

**MARK SCHEME for the October/November 2009 question paper
for the guidance of teachers**

9701 CHEMISTRY

9701/31

Paper 31 (Advanced Practical Skills), maximum raw mark 40

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes must be read in conjunction with the question papers and the report on the examination.

- CIE will not enter into discussions or correspondence in connection with these mark schemes.

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Page 2	Mark Scheme: Teachers' version	Syllabus	Paper
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Question	Sections	Indicative material	Mark	
1 (a)	PDO layout	Two balance readings and mass of FA 1 clearly recorded for each experiment. (Data for 2 nd experiment could be on page 4) <i>Examiner to check subtraction for each experiment – no penalty in this section but see section (e)</i>	1	[1]
(b)	PDO Recording MMO Collection	<p>If the candidate has only performed one experiment the following points <u>only</u> can be awarded: (ii), (iii), (vi), (vii) and (x).</p> <p>(i) Single table recording observations for both experiments. Times at ½ minute intervals.</p> <p>(ii) Appropriate headings and units <i>Allow times in minutes (min) or seconds</i></p> <p>(iii) All temps recorded to nearest 0.5 °C (Must be more than one at .5 as well as .0)</p> <p>(iv) Some temps recorded before mixing and some after mixing for each expt. or Candidate records initial temperature and at least three temperatures after mixing for each experiment</p> <p>(v) First temperature after mixing is clearly taken 1 minute after adding the zinc powder <i>(Examiner judgement re temperatures recorded before mixing / temperatures only recorded after mixing)</i> and cooling for at least 5 minutes after recorded maximum temperature.</p>	1 1 1 1 1	
If the candidate performs one experiment only, the following marks may not be awarded: (i) (iv) (viii) & (ix) (xi)				
For Supervisor -		calculate mean maximum ΔT to nearest 0.5 °C; calculate mean of time taken (to nearest ½ min) to reach max temperature after mixing.		
	MMO Quality	<p>(vi) & (vii) 1st expt. Compare ΔT with Supervisor. award (vi) and (vii) if within 2 °C award (vii) only if >2 °C and $\leq 5^\circ\text{C}$</p> <p>(viii) & (ix) 2nd expt. Compare ΔT with Supervisor. award (viii) and (ix) if within 2 °C award (ix) only if >2 °C and $\leq 5^\circ\text{C}$</p> <p>(x) (1st expt) & (xi) (2nd expt). Compare time after mixing at which max temp is obtained with same time for Supervisor, for each expt. If Supervisor ≤ 3 min; 1 mark for Δ time ≤ 1 min. If Supervisor >3 min; 1 mark for Δ time $\leq 1\frac{1}{2}$ min.</p>	2 2 1 1	[11]

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Question	Sections	Indicative material	Mark	
(f)	ACE Conclusions	To gain this mark the candidate must refer to: (i) the 1:1 <u>mole</u> ratio from the equation and (ii) the relative <u>moles</u> of Cu^{2+} and Zn(s) used, as calculated in (e) <i>If candidate states that "more moles of zinc were present" and this fits the calculated values in (e) – accept as the relative statement.</i>	1	[1]
(g)	ACE Interpretation	Shows $(25 \times 4.3 \times \text{candidate mean } \Delta T)$ with appropriate unit, J or kJ, on final answer. (Allow use of 4.2 or 4.18 without penalty) <i>Award this mark for the correct expression and unit OR where the expression is not shown, a correct evaluation of that expression and unit</i>	1	[1]
Where candidate has given a maximum temperature in (g), allow use here (ecf). Also allow use of ΔT calculated in this section.				
(h)	ACE Interpretation	No mark is awarded in this section if there is no division by (moles of zinc) or by (moles of Cu^{2+}). Calculates <u>answer to (g)</u> moles of reagent not stated as being in excess in (f) <i>If (moles of zinc) is used in this expression, candidate may use either value from (e) or the mean of the (moles of zinc).</i> Examiner evaluates the candidate expression which should be: (i) correctly rounded for sig fig displayed, (allow variation of ± 1 on 3 rd significant figure) (ii) have a -ve sign on the final answer; (iii) be correctly converted to kJ	1 1	[2]
(i)	ACE Interpretation	Candidate identifies one source of error in the experiment. This must be related to: Apparatus used or method described – no human error allowed. <i>Heat loss is most likely error to be seen Accept reference to the graduation (precision) of the thermometer.</i>	1	[1]
(j)	ACE Improvement	Answer must follow on from (i) Suggests a way in which method could be improved <i>e.g. Use of a lid or increased insulation to minimise heat loss.</i>	1	[1]
Qn 1	Total			[26]

