



# Mark Scheme (Results)

January 2020

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

Question Number	Answer	Additional Guidance	Mark
<b>1(a)(i)</b>	<ul style="list-style-type: none"> <li>(colourless sodium chloride) becomes brown / orange / yellow / darker Or</li> <li>bromine water turns lighter in colour (due to dilution) <b>(1)</b></li> </ul> <ul style="list-style-type: none"> <li>(Sodium iodide) solution turns darker/brown/orange <b>(1)</b></li> </ul>	<p>Standalone marks Do not award additional incorrect observations Ignore reference to layers</p> <p>Allow No change / no (visible) reaction or Remains brown/orange / yellow</p> <p>Do not award any indication of a reaction any other colour</p> <p>Allow black or grey <b>solid</b></p> <p>Do not award purple (vapour, solution, solid)</p>	<b>(2)</b>

Question Number	Answer	Additional Guidance	Mark
<b>1(a)(ii)</b>	<ul style="list-style-type: none"> <li>Test: Flame Test <b>(1)</b></li> <li>Observation: Yellow <b>(1)</b></li> </ul>	<p>Allow Orange or yellow-orange</p> <p>Ignore persistent / golden/ bright (yellow)</p>	<b>(2)</b>

Question Number	Answer	Additional Guidance	Mark
<b>1(b)(i)</b>	<ul style="list-style-type: none"> <li>Ammonium sulfate White precipitate /solid <b>(1)</b></li> <li>Ammonium nitrate No change / no reaction <b>(1)</b></li> </ul>	<p>Allow ppt for precipitate Do not award if any additional observations are made such as bubbles/fumes</p> <p>Allow no precipitate / no observation Ignore any formulae even if incorrect</p>	<b>(2)</b>

Question Number	Answer	Additional Guidance	Mark
<b>1(b)(ii)</b>	<ul style="list-style-type: none"> <li>Test: (add) (aqueous) sodium hydroxide (heat) <b>(1)</b></li> <li>Result: <b>Gas</b> evolved which turns (damp) red litmus blue <b>(1)</b></li> </ul>	<p>Allow any hydroxide</p> <p>Accept white smoke with HCl</p> <p>Allow <b>Gas</b> turns litmus blue / <b>Gas</b> turns universal indicator blue pungent smelling <b>gas</b></p> <p>Ignore NH<sub>3</sub> / alkali gas / steamy fumes</p> <p>The result mark is dependent on the correct test or just 'heat' for the test with no sodium hydroxide.</p>	<b>(2)</b>

Question Number	Answer	Additional Guidance	Mark
<b>1(c)(i)</b>	<ul style="list-style-type: none"> <li>(Turns) green <b>(1)</b></li> <li>No change/no reaction/remains orange <b>(1)</b></li> </ul>	<p>Allow blue / blue-green / green-blue / Grey-green Ignore smell Do not award if additional observations are made e.g. bubbles</p> <p>Allow no observation</p> <p>Colours reversed scores one mark</p> <p>If wrong starting colour stated max 1</p>	<b>(2)</b>

Question Number	Answer	Additional Guidance	Mark
<b>1(c)(ii)</b>	<ul style="list-style-type: none"> <li>Test: phosphorus(V)chloride/ <math>\text{PCl}_5</math> <b>(1)</b></li> <li>Result: Steamy fumes/ white fumes/misty fumes <b>(1)</b></li> </ul> <p>OR</p> <ul style="list-style-type: none"> <li>Test: sodium/Na <b>(1)</b></li> <li>Result: effervescence / bubbles/fizzing <b>(1)</b></li> </ul> <p>OR</p> <ul style="list-style-type: none"> <li>Test: add any named carboxylic acid and (conc) sulfuric acid (and warm) <b>(1)</b></li> <li>Result: (product has) sweet/fruity/ester smell <b>(1)</b></li> </ul>	<p>The result mark depends on a correct test or near miss</p> <p>Allow phosphorus pentachloride / thionyl chloride / <math>\text{SOCl}_2</math> / <math>\text{PCl}_3</math></p> <p>Do not award white smoke</p> <p>Ignore effervescence/gas turns litmus red/gas forms white smoke with <math>\text{NH}_3</math></p> <p>Accept gas given off burns with a squeaky pop Allow white solid / sodium dissolves</p> <p>Allow just carboxylic acid and any named strong acid</p>	<b>(2)</b>

Question Number	Answer	Additional Guidance	Mark
<b>1(d)</b>	<ul style="list-style-type: none"> <li>Hexane: (forms two layers and the lower layer) remains pink/purple <b>(1)</b></li> <li>Hexene: (potassium manganate(VII)) turns colourless <b>(1)</b></li> </ul>	<p>Allow no change / no reaction / no observation Ignore shades of pink / purple</p> <p>Allow 1 mark if the observations are reversed</p> <p>Do not award if the wrong colour is stated</p>	<b>(2)</b>

