



Mark Scheme (Results)

June 2024

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

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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)	<p>An answer that makes reference to the following points:</p> <ul style="list-style-type: none"> • calculation of moles of copper(II) carbonate • calculation of molar volume • volume to 2/3 SF 	<p><u>Example of calculation:</u> $n = (0.65 \div 123.5) = 0.0052632 \text{ (mol)}$ / $\frac{1}{190}$ / $= 5.2632 \times 10^{-3} \text{ (mol)}$</p> <p>(1) (1:1 ratio) (so) $V = (0.120 \div 0.0052632) = 22.800 \text{ (dm}^3 \text{ mol}^{-1}\text{)}$ or $V = (120 \div 0.0052632) = 22800 \text{ (cm}^3 \text{ mol}^{-1}\text{)}$ TE from incorrect number of moles</p> <p>(1) $V = 22.8 / 23 \text{ (dm}^3 \text{ mol}^{-1}\text{)}$</p> <p>Allow 22 800/23 000 cm³ mol⁻¹</p> <p>Correct answer without working scores (3)</p> <p>Do not award M3 for a value to 2/3 SF which is not obtained by dividing 0.12 or 120 by moles</p> <p>Rounding of moles to 1SF 0.005 gives 24 (dm³ mol⁻¹) which scores (2) but there must be some working otherwise scores (0)</p>	(3)

Question Number	Answer	Additional Guidance	Mark
1(b)(i)	An answer that makes reference to the following point: <ul style="list-style-type: none"> bubbles/effervescence/fizzing 	Ignore CO ₂ given off Ignore limewater turns cloudy Ignore reference to dissolving Do not award if given with any additional incorrect observation, e.g. white precipitate	(1)

Question Number	Answer	Additional Guidance	Mark
1(b)(ii)	An answer that makes reference to the following points: <ul style="list-style-type: none"> use of blue litmus paper/strip of blue litmus or use of universal indicator paper which goes red/pink 	M2 must be linked to M1 Allow use of pH meter/probe which shows $\text{pH} \leq 3$ (1) Ignore use of red litmus paper (1) Allow M2 if original colour of litmus paper not given Allow other tests such as: addition of magnesium/zinc (1) which results in bubbles/fizzing/effervescence (1) Allow (1) for use of universal indicator/litmus solution/indicator with goes red Penalise incorrect additional tests e.g. addition of barium chloride for the presence of sulfate Use of a carbonate/hydrogencarbonate scores (0)	(2)

Question Number	Answer	Additional Guidance	Mark
1(c)(i)	<p>An answer that makes reference to two of the following points:</p> <p>(Reason 1)</p> <ul style="list-style-type: none"> carbon dioxide/gas is lost in the first apparatus before the bung can be replaced (but the second apparatus is sealed and so no gas is lost) (1) <p>(Reason 2)</p> <ul style="list-style-type: none"> (some) carbon dioxide/gas dissolves in the water in the water bath in the first apparatus (but not in the second) (1) <p>(Reason 3)</p> <ul style="list-style-type: none"> the resolution is greater /there are more divisions on the gas syringe (than the 250 cm³ measuring cylinder) (1) 	<p>Ignore any references to the differences in the acids and carbonates</p> <p>Allow carbon dioxide/gas dissolves in the acid in the first apparatus (but not in the second) Allow the carbon dioxide/gas reacts with the water in the first apparatus</p> <p>Accept reverse argument Allow answers referring to the lower measurement uncertainty of a gas syringe</p> <p>Ignore just gas syringe is more accurate/precision</p>	(2)

