Mark Scheme (Results)

October 2022

Pearson 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.

Question Number	Answer	Additional Guidance	Mark
1(a)(i)	An answer that makes reference to the following points: • to remove insoluble barium compounds (other than barium sulfate)	Allow specific compounds/ions, e.g. carbonates/CO_3^{2-}, sulfites/SO_3^{2-}, hydrogencarbonates/HCO_3^- Allow remove other ions that would form a precipitate/react with barium chloride Allow to prevent unwanted (carbonate ion) compounds precipitating/giving a false positive result Ignore use of "BaCl" Ignore neutralisation Ignore barium sulfate doesn't dissolve in acid Ignore "to remove impurities"	1

Question Number	Answer	Additional Guidance	Mark
1(a)(ii)	An answer that makes reference to the following points: • hydrochloric acid / HCl (1) • will not precipitate barium ions (1)	Allow nitric acid / HNO_3 Allow ethanoic acid / CH_3COOH Do not award sulfuric acid Ignore concentrated/conc. Accept barium chloride / barium nitrate are soluble Allow because sulfuric acid / sulfate ions would give a white ppt Allow because chloride ions are already in the solution/no new ions are added Ignore use of "BaCl" Ignore "won't react with barium chloride" M2 is dependent on M1, or a near miss, e.g. HNO_4	2

Question Number	Answer		Additional Guidance	Mark
1(a)(iii)	An answer that makes reference to the following points:			2
	• dissolve (a small quantity of) the sample in (a small amount of deionised/distilled) water (and add the reagents)	(1)	Allow dissolve in (dilute) acid Do not award use of sulfuric acid Allow "Make an (aqueous) solution"	
	• white precipitate	(1)	Allow ppt / ppte / white crystals / white solid Ignore use of "BaCl" Marks are independent	

Question Number	Answer		Additional Guidance	Mark
1(b)(i)	An answer that makes reference to the following points:			3
	• flame test (for cations)	(1)	Allow a description of the process	
	• sodium: yellow / orange flame	(1)	Allow yellow-orange / golden flame Do not award orange-red flame	
	• barium: (apple) green flame	(1)	Do not award yellow flame Do not award blue-green flame Ignore modifiers, e.g. bright, pale	

Question Number	Answer		Additional Guidance	Mark
1 (b)(ii)	An answer that makes reference to the following points: • silver nitrate acidified with nitric acid • bromide: cream precipitate (that dissolves in concentrated ammonia) • chloride: white precipitate (that dissolves in dilute ammonia)	 (1) (1) (1)	Allow acidified silver nitrate Do not award hydrochloric acid/HCl or sulfuric acid/H_2SO_4 Allow off-white /creamy-white Allow crystals / solid Do not award pale-yellow Do not award bromine Allow white crystals / white solid Do not award chlorine Ignore spelling errors Ignore incorrect ions E.g. Ag^{2+}, Cl^{2-} Notes: M2 and M3 are dependent on M1, but can be awarded for a near-miss e.g. omission of the acid, or $Ag^+(aq)$ without nitrate If no colours are given for the precipitates, then the difference seen with dilute ammonia can be awarded M2 and M3 If both colours are correct but no precipitate, then only one mark from M2 and M3 can be awarded	3

(Total for Question 1 = 11 marks)

<table>
<tr><th>Question Number</th><th>Answer</th><th>Additional Guidance</th><th>Mark</th></tr>
<tr><td>2(a)(i)</td><td>table completed correctly</td><td>An example of a completed table:
<table>
<tr><th>Burette reading</th><th>Rough</th><th>1</th><th>2</th><th>3</th></tr>
<tr><td>Final reading / cm^3</td><td>13.45</td><td>25.60</td><td>37.85</td><td>12.35</td></tr>
<tr><td>Initial reading / cm^3</td><td>0.00</td><td>13.45</td><td>25.60</td><td>0.15</td></tr>
<tr><td>Titre / cm^3</td><td>13.45</td><td>12.15</td><td>12.25</td><td>12.2(0)</td></tr>
</table></td><td>1</td></tr>
</table>

<table>
<tr><th>Question Number</th><th>Answer</th><th>Additional Guidance</th><th>Mark</th></tr>
<tr><td>2(a)(ii)</td><td>calculation of the mean</td><td>An example of a calculation:
$\frac{12.15+12.25+12.2}{3} = 12.2(0)\ (cm^3)$
TE on 2(a)(i) for numbers within 0.2 cm^3</td><td>1</td></tr>
</table>