**(Total for Question 1 = 14 Marks)**

Question Number	Answer	Additional Guidance	Mark
2(a)(i)	<ul style="list-style-type: none"> <li>• <b>M1</b> Mass of 10 cm length of Mg ribbon <b>(1)</b></li> <li>• <b>M2</b> Converting mass of Mg ribbon to moles <b>(1)</b></li> </ul>	<p>Penalise rounding errors once only in 2a and 2bi and nowhere else in the paper.</p> <p>Example of calculation  <math>0.86/10 = 0.086 \text{ (g)}</math></p> <p><math>0.086/24.3 = 3.5391 \times 10^{-3} / 0.0035391 \text{ (mol)}</math>  <math>= 3.54 \times 10^{-3} \text{ (mol)} / 0.00354 \text{ (mol)}</math>            Do not award rounding error, e.g. <math>3.53 \times 10^{-3}</math></p> <p>TE on any incorrect mass in M1</p> <p>Ignore SF except 1SF</p> <p>Use of 24 gives <math>3.5833 \times 10^{-3}</math> scores (2)</p> <p>Correct answer with or without working scores(2)</p>	<b>(2)</b>

Question Number	Answer	Additional Guidance	Mark
2(a)(ii)	<ul style="list-style-type: none"> <li>• <b>M1</b> Calculates temp change <b>(1)</b></li> <li>• <b>M2</b> Calculates energy change <b>(1)</b></li> <li>• <b>M3</b> energy/moles <b>(1)</b></li> <li>• <b>M4</b> Completion of calculation, correct sign and units and 1, 2 or 3SF <b>(1)</b></li> </ul>	<p>Example of calculation</p> <p><math>29.2 - 21.4 = 7.8</math> (°C)</p> <p><math>50 \times 4.2 \times 7.8 = 1638</math> (joules) / 1.638 kJ Ignore minus sign</p> <p><math>1638 / 3.5391 \times 10^{-3} (= 462830)</math></p> <p><math>-463</math> / <math>-460</math> / <math>-500</math> kJ mol<sup>-1</sup> Or <math>-463000</math> / <math>-460000</math> / <math>-500000</math> J mol<sup>-1</sup></p> <p>Correct answer with or without working scores all marks</p> <p>Use of 24 gives <math>-457</math> kJ mol<sup>-1</sup>scores (4)</p> <p>Allow TE from (a)(i) and M1 to M3.</p>	<b>(4)</b>

Question Number	Answer	Additional Guidance	Mark
2(b)(i)	<ul style="list-style-type: none"> <li>Calculation of percentage uncertainty</li> </ul>	<p>Example of calculation</p> $\frac{(+/-) 0.1 \times 2}{7.8} \times 100 = 2.56 (\%)$ <p>Allow TE for wrong temperature change</p> <p>Do not award if either temp used</p> <p>Ignore SF</p>	(1)

Question Number	Answer	Additional Guidance	Mark
2(b)(ii)	<p>An explanation that makes reference to the following points:</p> <p><b>M1</b></p> <ul style="list-style-type: none"> <li>Use greater mass of magnesium</li> </ul> <p><b>Or</b></p> <ul style="list-style-type: none"> <li>Smaller volume of hydrochloric acid</li> </ul> <p><b>M2</b></p> <p>(So the) temperature <b>change</b> will be greater/temperature will <b>increase</b> more</p>	<p>(1)</p> <p>Standalone marks. Even if the answer to M1 would not produce a temperature rise M2 can be scored.</p> <p>Allow More magnesium</p> <p>Allow Less hydrochloric acid Ignore increase the concentration of hydrochloric acid</p> <p>Do not award reduce the concentration of the hydrochloric acid</p> <p>Do not award temperature cooling curve or any other changes to the procedure to reduce heat loss</p> <p>(1)</p>	(2)



Question Number	Answer	Additional Guidance	Mark
2(c)	<p>An explanation that makes reference to the following points:</p> <p><b>M1</b></p> <ul style="list-style-type: none"> <li>The enthalpy change will be less negative / less exothermic <b>(1)</b></li> </ul> <p><b>M2</b></p> <ul style="list-style-type: none"> <li>The heat loss will be greater</li> </ul> <p>Or</p> <ul style="list-style-type: none"> <li>(Because) polystyrene is a better insulator</li> </ul> <p>Or</p> <ul style="list-style-type: none"> <li>More energy is used to heat the container/ glass</li> </ul> <p>Or</p> <ul style="list-style-type: none"> <li>(Because) the polystyrene cup has a low heat capacity <b>(1)</b></li> </ul>	<p>Allow reverse arguments for <b>M2</b></p> <p>Allow lower/smaller</p> <p>Allow glass absorbs heat</p> <p>Ignore references to the mechanism of heat loss No TE on incorrect <b>M1</b></p>	<b>(2)</b>