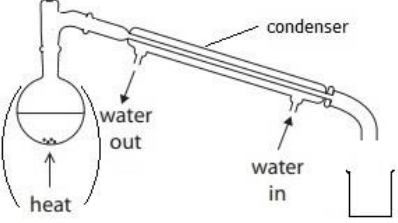
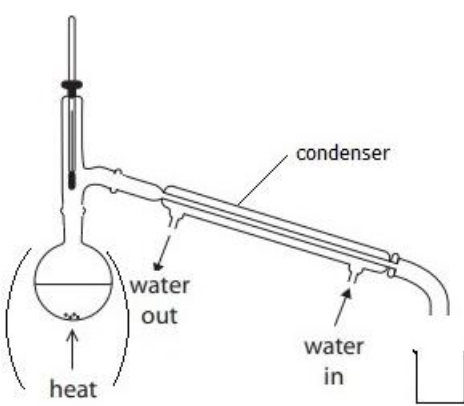
Question Number	Answer	Additional Guidance	Mark
1(c)(ii)	<ul style="list-style-type: none"> • calculation of moles of carbon dioxide • calculation of carbonate molar mass • identity of Group 2 metal 	<p><u>Example of calculation:</u></p> <p>(1) $n = (89.0 \div 24\,000) = 0.0037083 / 3.7083 \times 10^{-3} \text{ (mol)}$</p> <p>(1) (1:1 ratio) (so) $M = (0.320 \div 0.0037083) = 86.292 \text{ (g mol}^{-1}\text{)}$ Ignore SF except 1 SF penalise once in M1 or M2</p> <p>(1) (Metal = $(86 - 60) = 26$) (so nearest is) Magnesium/Mg</p> <p>Allow TE for M2 from an incorrect number of moles</p> <p>Allow TE for M3 provided a subtraction has been carried out and the metal is a Group 2 element</p> <p>Correct answer of magnesium without working scores (1)</p>	(3)

(Total for Question 1 = 11 marks)

Question Number	Answer	Additional Guidance	Mark
2(a)	<p>An answer that makes reference to the following point:</p> <ul style="list-style-type: none"> (to cool it down because) ethanol would evaporate/ is volatile/ has a low boiling temperature 	<p>Allow (to cool it down) to prevent a reaction occurring Allow (to cool it down because) the reaction is exothermic/heat is released</p> <p>Ignore references to vigorous reaction Ignore references to slowing the reaction Ignore references to the flask being too hot to handle Ignore references to boiling Ignore references to yield Ignore references to the volatility of sulfuric acid/ evaporation of sulfuric acid</p> <p>Do not award references to explosion/flammability Do not award reference to cooling bromoethane</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"> pestle and mortar 	<p>Allow use of glass rod if given with beaker or such</p> <p>Allow diagram of apparatus</p> <p>Do not award grinder</p>	(1)

Question Number	Answer		Mark
2(c)	<p>An explanation that makes reference to the following points:</p> <ul style="list-style-type: none"> • (orange colour is) bromine/ Br₂ • that is formed by the oxidation of bromide ions by sulfuric acid 	<p>(1) Standalone mark Ignore reference to state Do not award just Br/ bromine ions Do not award reference to colour of other substances</p> <p>(1) May be shown in an equation for two marks</p> $2\text{HBr} + \text{H}_2\text{SO}_4 \rightarrow \text{Br}_2 + \text{SO}_2 + 2\text{H}_2\text{O}$ <p>Allow formed by the oxidation of KBr by sulfuric acid Allow reference to the reduction of the sulfuric acid</p> <p>Allow reference to the reaction of sulfuric acid and potassium bromide for M2 provided M1 already awarded</p>	(2)

Question Number	Answer	Additional Guidance	Mark
2(d)	<p>An answer that makes reference to the following points:</p> <p>6 points scores 3 marks 4 or 5 points scores 2 marks 2 or 3 points scores 1 mark 0 or 1 point scores 0 marks</p> <ul style="list-style-type: none"> • still head with no gaps to outside • still head with entry to condenser • condenser with entry for water in and water out • labelling of condenser with water in and water out • condenser with exit for distillate or vent for gases • collection vessel 	<p><u>Exemplar diagrams</u></p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Without thermometer</p>  </div> <div style="text-align: center;"> <p>with thermometer</p>  </div> </div> <p>Ignore the position of the bulb if a thermometer is included</p> <p>Condenser to be drawn sloping and with suitable 'jacket'</p> <p>Water inlet shown on the right hand side and water outlet on the left but above or below the condenser</p> <p>Ignore the direction of arrows if included</p>	(3)