Question Number	Answer	Additional Guidance	Mark
2(b)(i)	• calculation of moles of NaOH (1) • indication of 2:1 ratio and final answer (1)	Example of a calculation: $\frac{12.2 \times 0.0250}{1000} = 0.000305$ / 3.05×10^{-4} (2(a)(ii) ÷ 1000) × 0.025) 2 mol NaOH = 1 mol H_2SO_4 moles H_2SO_4 = 0.0001525 / 0.000153 / 1.525×10^{-4} / 1.53×10^{-4} (mol) (M1 ÷ 2) Ignore SF except 1 SF TE from (a)(ii) and M1 to M2	2

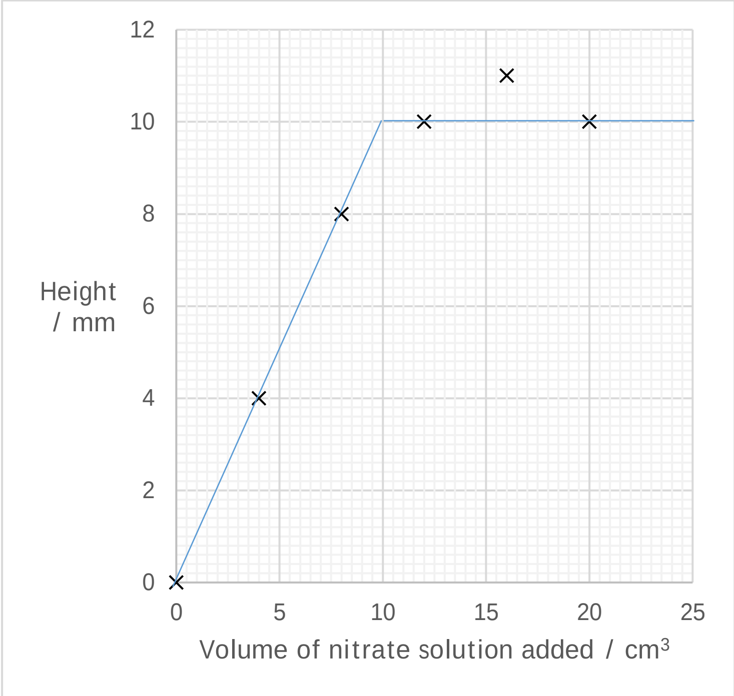
Question Number	Answer	Additional Guidance	Mark
2(b)(ii)	• calculation of moles of H_2SO_4	Example of a calculation: $\frac{75 \times 0.200}{1000} = 0.015$ / 1.5×10^{-2} (mol) Ignore SF except 1 SF	1

Question Number	Answer	Additional Guidance	Mark
2(b)(iii)	• calculation of total moles of acid that remained after reacting with one tablet (1) • calculation of moles of acid that reacted with one tablet (1) • mass of $MgCO_3$ (1) • % $MgCO_3$ (1)	Example of a calculation: $\frac{0.0001525}{25}$ × 250 = 0.001525 / 1.525 × 10^{-3} mol (TE (b)(i) × 10) 0.015 – 0.001525 = 0.013475 / 1.3475 × 10^{-2} mol TE from (b)(ii) and M1 (moles H_2SO_4 = moles $MgCO_3$) 0.013475 × 84.3 = 1.1359 (g) (M2 × 84.3) (1.1359 ÷ 1.30) × 100 = 87.380% (M3 ÷ (1.30 × 100)) Ignore SF except 1SF TE throughout Do not award M4 for % $MgCO_3$ greater than 100% Comment: Correct answer with no working scores (4)	4

Question Number	Answer	Additional Guidance	Mark
2(c)(i)	An answer that makes reference to one of the following points: • to know the approximate end-point • so other titrations to be completed more quickly • to know the approximate titre • to know when the colour changes • so that you can go dropwise near the end-point	Allow estimate the range of results Allow saves time on other titrations Estimate the volume (of NaOH) in the titration Ignore improve accuracy Do not award to eliminate bubbles, decrease percentage error, cost	1

