Mark Scheme (Results)

Summer 2019

Pearson International Advanced Subsidiary Level
In Chemistry (WCH03) Paper 01 Chemistry Laboratory Skills 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.
- 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.

Question Number	Acceptable Answers	Reject	Mark
1(a)(i)	IGNORE State symbols, even if incorrect **Cation** Potassium / K^+ **(1)** **Gas** Oxygen / O_2 **(1)** **Anion** Nitrate ((V)) / NO_3^- ALLOW Other anions that decompose on heating to give oxygen e.g. ClO_3^- / BrO_3^- / IO_3^- / ClO_4^- / MnO_4^- **(1)**	 K O Nitrate(III) / nitrite / NO_2^- Just 'oxide'	**(3)**

Question Number	Acceptable Answers	Reject	Mark
1(a)(ii)	$2KNO_3 \rightarrow 2KNO_2 + O_2$ TE on cation in (a)(i) TE on anion if it decomposes on heating to give oxygen e.g. $2KClO_3 \rightarrow 2KCl + 3O_2$ ALLOW Multiples or half IGNORE State symbols, even if incorrect	Equation for decomposition of oxide / peroxide / superoxide	**(1)**

Question Number	Acceptable Answers	Reject	Mark
1(b)(i)	IGNORE State symbols, even if incorrect **Cation** Strontium / Sr^{2+} **(1)** **Precipitate** Strontium sulfate / $SrSO_4$ TE on calcium or barium cation in **Test 3** **(1)** **Anion** Bromide / Br^{-} **(1)** IGNORE Bromine (ion)	 Sr / incorrect charge Magnesium sulfate Br / incorrect charge	**(3)**

Question Number	Acceptable Answers	Reject	Mark
1(b)(ii)	$Sr^{2+}(aq) + SO_4^{2-}(aq) \rightarrow SrSO_4(s)$ **First mark** Correct formulae and balancing TE on Group **2** cation in **Test 3** or **Test 4** **(1)** **Second mark** State symbols TE on calcium or barium in **Test 3** or **Test 4** Conditional on correct or nearly correct species e.g. $Sr^{+}(aq) + SO_4^{-}(aq) \rightarrow SrSO_4(s)$ **(1)**		**(2)**

Question Number	Acceptable Answers	Reject	Mark
1(b)(iii)	**Reagent** Add **dilute** ammonia ALLOW $NH_3(aq)$ **(1)** **Observations –** conditional on correct reagent The precipitate / solid / it will dissolve if it contains chloride ions / Cl^- / is AgCl **and** **either** will not dissolve / no change if it contains bromide ions / Br^- / is AgBr **or** bromide ions will only dissolve in concentrated ammonia ALLOW The precipitate / solid / it will **only** dissolve if it contains chloride ions / Cl^- The white precipitate will dissolve and the cream precipitate will not Reference to chlorine / bromine ions **(1)** IGNORE Both precipitates / solids dissolve in concentrated ammonia Reference to iodide ions Just 'chloride ions dissolve but bromide ions do not' **ALLOW alternative method**: Concentrated sulfuric acid/ H_2SO_4 **(1)** Steamy fumes with chloride **and** red brown fumes with bromide **(1)**	Just NH_3	**(2)**

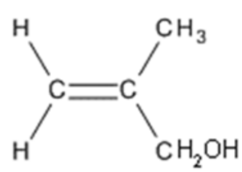
(Total for Question 1 = 11 marks)

Question Number	Acceptable Answers	Reject	Mark
2(a)(i)	Phosphorus(V) chloride / phosphorus pentachloride / PCl_5 ALLOW Phosphorus chloride if PCl_5 is also given ALLOW Thionyl chloride / sulfuryl chloride / sulfonyl chloride / $SOCl_2$ / SO_2Cl_2	Reference to aqueous / (aq) Phosphorus(III) chloride / phosphorus trichloride / PCl_3	**(1)**

Question Number	Acceptable Answers	Reject	Mark
2(a)(ii)	Hydrogen chloride / HCl / HCl(g) ALLOW HCl(aq) / hydrochloric acid		**(1)**

Question Number	Acceptable Answers	Reject	Mark
2(a)(iii)	Aqueous bromine / bromine water / $Br_2(aq)$ / bromine in an organic solvent ALLOW Bromine / Br_2 / $Br_2(l)$ Bromine solution	Br HBr	**(1)**

Question Number	Acceptable Answers	Reject	Mark
2(b)	ALLOW Any combination of structural and displayed formulae Charge anywhere on the ion or outside of brackets e.g. $[CH_3]^+$ **Comment** Ignore additional bond e.g. $–CH_3^+$ **Ion giving peak at m / e = 15** CH_3^+ **(1)** **Ion giving peak at m / e = 31** CH_2OH^+ **(1)**	Missing or incorrect charge once only CH_3O^+	**(2)**

