(1)

Question Number	Answer	Additional Guidance	Mark
4(e)(ii)	An answer that makes reference to the following point: <ul style="list-style-type: none"> • suitable drying method such as desiccator / (warm) oven 	Allow use filter paper / paper towel Allow leave (in a warm place) to dry Ignore leave in a cool place Do not award hot oven	(1)

Question Number	Answer	Additional Guidance	Mark
4(f)	<p>Method 1</p> <ul style="list-style-type: none"> • evaluation of mass of methyl benzoate • evaluation of moles of methyl benzoate • evaluation of mass of methyl 3-nitrobenzoate and percentage yield <p>or</p> <p>evaluation of moles of moles of methyl 3-nitrobenzoate and percentage yield</p> <p>Method 2</p> <ul style="list-style-type: none"> • evaluation of mass of methyl benzoate • evaluation of maximum mass • percentage yield 	<p>Example of calculation:</p> <p>(1) $m = (1.08 \times 4 =) 4.32 \text{ (g)}$</p> <p>(1) $n = (4.32 \div 136 =) 0.031765 \text{ (mol)}$</p> <p>(1) $m = (0.0317647 \times 181 =) 5.7494 / 5.75 \text{ (g)}$ and $\% = ((3.05 \div 5.75) \times 100 =) 53.043 / 53\%$</p> <p>$n = (3.05 \div 181 =) 0.016851 \text{ (mol)}$ and $\% = ((0.016851 \div 0.0317647) \times 100 =) 53.043 / 53\%$</p> <p>Accept 53.049% from keeping values in calculator</p> <p>(1) $m = (1.08 \times 4 =) 4.32 \text{ (g)}$</p> <p>(1) $m = ((181 \div 136) \times 4.32 =) 5.7494 / 5.75 \text{ (g)}$</p> <p>(1) $\% = ((3.05 \div 5.75) \times 100 =) 53.043 / 53\%$</p> <p>Ignore SF except 1 SF</p> <p>Allow TE throughout but do not allow M3 if yield is higher than 100%</p> <p>Allow 53% scores 3</p>	(3)

Question Number	Answer	Additional Guidance	Mark
4(g)	An answer that makes reference to the following points: <ul style="list-style-type: none"> <li>• any melting temperature range of 4 or more degrees and higher figure 70-79°C and lower figure no lower than 65°C (1) <li>• impurities make the melting temperature range lower and wider (1) 	Mark independently Ignore comments about sharp	(2)

(Total for Question 4 = 16 marks)

TOTAL FOR PAPER = 50 MARKS