Question Number	Answer	Additional Guidance	Mark
2(c)(ii)	An answer that makes reference to the following points: • colourless to (1) • (pale) pink (1)	Ignore clear Correct colours the wrong way round scores (1)	2

(Total for Question 2 = 12 marks)

Question Number	Answer	Additional Guidance	Mark
3(a)(i)	• suitable choice of scale so that the points cover at least 50% of the grid in both directions and correct orientation and scale suitably labelled including units (1) • all six points plotted correctly (1) or five points plotted correctly and a line going through 0,0 (within 1 small square)	 Allow units in brackets e.g. (mm) in place of "/ mm" Ignore joining of the points in this part Non-uniform axes negate both marks	2

Question Number	Answer	Additional Guidance	Mark
3(a)(ii)	An explanation that makes reference to the following points: • The metal nitrate is now in excess / there is no more iodide to precipitate	Allow no more metal iodide can form Allow all (potassium) iodide had reacted Allow KI is the limiting reagent Ignore reaction is complete Do not award there is no more nitrate /all the nitrate has reacted	1

Question Number	Answer	Additional Guidance	Mark
3(b)(i)	• two straight lines shown on the graph (1) • appropriate volume chosen (1)	One line to be horizontal and the other diagonal 9.5 to 11.0 (cm^3) Marks are independent	2

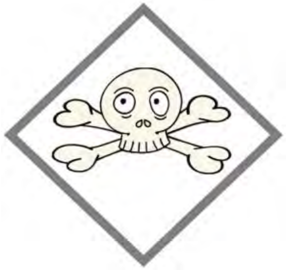
Question Number	Answer	Additional Guidance	Mark
3(b)(ii)	• calculation of the number of moles of KI in each test tube	Example of a calculation: $\frac{5}{1000} \times 1.50 = 0.0075$ / 7.5×10^{-3} (mol) Ignore units even if incorrect	1

Question Number	Answer	Additional Guidance	Mark
3(b)(iii)	• calculation of concentration of $X(NO_3)_2$ solution in g dm^{-3}	Example of a calculation: $12.41 \times 1000 \div 100 = 124.1$ (g dm^{-3}) Allow rounding of the answer to 3sf Ignore units even if incorrect	1

Question Number	Answer	Additional Guidance	Mark
3(b)(iv)	• calculation of moles of metal nitrate (1) • calculation of grams of metal nitrate in test tube (1) • calculation of M_r of metal nitrate (1) • identification of A_r of X (1)	Example of a calculation: (2 moles of KI = 1 mol of metal nitrate) 0.0075 ÷ 2 = 0.00375 (answer from 3bii ÷ 2) 124.1 × (10 ÷ 1000) = 1.241 g (Answer from 3biii multiplied by (3bi ÷ 1000)) 1.241 ÷ 0.00375 = 330.93 (M2 ÷ M1) 330.93 - (2 × 62) = 206.9 (so the metal is lead, Pb) Correct answer with some working scores 4 TE throughout M4 only to be awarded if final answer is between 7 and 272 Alternative method for M2 and M3: M2 calculation of molar concentration (1) 0.00375 ÷ (10 ÷ 1000) = 0.375 (mol dm^{-3}) (M1 ÷ (3bi ÷ 1000) M3 concentration in g dm^{-3} ÷ molar concentration (1) 124.1 ÷ 0.375 = 330.93 (3biii) ÷ molar concentration (alt M2) NOTE: Do not penalise M4 if the metal is incorrect for the derived A_r	4

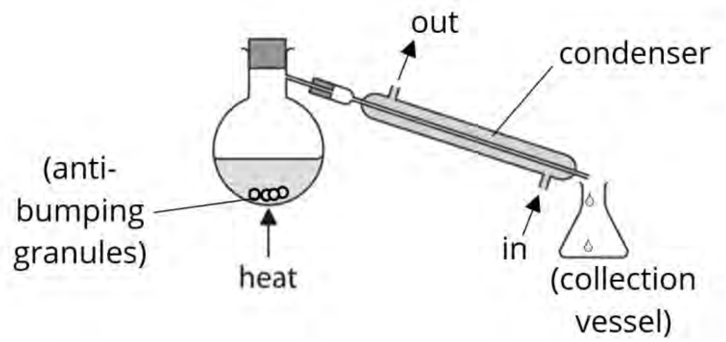
Question Number	Answer	Additional Guidance	Mark
3(b)(v)	• balanced ionic equation	$Pb^{2+}(aq) + 2I^-(aq) \rightarrow PbI_2(s)$ Allow $X^{2+}(aq) + 2I^-(aq) \rightarrow XI_2(s)$ Allow use of <u>any</u> metal, other than Group 1, with a 2+ charge	1