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Question	Sections	Indicative material	Mark	
FA 3 is $\text{MnSO}_4(\text{s})$; FA 4 is $\text{PbCO}_3(\text{s})$; FA 5 is $\text{CuCO}_3(\text{s})$				
2 (a)	MMO Collection	As FA 5 is heated, observes: green or blue <u>solid</u> turning black, or green/blue (solid) turning to a black <u>solid or residue</u>	1	[2]
	MMO Decisions	Tests gas given off with: <i>Ignore results</i> limewater, <i>in any of</i> a glowing (not burning) splint, <i>these tests</i> red litmus paper	1	
(b)	MMO Collection	Observes each of the following: colourless solution with FA 3 or colourless solution with FA 4, and blue or green solution with FA 5 and observation of a gas evolved with FA 4 or with FA 5 . <i>[Second mark from (a) may be awarded here if not already</i> <i>given in (a)]</i>	1	[1]
(c)	ACE Conclusion	Identifies carbonate in FA 4 or FA 5 and refers to carbon dioxide; <i>providing there has been evidence in the tests:</i> <i>a positive test with limewater, or</i> <i>effervescence with dilute acid</i> or Identifies carbonate in FA 4 or FA 5 and refers to specific test for carbon dioxide and its result in the conclusion.	1	[1]

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Question	Sections	Indicative material	Mark	
(d)	PDO Recording	(i) All observations in a single table. Both reagents are required <i>There must be no repetition of "headings".</i>	1	
	MMO Collection	(ii) Reports addition of reagents to excess whenever a precipitate is formed on first addition of the reagent. (Minimum of 2 ppt)	1	
		(iii) white / off-white / buff / (light or pale) brown precipitate with solution from FA 3 . Precipitate insoluble in excess <u>with both reagents</u> and turning brown (light or pale brown precipitate darkening) recorded for at least one of the reagents	1	
		(iv) Give one mark for both observations. FA 4 – white precipitate – both reagents. soluble in excess NaOH; insoluble in excess NH ₃ (aq). and FA 5 – blue precipitate – both reagents. insoluble in excess NaOH; soluble in excess NH ₃ (aq) or colour goes to dark/deep blue. <i>Mark conclusions consequentially to observations.</i>	1	
	ACE Conclusions	(v) Expected cations: FA 3 (Mn ²⁺) and FA 5 (Cu ²⁺) <i>Minimum observations required:</i> <i>Mn²⁺ – off-white (buff, pale or light brown) ppt with each reagent but NOT from white ppt alone. Allow from white ppt turning brown.</i> <i>Cu²⁺ – blue ppt insoluble in excess NaOH or dark blue colour with aqueous NH₃</i>	1	
		(vi) Identifies Pb ²⁺ and Al ³⁺ as possible cations. (a single consequential ion is acceptable)	1	[6]

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Question	Sections	Indicative material	Mark	
(e)	MMO Decisions	<p>If no pair of ions is given in (d), no mark can be awarded in this section</p> <p><i>Mark consequentially</i></p> <p>Selects appropriate reagent to distinguish between any pair of cations identified in (d).</p> <p>For Pb^{2+}/Al^{3+} accept HCl, H_2SO_4 KI or chromate/dichromate</p> <p><i>The candidate should name a reagent, e.g. potassium dichromate.</i></p> <p><i>If $Cr_2O_7^{2-}$, or dichromate is given as the reagent the (aq) state symbol must also be given or reference made to an aqueous solution of the ions.</i></p>	1	[2]
	MMO Collection	<p><i>If selected reagent is suitable; mark consequentially for chosen reagent and Pb^{2+}.</i></p> <p>For Pb^{2+}/Al^{3+}</p> <p>FA 4 gives white precipitate with HCl and with H_2SO_4 and yellow precipitate with chromate/dichromate or iodide.</p> <p><i>Ignore any conclusion.</i></p>	1	
(f)	MMO Collection	<p>Observes as only reaction:</p> <p>FA 3 gives white precipitate with $Ba(NO_3)_2$ which is insoluble in dilute nitric acid,</p> <p>but</p> <p><i>Ignore any white ppt or cloudiness with FA 3 and silver nitrate, and</i></p> <p><i>ignore cation precipitates on adding $NH_3(aq)$</i></p>	1	[2]
	ACE Conclusions	<p><i>Accept a dash in the boxes for reaction of</i></p> <p>FA 3, FA 4 and FA 5 with barium nitrate and with silver chloride as evidence of “no reaction” with that reagent</p> <p>A conclusion that fits observations for</p> <p>(i) barium chloride with all solutions</p> <p>or</p> <p>(ii) silver nitrate with all solutions</p>	1	
Qn 2	Total			[14]