Pearson

Mark Scheme (Results)

Summer 2026

Pearson Edexcel International Advanced Level In Chemistry
WCH16/01A

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Summer 2026
Question Paper Log Number P81809A
Publication Code WCH16_01A_2606_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.

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: • $[Co(H_2O)_6]^{2+}$	 Allow $Co(H_2O)_6^{2+}$ Ignore state symbols <u>Comment</u> Allow what looks like CO	**(1)**

Question Number	Answer	Additional Guidance	Mark
1(a)(ii)	An answer that makes reference to the following point: • deprotonation	 Allow acid-base Allow neutralisation Ignore precipitation Ignore “ligand exchange” Do not award substitution	**(1)**

Question Number	Answer	Additional Guidance	Mark
1(b)(i)	An answer that makes reference to the following point: • yellow / straw / brown (solution)	 Allow yellow-brown / brown-yellow Ignore pale / light Do not award “dark brown” Do not award any other colours	**(1)**

Question Number	Answer	Additional Guidance	Mark
1(b)(ii)	An answer that makes reference to the following point: • oxidation (of Co^{2+})	Allow change of Co^{2+} to Co^{3+} Allow formation Co^{3+} (complex) / to form $[Co(NH_3)_6]^{3+}$ Comment Allow oxidation of the solution	(1)

Question Number	Answer	Additional Guidance	Mark
1(c)	An answer that makes reference to the following points: • hydrochloric / nitric acid and barium chloride / barium nitrate (solution) **(1)** • (formation of) white precipitate (of $BaSO_4$) **(1)**	Accept correct formulae Ignore just "acidified" Ignore dilute / concentrated Ignore just Ba^{2+} If both name and formula given, both must be correct Allow solid / crystals / ppt for precipitate Do not award any other colour precipitate M2 dependent on M1 or near miss	(2)

(Total for Question 1 = 6 marks)

Question Number	Answer	Additional Guidance	Mark
2(a)	An explanation that makes reference to two of the following points: Either • the concentration of chloride ions is too high **(1)** and either • so, a low(er) concentration of silver nitrate (solution) can be used as silver nitrate contains silver so is expensive or (so) the volume of silver nitrate needed to react is greater than the volume of the burette **(1)**	Allow reverse argument Allow sodium chloride / NaCl Allow reference to not reaching the endpoint. Ignore "just the titre is too large" Ignore references to speed of reaction / speed of colour change Allow "to enable multiple titrations" scores M1 and "to calculate a mean titre" scores M2	**(2)**

Question Number	Answer	Additional Guidance	Mark
2(b)	An answer that makes reference to the following point: • white precipitate (of AgCl)	Allow solid / crystals / ppt for precipitate Allow off-white / yellow for white Ignore formula of precipitate, even if incorrect Ignore colour of solution Do not award any other colours if stated Do not award precipitate redissolving / disappearing	**(1)**

Question Number	Answer	Additional Guidance	Mark
2(c)	An answer that makes reference to the following point: • equation with state symbols	<u>Example of equation</u> $2Ag^{+}(aq) + CrO_4^{2-}(aq) \rightarrow Ag_2CrO_4(s)$ Allow multiples	**(1)**

Question Number	Answer		Additional Guidance	Mark
2(d)			<u>Example of calculation</u>	**(5)**
	• calculation of moles of $AgNO_3(aq)$	**(1)**	$n = ((10.20 \div 1000) \times 0.100) = 1.02 \times 10^{-3}$ / 0.00102 (mol)	
	• calculation of moles of Cl^- ions in 100 cm^3 of diluted seawater	**(1)**	$n(AgNO_3) = n(Cl^-)$ so $n(Cl^-) = (1.02 \times 10^{-3} \times 10) = 1.02 \times 10^{-2}$ / 0.0102 (mol)	
	• calculation of concentration of Cl^- ions in undiluted seawater in mol dm^{-3}	**(1)**	$c = (1.02 \times 10^{-2} \div (20 \div 1000) =) 0.510$ (mol dm^{-3})	
	• calculation of concentration of Cl^- ions in undiluted seawater in g dm^{-3}	**(1)**	$c = (0.510 \times 35.5 =) 18.105$ (g dm^{-3})	
	• concentration of seawater in mg dm^{-3} **and** to 2 or 3 SF	**(1)**	$c = 18.105 \times 1000$ (mg dm^{-3}) 18100 / 18000 (mg dm^{-3})	
			Allow TE throughout Ignore SF except 1 SF in M1 to M4 Correct answer with no working scores (5) marks	