Question Number	Answer	Additional Guidance	Mark
3(c)	An answer that makes reference to the following point: • (precipitate was) not given long enough to settle	Allow air bubbles/solution trapped in the precipitate Allow test tube has a different diameter	1

Question Number	Answer	Additional Guidance	Mark
3(d)	• toxic hazard symbol drawn 	Allow any representation of skull and crossbones  Some representation of a face and two crossed lines is the minimum	1

(Total for Question 3 = 14 marks)

Question Number	Answer	Additional Guidance	Mark
4(a)	An answer that makes reference to the following points: • (from) orange (1) • (to) green (1)	Allow to blue Allow 1 mark for colours reversed	2

Question Number	Answer	Additional Guidance	Mark
4(b)	A diagram that shows: • round-bottomed/pear shaped flask containing the mixture with heat label (1) • anti-bumping granules in round-bottomed flask (1) • (labelled) sloping condenser with correct direction of water in and out (1) • collection vessel and system sealed on the left and open on the right (1)	Example of a diagram:  Allow any indication of heat including just an arrow Allow just arrows showing the water direction Ignore inclusion of thermometer/dropping funnel even if incorrectly placed The condenser should have some indication of a water jacket Incorrect labelling, e.g. a round bottom flask labelled as a conical flask, would not be awarded the corresponding mark (M1 in this case) Max 3 for one-piece apparatus NB reflux set up would be able to score M1 and M2	4

Question Number	Answer	Additional Guidance	Mark
4(c)(i)	• (alcohols/products are) flammable / may ignite / can burn	Ignore more even heating/avoids hot-spots Ignore easier to control the temperature Ignore heat more safely Ignore references to explosions Ignore references to fire as a hazard Do not award potassium dichromate is flammable	1

Question Number	Answer	Additional Guidance	Mark
4(c)(ii)	An answer that makes reference to the following point: (2-methylpropan-2-ol resists oxidation because 2-methylpropan-2-ol is a) tertiary (alcohol) / 3°	Allow tertiary alcohols are resistant to oxidation Allow tertiary (alcohols) cannot be oxidised Ignore no reaction Ignore minor errors in the alcohols name	1

Question Number	Answer	Additional Guidance	Mark
4(c)(iii)	A description that makes reference to the following points: • identification of the three oxidation products	Additional guidance: Propanal / CH_3CH_2CHO and propanoic acid / CH_3CH_2COOH (from propan-1-ol) and propanone / CH_3COCH_3 (from propan-2-ol) Accept skeletal/displayed formulae Allow propan-1-al and propan-2-one Ignore carbon dioxide/CO_2 and water/H_2O If both name and formula are given, then both must be correct	1

Question Number	Answer	Additional Guidance	Mark
4(c)(iv)	A description that makes reference to the following points: • test for propanal/aldehyde (1) • result for propanal (1) • test for (propanoic) acid (1) • result for propanoic acid (1) Note: If extra oxidation products are given, then ignore those with correct tests. An incorrect test or result negates one mark for each extra compound. A near miss on the test would allow the corresponding result mark to be awarded e.g. Add ethanol (no acid catalyst) gives a fruity smell would score 1 mark for M4 If candidates have omitted the names of the compounds being tested then assume the tests are for the correct compounds	Additional guidance: Benedict's or Fehling's solution Accept alkaline copper(II) sulfate solution propanal will form a red precipitate or ammoniacal silver nitrate / Tollen's reagent propanal gives a silver mirror Do not award acidified potassium dichromate(VI) addition of carbonate / hydrogencarbonate (solution) will give effervescence / fizz (of carbon dioxide) / gas given off which turns limewater cloudy or addition of reactive metal will give effervescence / fizz (of hydrogen) / gas given off pops with a lighted splint or addition of a named alcohol and acid catalyst to form a sweet-smelling ester Ignore addition of PCl_5 , gives misty fumes Ignore reference to indicators	4

(Total for Question 4 = 13 marks)
(Total for Paper = 50 marks)

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