Question Number	Answer	Additional Guidance	Mark
2(e)	An answer that makes reference to the following point: <ul style="list-style-type: none"> • anti-bumping granules/ glass beads 	Allow pieces of ceramic/boiling chips Allow description granules to promote formation of smaller bubbles Ignore just 'granules'	(1)

Question Number	Answer	Additional Guidance	Mark
2(f)	An answer that makes reference to the following point: <ul style="list-style-type: none"> • cool with ice/ice-water/cold water 	Ignore references to use of a lid or to seal the beaker	(1)

Question Number	Answer	Additional Guidance	Mark
2(g)	<p>A description that makes reference to the following points:</p> <ul style="list-style-type: none"> • (separating funnel shows two layers with) bromoethane being the lower layer (after shaking and leaving to settle) • the bromoethane layer is separated by opening the tap 	<p>Allow use of a labelled diagram Ignore descriptions of shaking/release of pressure</p> <p>Accept water is the upper layer Allow lower organic layer</p> <p>Ignore just reference to removal of the bromoethane layer without mention of opening tap</p> <p>Do not award M2 if reference is made to addition of a drying agent to the separating funnel</p> <p>Allow the removal of upper layer by use of a pipette for M2</p> <p>If no other mark awarded allow (1) if the layers are inverted for reference to the bromoethane/organic layer being separated by removing of the aqueous layer by opening the tap</p>	(2)

Question Number	Answer	Additional Guidance	Mark
2(h)	<p>An answer that makes reference to the following point:</p> <ul style="list-style-type: none"> (bromoethane) would evaporate (before any water was removed) 	<p>Allow reference to water requiring 100°C or a higher temperature to be removed Allow bromoethane/it is volatile</p> <p>Ignore references to flammability Do not award references to decomposition</p>	(1)

Question Number	Answer	Additional Guidance	Mark
2(i)	<p>An answer that makes reference to the following point:</p> <ul style="list-style-type: none"> completed equation 	<p>$(\text{CaCl}_2(\text{s}) + 2\text{H}_2\text{O}(\text{l}) \rightarrow) \text{CaCl}_2 \cdot 2\text{H}_2\text{O}(\text{s})$</p> <p>Allow varying size and height of 'dot' but the dot is essential Do not award aq Do not award $\text{CaCl}_2(\text{H}_2\text{O})_2(\text{s})$ Do not award $2\text{H}_2\text{O} \cdot \text{CaCl}_2(\text{s})$</p>	(1)

Question Number	Answer	Additional Guidance	Mark
2(j)	<p>An answer that makes reference to the following points:</p> <p>–OH group</p> <ul style="list-style-type: none"> • add phosphorus(V) chloride/ PCl_5 • which produces steamy/misty/white fumes <p>–Br group</p> <ul style="list-style-type: none"> • add (acidified) silver nitrate/AgNO_3 (solution) • which forms a cream/off-white precipitate 	<p>Ignore ‘secondary’ tests such as ammonia with either the misty fumes or the cream precipitate</p> <p>(1) Do not award any reference to solution/aqueous</p> <p>(1) Do not award reference to smoke for fumes</p> <p>Allow other suitable tests such as addition of sodium metal which produces effervescence/bubbles/fizzing or orange to green with use of acidified dichromate((VI))</p> <p>(1) Accept ethanolic solution of silver nitrate</p> <p>(1) Allow solid/ppt/ppte for precipitate Allow (very) pale yellow precipitate</p> <p>Apply the list principle if 2 or more tests given for the same group</p>	(4)

(Total for Question 2 = 17 marks)