Question Number	Answer	Additional Guidance	Mark
2(e)	An answer that makes reference to the following points: • levels of chloride ions in tap water are (much) lower **(1)** Either No because • (so) titre would be very small or percentage uncertainty would be (much) greater **(1)** **or** Yes because • but the concentration of silver nitrate used would have to be (much) lower **(1)**	Allow endpoint is reached too quickly Ignore references to other ions that form a precipitate with Ag^+ being present Do not award references to fluoride ions reacting with silver nitrate (as they do not form a precipitate)	**(2)**

(Total for Question 2 = 11 marks)

Question Number	Answer	Additional Guidance	Mark
3(a)(i)	An answer that makes reference to two of the following points: • smaller (percentage) uncertainty / error / greater precision **(1)** • greater control when solution (so over / under filling is easier to resolve) **(1)** • splashes / spills less likely (so safer) **(1)** • using burettes for multiple aliquots is easier (to dispense) **(1)** • less chance of residual solution remaining **(1)**	Allow greater accuracy (in measurement) Allow greater / higher resolution / smaller measurement intervals Ignore more reliable / repeatable / reproducible measurements Do not award smaller / lower resolution Allow can add drop by drop	**(2)**

Question Number	Answer	Additional Guidance	Mark
3(a)(ii)	An explanation that makes reference to the following points: • to keep the overall volume constant / the same **(1)** • so changes in volume are proportional to changes in concentration (for each reactant) **(1)**	Allow amount Ignore references to seeing if water is a reactant Ignore references to “fair” test Ignore unqualified references to improved validity	**(2)**

<table>
<tr><th>Question Number</th><th>Answer</th><th>Additional Guidance</th><th>Mark</th></tr>
<tr><td>3(a)(iii)</td><td>• correctly completed table</td><td>
<table>
<tr><th>Run</th><th>Volume $C_6H_{12}O_6(aq)$ / cm^3</th><th>Volume $H_2SO_4(aq)$ / cm^3</th><th>Volume $KMnO_4(aq)$ / cm^3</th><th>Volume $H_2O(l)$ / cm^3</th><th>Time / s</th><th>Rate / $cm^3\ s^{-1}$</th></tr>
<tr><td>A</td><td>20.0</td><td>15.0</td><td>5.0</td><td>0.0</td><td>43</td><td>0.116</td></tr>
<tr><td>B</td><td>20.0</td><td>15.0</td><td>2.5</td><td>2.5</td><td>41</td><td>0.061</td></tr>
<tr><td>C</td><td>10.0</td><td>15.0</td><td>2.5</td><td>12.5</td><td>45</td><td>0.056</td></tr>
<tr><td>D</td><td>10.0</td><td>7.5</td><td>5.0</td><td>17.5</td><td>88</td><td>0.057</td></tr>
</table>
Both values to 3 DP needed to score the mark
</td><td>(1)</td></tr>
</table>

Question Number	Answer	Additional Guidance	Mark
3(a)(iv)	An answer that makes reference to the following points: • (order with respect to) $C_6H_{12}O_6(aq)$ • (order with respect to) $H_2SO_4(aq)$ • (order with respect to) $KMnO_4(aq)$ 3 correct orders scores 2 marks 2 correct orders scores 1 mark 0 or 1 correct orders scores 0 marks	 = 0 / zero /$[C_6H_{12}O_6]^{\mathbf{0}}$ = 1 / first / 1^{st} / $[H_2SO_4]^{\mathbf{1}}$ = 1 / first / 1^{st} / $[KMnO_4]^{\mathbf{1}}$ A rate equation with all three reactants and powers are included scores 2 e.g. (Rate = k) $[KMnO_4]^1[C_6H_{12}O_6]^0[H_2SO_4]^1$ The rate equation (Rate = k) $[KMnO_4]^1$ $[H_2SO_4]^1$ scores 1 Ignore references to water / H_2O Ignore explanations even if incorrect	**(2)**

<table>
<tr><th>Question Number</th><th>Answer</th><th>Additional Guidance</th><th>Mark</th></tr>
<tr>
<td>3(b)</td>
<td>An answer that makes reference to the following points:

• appropriate choice of volumes (1)

• correct run compared to (1)

Ignore absence of decimal places i.e 20.(0)
M2 dependent on M1</td>
<td>Examples of correct responses

<table>
<tr><th>Run</th><th>Volume $C_6H_{12}O_6(aq)$ / cm^3</th><th>Volume $H_2SO_4(aq)$ / cm^3</th><th>Volume $KMnO_4(aq)$ / cm^3</th><th>Volume $H_2O(l)$ / cm^3</th></tr>
<tr><td>A</td><td>20.0</td><td>15.0</td><td>5.0</td><td>0.0</td></tr>
<tr><td>B</td><td>20.0</td><td>15.0</td><td>2.5</td><td>2.5</td></tr>
<tr><td>C</td><td>10.0</td><td>15.0</td><td>2.5</td><td>12.5</td></tr>
<tr><td>D</td><td>20.0</td><td>7.5</td><td>5.0</td><td>7.5</td></tr>
</table>