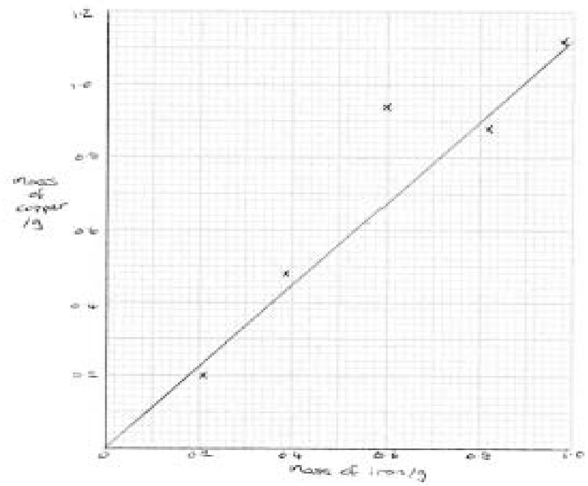
Question Number	Acceptable Answers	Reject	Mark
2(c)	 ALLOW Any combination of structural and displayed formulae / skeletal formula IGNORE Connectivity of OH to C through vertical bond	OH-C on left of structure	**(1)**

Question Number	Acceptable Answers	Reject	Mark
2(d)	**D** will have a characteristic peak / absorption for C=C / alkene / double bond **and** cyclobutanol will not OR **Only D** will have a characteristic peak / absorption for C=C / alkene / double bond OR **Only D** will have a characteristic peak / absorption for H-C=C ALLOW Cyclobutanol will not have a characteristic peak / absorption for C=C / alkene / double bond IGNORE Reference to OH peak / fingerprint region		**(1)**

(Total for Question 2 = 7 marks)

Question Number	Acceptable Answers	Reject	Mark
3(a)	Measuring cylinder ALLOW Measurement on the side of the beaker Pipette	Burette / volumetric flask / weighing	**(1)**

Question Number	Acceptable Answers	Reject	Mark
3(b)	The copper / filter paper was still damp / wet OR The copper / filter paper was not (completely) dry OR The mass of the filter paper was included / not subtracted ALLOW Copper may become oxidised IGNORE Reference to other experimental errors	Incomplete reaction	**(1)**

Question Number	Acceptable Answers	Reject	Mark
3(c)	 **First mark** Axes with linear scale and points covering at least half the grid ALLOW Mass of copper on x axis **(1)** **Second mark** Both axes labelled, including units and 'mass' **(1)** IGNORE Produced / used, even if the wrong way around **Third mark** Points plotted correctly (±1 small square) **and** best fit straight line through the 4 accurate points **(1)** IGNORE Absence of anomalous point Additional point at 0.56 g of iron Line not extended to origin		**(3)**

Question Number	Acceptable Answers	Reject	Mark
3(d)	0.62 (g) ALLOW Value from graph (±1 small square) 0.6 (g) for 0.60 (g)		**(1)**

<table>
<tr><th>Question Number</th><th>Acceptable Answers</th><th>Reject</th><th>Mark</th></tr>
<tr><td>3(e)</td><td>Correct working to show that mole ratio
Fe : Cu = 1 : 1 / 1 : 0.96875
e.g. 0.01 mol iron produces 0.01 / 0.0096875 mol copper
OR
56 g of iron produces 62 g copper
TE on mass in (d)

ALLOW
Working from any pair of masses from graph or from table in question paper (1)

So equation is
$Fe + CuSO_4 \rightarrow FeSO_4 + Cu$

ALLOW
$Fe + Cu^{2+} \rightarrow Fe^{2+} + Cu$

ALLOW
Multiples (1)

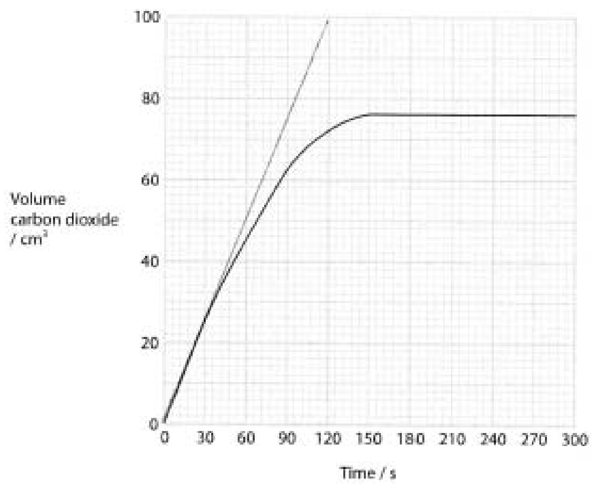
IGNORE
State symbols, even if incorrect</td><td></td><td>(2)</td></tr>
</table>