Question Number	Answer	Additional Guidance	Mark
3(a)(i)	<p>An explanation that makes reference to the following points:</p> <p>(Observations)</p> <ul style="list-style-type: none"> • (more) brown liquid forms (of ICl) • (then more) yellow solid forms (ICl₃) <p>(Reasoning)</p> <ul style="list-style-type: none"> • because the equilibrium position shifts to the right (due to the increase in chlorine gas) 	<p>Ignore references to fizzing/bubbles/green gas Ignore references to heat/enthalpy change</p> <p>(1) Ignore references to a subsequent decrease after an increase/more is stated</p> <p>(1) Allow precipitate/ppt for solid</p> <p>Allow 1 mark for M1 and M2 for goes brown then yellow without states and in the correct order</p> <p>(1) Allow equilibrium shifts to the products/ICl₃ Standalone mark</p>	(3)

Question Number	Answer	Additional Guidance	Mark
3(a)(ii)	<p>An explanation that makes reference to the following points:</p> <ul style="list-style-type: none"> (label) to the fume cupboard / fume hood because chlorine is toxic/poisonous 	<p>(1) Allow open window/vent Allow reference to aqueous/solution of NaOH Do not award dissolving in water</p> <p>(1) Allow hazardous for toxic Ignore harmful/dangerous/pressure references</p> <p>Standalone mark Do not award references to flammability</p>	(2)

Question Number	Answer	Additional Guidance	Mark
3(b)	<p>An explanation that makes reference to the following points:</p> <ul style="list-style-type: none"> (action) warming/heating the U-tube because an increase in temperature will shift the equilibrium position to the left (and result in more brown liquid) 	<p>(1) Accept any reasonable means of gently warming the U-tube, e.g. water bath</p> <p>Allow reference to heat shifting the reaction to the left</p> <p>(1) Accept alternative answer: description of turning the U-tube upside down (1) as chlorine gas falls to the bottom and this shifts the equilibrium to the left (1)</p> <p>Ignore references to adding more iodine/changes in pressure</p>	(2)

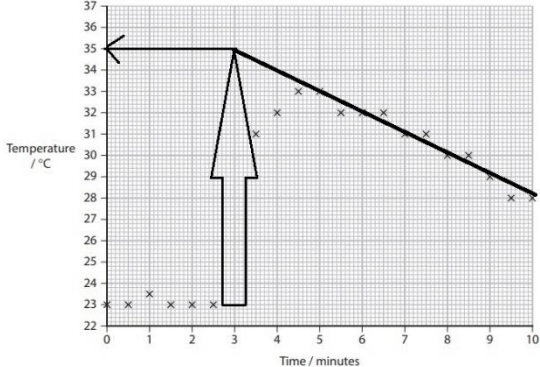
Question Number	Answer	Additional Guidance	Mark
3(c)	An answer that makes reference to the following points <ul style="list-style-type: none"> • correct species • balancing 	Example of equation $2\text{NaOH} + \text{Cl}_2 \rightarrow \text{NaClO} + \text{NaCl} + \text{H}_2\text{O}$ (1) (1) Accept NaOCl for NaClO M2 dependent on M1 Allow multiples Ignore state symbols even if incorrect Allow (1) for $6\text{NaOH} + 3\text{Cl}_2 \rightarrow \text{NaClO}_3 + 5\text{NaCl} + 3\text{H}_2\text{O}$	(2)

(Total for Question 3 = 9 marks)

Question Number	Answer	Additional Guidance	Mark
4(a)	An answer that makes reference to the following point: <ul style="list-style-type: none"> • to prevent the polystyrene cup from ‘falling over’ 	Accept descriptions Allow to stabilise the polystyrene cup Allow to prevent spillages Ignore references to heat loss	(1)

Question Number	Answer	Additional Guidance	Mark
4(b)	An answer that makes reference to the following point: <ul style="list-style-type: none"> • to determine a consistent/steady/constant temperature (before adding the sodium hydroxide) 	Allow for determine a mean initial temperature Allow reference to achieve room temperature Ignore just to have a more accurate temperature Do not award references to the temperature cooling since this implies the effect after the reaction	(1)