Compare to Run A

<table>
<tr><th>Run</th><th>Volume $C_6H_{12}O_6(aq)$ / cm^3</th><th>Volume $H_2SO_4(aq)$ / cm^3</th><th>Volume $KMnO_4(aq)$ / cm^3</th><th>Volume $H_2O(l)$ / cm^3</th></tr>
<tr><td>A</td><td>20.0</td><td>15.0</td><td>5.0</td><td>0.0</td></tr>
<tr><td>B</td><td>20.0</td><td>15.0</td><td>2.5</td><td>2.5</td></tr>
<tr><td>C</td><td>10.0</td><td>15.0</td><td>2.5</td><td>12.5</td></tr>
<tr><td>D</td><td>20.0</td><td>7.5</td><td>2.5</td><td>10.0</td></tr>
</table>

Compare to Run B</td>
<td>(2)</td>
</tr>
</table>

		<table><tr><th>Run</th><th>Volume $C_6H_{12}O_6(aq)$ / cm^3</th><th>Volume $H_2SO_4(aq)$ / cm^3</th><th>Volume $KMnO_4(aq)$ / cm^3</th><th>Volume $H_2O(l)$ / cm^3</th></tr><tr><td>A</td><td>20.0</td><td>15.0</td><td>5.0</td><td>0.0</td></tr><tr><td>B</td><td>20.0</td><td>15.0</td><td>2.5</td><td>2.5</td></tr><tr><td>C</td><td>10.0</td><td>15.0</td><td>2.5</td><td>12.5</td></tr><tr><td>D</td><td>10.0</td><td>7.5</td><td>2.5</td><td>20.0</td></tr></table> Compare to Run C	

Question Number	Answer		Additional Guidance	Mark
3(c)(i)	• calculation of E_{cell}	**(1)**	Example of calculation E_{cell} (= 1.51 − −0.43) = (+) 1.94 (V) or E_{cell} (= 1.70 − −0.43) = (+) 2.13 (V) or E_{cell} (= 1.23 − −0.43) = (+) 1.66 (V)	**(2)**
	• statement that value is positive (so feasible)	**(1)**	positive value / > 0 TE from incorrect M1 as long as feasibility statement matches value	

Question Number	Answer		Additional Guidance	Mark
3(c)(ii)	An answer that makes reference to the following points:			**(2)**
	• precipitate is due to formation of MnO_2 (precipitate)	**(1)**	Accept $MnO_4^- + 4H^+ + 3e^- \rightleftharpoons MnO_2 + 2H_2O$ and precipitate	
	• due to insufficient concentration of H^+ (ions) / H_2SO_4	**(1)**	Accept $MnO_2 + 4H^+ + 2e^- \rightleftharpoons Mn^{2+} + 2H_2O$ does not occur Allow amount/mol for concentration Allow acid for H^+	

(Total for Question 3 = 13 marks)

Question Number	Answer	Additional Guidance	Mark
4(a)(i)	An answer that makes reference to the following point: • esterification	Ignore reference to condensation / elimination / dehydration / carboxylic acid	**(1)**

Question Number	Answer	Additional Guidance	Mark
4(a)(ii)	An answer that makes reference to the following point: • catalyst / catalysis / speeds up the rate of reaction	Allow provides an alternative pathway with a **lower** activation energy	**(1)**

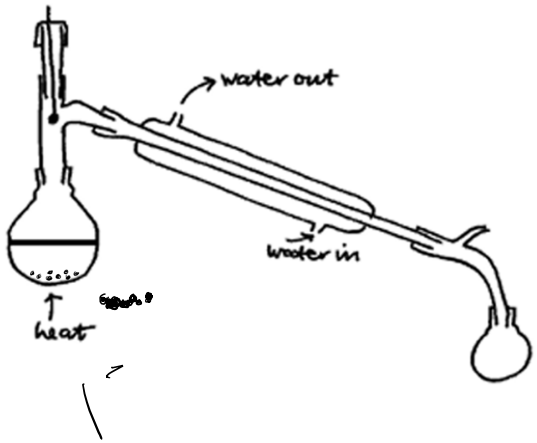
Question Number	Answer	Additional Guidance	Mark
4(b)	An answer that makes reference to the following points: • the risk of fire **(1)** • because **methanol / CH_3OH** is flammable **(1)**	Allow methanol / mixture may burn Ignore explosion Ignore ethyl ethanoate / oil of wintergreen is flammable Ignore references to toxicity / corrosivity of sulfuric acid	**(2)**