Question Number	Acceptable Answers	Reject	Mark
3(f)	Masses (of copper and iron) are (only) given to 2 significant figures ALLOW Student data / measurement is given to 2 significant figures OR Only need ratio of 1:1 or 1:1.5 so only approximate molar mass / A_r are needed ALLOW Numbers of moles / mole ratio is rounded to 1 significant figure / whole number (in the balanced equation) OR If the product was $FeSO_4$ then mass ratio of Cu to Fe = 1.14 / 1.13:1 but for $Fe_2(SO_4)_3$ then mass ratio of Cu to Fe = 1 : 1.7 / 1.75 so 2 SF gives sufficiently precise result to discriminate IGNORE Just 'numbers/ values are rounded to the nearest whole number' Reference to isotopes		**(1)**

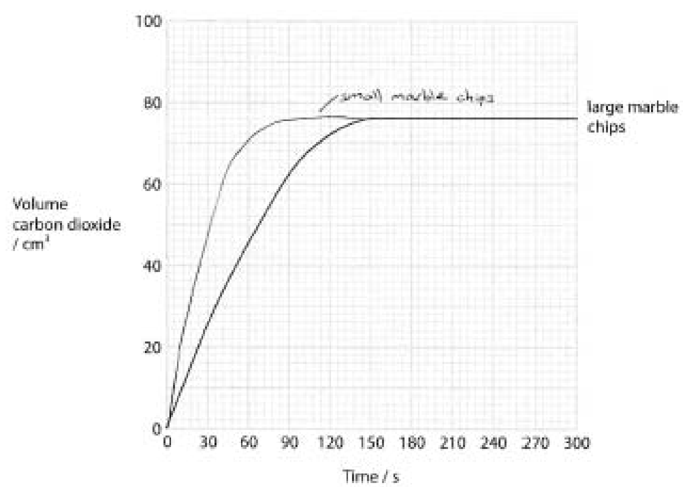
Question Number	Acceptable Answers	Reject	Mark
3(g)	Copper(II) sulfate is in excess / the extra copper(II) sulfate will not react OR The mass of iron is the limiting quantity / factor IGNORE The mass of copper is proportional to / depends on the mass of iron The amount of copper is the same as the amount of iron / the mol ratio of copper : iron = 1 : 1 References to rate of reaction Just 'the mass of iron does not change'	Copper is in excess	**(1)**

(Total for Question 3 = 10 marks)

Question Number	Acceptable Answers	Reject	Mark
4(a)	150 (s / seconds / sec) ALLOW 144-150 (s / seconds / sec) 2½ min / minutes 2 min / minutes **and** 30 s / seconds / sec	3 min / minutes	**(1)**

Question Number	Acceptable Answers	Reject	Mark
4(b)	 **Tangent** Tangent drawn at t=0 This must touch the curve for at least the first 18 s (3 small squares horizontally) and extend to at least 60 s **(1)** **Gradient -** conditional on a tangent / line drawn Gradient = $\frac{100}{120}$ = 0.833 TE on tangent / line drawn, even if not at t = 0 **(1)** IGNORE SF including 1SF **Units –** stand alone mark cm^3 s^{-1} / cm^3/s / $\frac{cm^3}{s}$ **(1)**	Incorrect rounding	**(3)**

Question Number	Acceptable Answers	Reject	Mark
4(c)(i)	Any two from: (Same) volume (of hydrochloric acid) **(1)** (Same) concentration (of hydrochloric acid**)** ALLOW (Same) amount / moles of (hydrochloric) acid (Same) dilution (of hydrochloric acid) **(1)** Temperature **(1)** IGNORE Mass of marble chips / size of marble chips / time / pressure / mass of acid / pH of acid		**(2)**

Question Number	Acceptable Answers	Reject	Mark
4(c)(ii)	 Added line, starting at or near the origin, and steeper than original line **(1)** Line finishes at same volume of carbon dioxide **(1)**		**(2)**

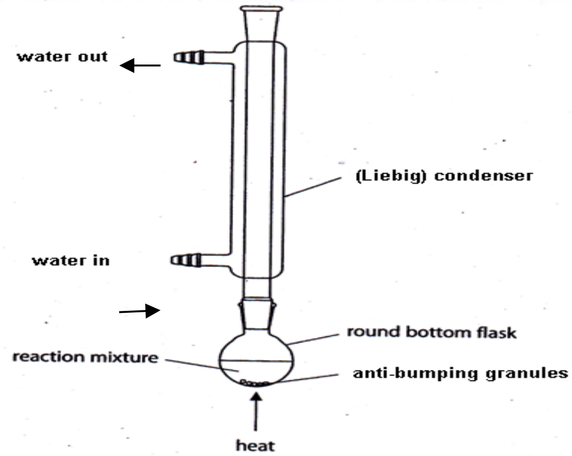
Question Number	Acceptable Answers	Reject	Mark
4(c)(iii)	The rate of reaction increases because) small marble chips have a greater surface (area to volume ratio) ALLOW More exposed particles of $CaCO_3$ **(1)** So the frequency / rate of collisions (between the acid particles and the marble) increases ALLOW Just 'more collisions' **(1)** IGNORE Reference to energy change	Slower rate for M1 only Reference to activation energy changing	**(2)**