Question Number	Answer	Additional Guidance	Mark
2(d)	<p>An explanation that makes reference to the following points:</p> <ul style="list-style-type: none"> <li>• <b>M1</b> To remove magnesium oxide</li> <li>• <b>M2</b> The two enthalpy changes would be different</li> </ul>	<p><b>(1)</b> Allow The magnesium is oxidised / corroded / tarnished Ignore just impurities Do not award rust</p> <p><b>(1)</b> Allow The enthalpy change will be less exothermic / less negative Allow Only Mg is being weighed / reacted Or So the Mg is pure Or the mass of Mg would be lower if the layer were not removed.  Ignore any references to rate of reaction</p>	<b>(2)</b>

**(Total for Question 2 = 13 marks)**

Question Number	Answer	Additional Guidance	Mark
<b>3(a)</b>	<ul style="list-style-type: none"> <li>(From) Yellow <b>(1)</b></li> <li>(to) orange <b>(1)</b></li> </ul>	Do not award red Colours correct in reverse order scores (1)	<b>(2)</b>

Question Number	Answer					Additional Guidance	Mark																				
3(b) (i)	<table border="1"><thead><tr><th>Number of titration</th><th>1</th><th>2</th><th>3</th><th>4</th></tr></thead><tbody><tr><td>Burette reading (final) / cm<sup>3</sup></td><td>27.55</td><td>26.25</td><td>28.30</td><td>26.15</td></tr><tr><td>Burette reading (start) / cm<sup>3</sup></td><td>0.00</td><td>0.05</td><td>1.05</td><td>0.05</td></tr><tr><td>Volume of HCl used / cm<sup>3</sup></td><td>27.55</td><td>26.2(0)</td><td>27.25</td><td>26.1(0)</td></tr></tbody></table>					Number of titration	1	2	3	4	Burette reading (final) / cm <sup>3</sup>	27.55	26.25	28.30	26.15	Burette reading (start) / cm <sup>3</sup>	0.00	0.05	1.05	0.05	Volume of HCl used / cm <sup>3</sup>	27.55	26.2(0)	27.25	26.1(0)		
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	Volume of HCl used / cm <sup>3</sup>	27.55	26.2(0)	27.25	26.1(0)																						
	4 correct values					(1)																					
correct calculation using concordant values					(1)	Example of calculation  (26.10 + 26.20= 52.30/2) = 26.15 (cm <sup>3</sup> )  TE on incorrect subtractions as long as the values chosen are concordant.																					

Question Number	Answer	Additional Guidance	Mark
<b>3(b)(ii)</b>	<p>Possible route through the calculation</p> <ul style="list-style-type: none"> <li>• <b>M1</b> Calculation of the amount of hydrochloric acid (1)</li> <li>• <b>M2</b> Calculation of the amount of sodium carbonate in 25 cm<sup>3</sup> (1:2 ratio) (1)</li> <li>• <b>M3</b> <math>M_r</math> Na<sub>2</sub>CO<sub>3</sub> (1)</li> <li>• <b>M4</b> Mass of Na<sub>2</sub>CO<sub>3</sub> in 250 cm<sup>3</sup> (1)</li> <li>• <b>M5</b> Calculation of the percentage purity of Na<sub>2</sub>CO<sub>3</sub> (1)</li> </ul>	<p>Example of calculation TE on mean titre from (b)(i)</p> <p>Mol of HCl = <math>26.15 \times 0.200/1000</math> = <math>5.23 \times 10^{-3}/0.00523</math> (mol)</p> <p>Mol of Na<sub>2</sub>CO<sub>3</sub> = <math>5.23 \times 10^{-3}/2</math> = <math>2.615 \times 10^{-3}/0.002615</math> (mol)</p> <p>106 or allow correct value used in a calculation</p> <p>= <math>2.615 \times 10^{-3} \times 10 \times 106 = 2.7719</math> (g)</p> <p><math>2.7719/4.89 \times 100 = 56.685 = 56.7</math> (%)</p> <p>TE at each stage</p> <p>IGNORE SF except 1</p> <p>% impurity 43.315 % scores (4)</p> <p>Correct answer with or without working scores (5) marks</p> <p>Ignore rounding errors</p>	<b>(5)</b>