Question Number	Answer	Additional Guidance	Mark
4(c)	<p>An explanation that makes reference to the following points:</p> <ul style="list-style-type: none"> • the temperature will be changing • because it takes time to add 50 cm³ of sodium hydroxide 	<p>(1) Allow the temperature was not uniform/the same throughout the mixture Allow the temperature is still rising Ignore just the temperature will be inaccurate</p> <p>(1) Allow because that's when the sodium hydroxide was added</p> <p>Allow because you cannot add the alkali and measure the temperature at the same time (1)</p> <p>Ignore references to the reaction 'just' starting or hasn't finished</p> <p>If no other mark awarded, allow (1) for the thermometer was used for stirring/ the mixture was being stirred</p>	(2)

Question Number	Answer	Additional Guidance	Mark
4(d)(i)	<ul style="list-style-type: none"> • best fit line extrapolated to 3 minutes shown on the graph (1) • maximum temperature change (1) 	<p>Example of working on graph:</p>  <p>Ignore longer extrapolated lines Ignore vertical line not at 3 minutes for M1</p> <p>(1) $\Delta T = (35 - 23) = 12 \text{ }^\circ\text{C}$</p> <p>M2 dependent on the temperature change being measured at 3 mins</p> <p>Allow ± 1 for the highest temperature so range for $\Delta T = 11 - 13 \text{ }^\circ\text{C}$</p>	(2)

Question Number	Answer	Additional Guidance	Mark
4(d)(ii)	<p>An explanation that makes reference to the following points:</p> <ul style="list-style-type: none"> • there is no more reaction occurring • and heat is being lost (to the surroundings) 	<p>(1) Accept no more energy being released Allow the reaction is complete/ all the acid reacted /all the NaOH has reacted Ignore the reaction is slowing down</p> <p>(1) Ignore just the mixture cools down</p>	(2)

Question Number	Answer	Additional Guidance	Mark
4(d)(iii)	<p>An answer that makes reference to the following point:</p> <ul style="list-style-type: none"> • the thermometer is not sufficiently precise/ thermometer resolution insufficient (to show the change) 	<p>Allow the thermometer only measures $\pm 1^{\circ}\text{C}$ Allow the thermometer is not sufficiently accurate</p> <p>Ignore references to incorrect reading of the thermometer</p>	(1)

Question Number	Answer	Additional Guidance	Mark
4(d)(iv)	<p>An answer that makes reference to the following point:</p> <ul style="list-style-type: none">the (starting) temperature is below 25 °C / 298K	<p>Allow standard temperature is not 23 °C / 296K Allow the temperature is not 25 °C / 298K Allow the temperature is lower than/not standard temperature</p> <p>Ignore just non-standard conditions Ignore references to pressure Ignore references to the number of moles of water formed</p>	(1)

Question Number	Answer	Additional Guidance	Mark
4(e)(i)	<p>An explanation that makes reference to the following points:</p> <p>Either</p> <ul style="list-style-type: none"> the specific heat capacity of acid/alkali is different from water/ there is salt/sodium sulfate (dissolved) so the specific heat capacity is different (1) so the assumption is not valid (1) <p>Or</p> <ul style="list-style-type: none"> 'most' of the acid and alkali solutions are water (1) so the assumption is valid (1) 	<p>M2 dependent on award of M1 for both options</p> <p>Ignore any references to densities</p> <p>Allow the acid and alkali/reactants are aqueous Ignore references to water as a product</p>	(2)

Question Number	Answer	Additional Guidance	Mark
4(e)(ii)	<p>An answer that makes reference to the following point:</p> <ul style="list-style-type: none"> (neutralisation is per mol of water and) the number of moles of sodium hydroxide is the same as that of water 	<p>Allow reference to dividing the number of moles of sulfuric acid by two Allow reference to dividing the answer by two</p> <p>Ignore reference to sodium hydroxide/sulfuric acid being the limiting reagent</p>	(1)

(Total for Question 4 = 13 marks)
TOTAL FOR PAPER = 50 MARKS