Question Number	Acceptable Answers	Reject	Mark
4(d)	Some gas / carbon dioxide escapes before the stopper is replaced on the conical flask OR Some gas is soluble / dissolves in / reacts with the solution / hydrochloric acid / water IGNORE Just 'gas / carbon dioxide escapes'	Gas / carbon dioxide evaporates Incomplete reaction Side reaction	**(1)**

(Total for Question 4 = 11 marks)

Question Number	Acceptable Answers	Reject	Mark
5(a)(i)	The reaction is exothermic / releases heat (energy) IGNORE The reaction is violent / vigorous Reagents are flammable / volatile To stop spitting / flash boiling To prevent side reactions	Explosive	**(1)**

Question Number	Acceptable Answers	Reject	Mark
5(a)(ii)	To prevent the loss / escape of any volatile substances / volatile reactants / volatile products / organic compounds / named organic compound OR To make sure that vapours condense ALLOW To prevent vapour escaping To ensure the reactants and products remain in the flask So the reaction / oxidation goes to completion So all the propan-1-ol is oxidised So propanoic acid forms instead of propanal IGNORE To prevent gas escaping Just 'to prevent loss of reactants / products' Just 'reactants / products are volatile' Because propan-1-ol / alcohol is flammable		**(1)**

Question Number	Acceptable Answers	Reject	Mark
5(a)(iii)	 **First mark** Round bottom flask **and** heat ALLOW Pear-shaped flask Bunsen burner / electric heater / just an arrow **(1)** **Second mark** Reaction mixture **and** anti-bumping granules ALLOW Reaction mixture not labelled provided a liquid line is shown in the flask / other labels for reaction mixture e.g. propan-1-ol , propanoic acid Anti-bumping granules drawn but not labelled **(1)** **Third mark** **Vertical** condenser with jacket **(1)** **Fourth mark** Water in and out of condenser labelled **(1)**	No join between flask and condenser Obvious gap between condenser and flask Water bath / ice bath Sealed apparatus	**(4)**

Question Number	Acceptable Answers	Reject	Mark
5(a)(iv)	Propan-1-ol / $CH_3CH_2CH_2OH$ ALLOW Propanol Propanal / CH_3CH_2CHO Propyl propanoate / $CH_3CH_2COOCH_2CH_2CH_3$ Any combination of structural and displayed formulae / skeletal formula IGNORE Water / propanoic acid	Sulfuric acid CH_3CH_2COH propanone	**(1)**

Question Number	Acceptable Answers	Reject	Mark
5(b)(i)	Correct answer, with or without working, scores (3) Amount (mol) of NaOH used $= \frac{25.0 \times 0.102}{1000} = 0.00255 / 2.55 \times 10^{-3}$ **(1)** (Amount (mol) of propanoic acid $= 0.00255 / 2.55 \times 10^{-3}$) Concentration of propanoic acid $= \frac{0.00255 \times 1000}{18.60} = 0.137097$ (mol dm^{-3}) TE on amount (mol) NaOH **(1)** Concentration of propanoic acid **=** 0.137097×74 $= 10.145$ (g dm^{-3}) TE on concentration in mol dm^{-3} **(1)** **Alternative method for M2 and M3** Mass of propanoic acid (in 18.60 cm^3) $= 0.00255 \times 74 = 0.1887$ (g) TE on amount (mol) NaOH **(1)** Concentration of propanoic acid $= \frac{0.1887 \times 1000}{18.60} = 10.145$ (g dm^{-3}) TE on mass in 18.60 cm^3 **(1)** ALLOW Answers from earlier correct rounding to 2 or more SF e.g. 0.137 mol dm^{-3} gives 10.138 g dm^{-3} IGNORE SF except 1SF		**(3)**

Question Number	Acceptable Answers	Reject	Mark
5(b)(ii)	Correct answer, with or without working, scores (1) (percentage uncertainty) $= \dfrac{0.06}{25.0} \times 100 = (\pm)0.24\ (\%)$	(±)0.2 (%)	**(1)**

(Total for Question 5 = 11 marks)

Total for Paper = 50 marks

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