**(Total for Question 3 = 9 marks)**

Question Number	Answer	Additional Guidance	Mark
<b>4(a)</b>	<p>An explanation that makes reference to the following points:</p> <ul style="list-style-type: none"> <li>the reaction is exothermic <b>(1)</b></li> <li>prevents the mixture boiling over <b>(1)</b></li> </ul>	<p>Allow the reaction gives out heat Ignore the reaction is vigorous</p> <p>Allow To prevent the ethanol evaporating/boiling To prevent bubbling / spitting / spraying / splattering</p> <p>Ignore splashing / explosions / spilling / cracking flasks</p>	<b>(2)</b>

Question Number	Answer	Additional Guidance	Mark
<b>4(b)</b>	<p>An answer that makes reference to the following points:</p> <ul style="list-style-type: none"> <li>increases / speeds up the rate of reaction <b>(1)</b></li> <li>because the surface area (of the potassium bromide) is increased <b>(1)</b></li> </ul>	<p>Standalone marks</p> <p>Allow large surface area</p> <p>Ignore goes to completion</p>	<b>(2)</b>

Question Number	Answer	Additional Guidance	Mark
4(c)(i)	<p>A diagram that shows the following points:</p> <ul style="list-style-type: none"> <li> <b>M1</b> Round-bottomed flask, heat and thermometer in the correct position opposite the condenser opening. </li> <li> <b>M2</b> Correct downward sloping condenser <b>and</b> water flowing in the correct direction </li> <li> <b>M3</b> No gaps on the LHS and open collecting vessel or vent </li> </ul>	<p>Allow</p> <p>Pear-shaped flask, arrow for heat / <b>hot</b> water bath / electric heater / Bunsen burner</p> <p>The bulb of the thermometer anywhere above the flask</p> <p>One-piece apparatus</p> <p>Do not award conical flask</p> <p>Ignore lack or presence of anti-bumping granules</p> <p>Ignore fractional distillation column</p> <p>Ignore lines between apparatus</p> <div data-bbox="1294 938 1966 1315"> </div> <p>Reflux apparatus can only score one mark for correct flask, heat and condenser with the correct correct water flow</p>	(3)

Question Number	Answer	Additional Guidance	Mark
<b>4(c)(ii)</b>	<ul style="list-style-type: none"> <li>Promotes smooth or even boiling or</li> <li>Provides sites for bubbles to form / site for nucleation / promotes (small) bubble formation</li> </ul>	<p>Allow to stir the mixture</p> <p>Allow to prevent the formation of large bubbles / to break up large bubbles</p> <p>Ignore to prevent bumping</p>	<b>(1)</b>

Question Number	Answer	Additional Guidance	Mark
<b>4(d)(i)</b>	<p>Any 2 of the following</p> <ul style="list-style-type: none"> <li>The density of bromobutane is greater (than the aqueous layer) <b>(1)</b></li> <li>Bromoethane is immiscible (with water) <b>(1)</b></li> <li>Bromoethane is a liquid (at room temperature) <b>(1)</b></li> </ul>	<p>Allow water/ <math>1 \text{ g cm}^{-3}</math> reverse argument</p> <p>Allow does not mix / insoluble (in water) / bromoethane is non polar</p>	<b>(2)</b>

Question Number	Answer	Additional Guidance	Mark
<b>4(d)(ii)</b>	<p>A description that makes reference to the following points:</p> <ul style="list-style-type: none"> <li>(open the tap and) run off the bromobutane layer into a beaker (and discard the aqueous layer) or</li> <li>Remove the aqueous layer with a (teat) pipette/ syringe</li> </ul>	<p>Do not award</p> <p>Just pouring off/decant the aqueous layer from the top</p>	<b>(1)</b>

Question Number	Answer	Additional Guidance	Mark
<b>4(e)</b>	<ul style="list-style-type: none"> <li>To neutralise the acid / <math>H^+</math> ions / <math>H_3O^+</math></li> </ul>	Allow Remove the acid Hydrobromic acid / sulfuric acid  Ignore reference to impurities	<b>(1)</b>

Question Number	Answer	Additional Guidance	Mark
<b>4(f)(i)</b>	<ul style="list-style-type: none"> <li>(solid) (anhydrous) calcium chloride/sodium sulfate/calcium sulfate/magnesium sulfate</li> </ul>	Name or correct formula.  Allow silica gel  Do not award Conc $H_2SO_4$ / anhydrous copper sulfate  If a list is given all must be suitable drying agents to score. If name and formula given both must be correct.	<b>(1)</b>

Question Number	Answer	Additional Guidance	Mark
<b>4(f)(ii)</b>	<ul style="list-style-type: none"> <li>(Bromoethane) becomes less cloudy/ goes clear</li> </ul>	Do not award just colourless  Ignore any stated colour as long as it does not change.	<b>(1)</b>

**(Total for Question 4 = 14 Marks)**  
**Total for the paper = 50 Marks**