Question Number	Answer	Additional Guidance	Mark
4(c)	An answer that makes reference to the following points: Either • aqueous layer / liquid will not flow (into the flask / from the funnel) / no liquid flow from tap **(1)** and any one from • as the stopper prevents air from replacing the aqueous layer / air cannot enter the (top of) (separating) funnel or due to creation of a vacuum / lower pressure (in the separating funnel) **(1)** Or • some of the (aqueous) layer flows out (of the funnel) **(1)** and any one from • bubbles of air enter the funnel (through the tap) or which mixes / disturbs the two layers **(1)**	Accept (only a) small amount of the aqueous layer drips into the flask Allow nothing will happen Allow as stopper prevents air from keeping the pressure (in the flask) the same as the (external) air pressure Do not award (opening the stopper) releases the pressure / pressure build up in funnel Accept small volume for some Must be clear that not all the aqueous layer will flow M2 dependent on M1 or near miss	**(2)**

Question Number	Answer	Additional Guidance	Mark
4(d)	An answer that makes reference to the following points: • add sodium hydrogencarbonate (solution) (to neutralise acid) **(1)** • (replace stopper) and shake gently / invert funnel **(1)** • release stopper / open tap (whilst upside down) to release pressure (due to CO_2) **(1)** • allow to settle (remove stopper) **and** open tap to release aqueous layer **(1)**	Allow sodium carbonate solution Ignore references to NaCl / sodium chloride addition Do not award reference to solid Do not award addition of any other substance Allow mix the (contents) M2 dependent on something added in M1 Allow release stopper / open tap (whilst upside down) (to release CO_2) Must be reference to settling **before** tap opened to release the aqueous layer Do not award open tap to release ethyl ethanoate / organic layer	**(4)**

Question Number	Answer	Additional Guidance	Mark
4(e)(i)	An answer that makes reference to the following point: • named drying agent **(1)**	(anhydrous) calcium chloride / $CaCl_2$ or silica gel / SiO_2 or (anhydrous) sodium sulfate / Na_2SO_4 or (anhydrous) magnesium sulfate / $MgSO_4$ Allow (anhydrous) calcium sulfate / $CaSO_4$ Do not award $CuSO_4$ Do not award incorrect formulae If name and formula are given, both must be correct	**(1)**

Question Number	Answer	Additional Guidance	Mark
4(e)(ii)	An answer that makes reference to the following point: • organic liquid / ethyl ethanoate (layer) turns clear (from cloudy)	Accept organic liquid is no longer cloudy Allow drying agent remains powdery Allow drying agent stops clumping together / fine particles of drying agent seen Do not award colourless for clear	**(1)**

Question Number	Answer	Additional Guidance	Mark
4(f)(i)	An answer that makes reference to the following points: 7 points scores 3 marks 5 - 6 points scores 2 marks 2 - 4 points scores 1 mark 0 or 1 point scores 0 marks • round-bottomed / pear shaped flask • anti-bumping granules • labelled heat source • still head drawn with no gaps to outside • thermometer bulb opposite entrance to condenser • condenser with correct direction of water flow labelled • unsealed collection vessel	Exemplar diagram  Condenser must be drawn sloping downwards to the collection vessel from the still head and with a suitable "jacket" Steam distillation apparatus shown anywhere on the diagram, penalise 1 marking point Penalise completely sealed apparatus at any point in the diagram	**(3)**

Question Number	Answer	Additional Guidance	Mark
4(f)(ii)	• calculation of mass of methanol **(1)** • calculation of moles of methanol **and** calculation of moles of 2-hydroxybenzoic acid **(1)** • proof of identity of limiting reagent **(1)**	<u>Example of calculation</u> m = (15.0 × 0.793 =) 11.895 (g) n = (11.895 ÷ 32 =) 0.3717 (mol) **and** n = (9 ÷ 138 =) 0.06522 (mol) 0.06522 < 0.3717 so 2-hydroxybenzoic acid is limiting reagent Allow TE Ignore SF except 1 SF	**(3)**

Question Number	Answer	Additional Guidance	Mark
4(f)(iii)	• calculation of theoretical yield of oil of wintergreen **(1)** • calculation of % yield **(1)** or • calculation of moles of oil of wintergreen **(1)** • calculation of % yield **(1)**	<u>Example of calculation</u> m = (0.06522 × 152 =) 9.9130 (g) Allow TE from 4f(ii) M3 % = (2.52 ÷ 9.9130 × 100 =) 25.4 % n = (2.52 ÷ 152 =) 0.01658 (mol) % = ((0.01658 ÷ 0.06522) x 100 =) 25.4% M2 dependent on an attempt to calculate mass / moles in comparison to the limiting reactant in M1 Allow TE from M1 Allow TE from (f)(ii) TE only if the final answers is less than 100% Ignore SF unless 1SF	**(2)**

(Total for Question 4 = 20 marks)
TOTAL FOR PAPER = 50 MARKS