

**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.

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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	If the candidate has only performed one experiment the following points <u>only</u> can be awarded: (ii), (iii), (vi), (vii) and (x). (i) Single table recording observations for both experiments. Times at ½ minute intervals. (ii) Appropriate headings and units <i>Allow times in minutes (min) or seconds</i> (iii) All temps recorded to nearest 0.5 °C (Must be more than one at .5 as well as .0) (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 (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.	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	(vi) & (vii) 1st expt. Compare ΔT with Supervisor. award (vi) and (vii) if within 2 °C award (vii) only if >2 °C and ≤5°C (viii) & (ix) 2nd expt. Compare ΔT with Supervisor. award (viii) and (ix) if within 2 °C award (ix) only if >2 °C and ≤5°C (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 ≤1½ min.	2 2 1 1	[11]

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(c)	PDO Layout	Plots temperature on y-axis and time on x-axis and has at least one temperature and one time label (<i>ignore absent or incorrect units</i>) Scales used are linear and easy for the examiner to use, (3 or 4 min. per large square are acceptable) Scales should enable the temperature when zinc is added and <u>all</u> points after the addition of zinc to be plotted. <i>Points should be within a minimum of 5 large squares on temperature axis</i> If the candidate has recorded temperatures and times before zinc is added: Correctly plots on <u>each</u> graph: the last temperature/time, from results before zinc is added or the temperature and maximum temperature (<i>associated time not required</i>) If the candidate has only recorded the initial temperature of the solution: Correctly plots on <u>each</u> graph: the temperature when zinc is added and maximum temperature (<i>associated time not required</i>) Draws a cooling curve or straight line and projects the curve / line back to the time of mixing	1 1 1 1	[4]
	A completely horizontal line, drawn at the initial temperature can be accepted as equivalent to plotting of initial temperature.			
	If only one graph has been drawn, the 1 st and 2 nd marks may be awarded and one further mark if the initial and maximum temperatures are correctly plotted and there is an appropriate extrapolation.			
(d)	ACE Interpretation	For experiment 1: Correctly reads the temperature rise from the graph to within 1 °C of the value obtained from the graph by the examiner. If the value is incorrect for experiment 1, check value for experiment 2. Award mark if either value is correct.	1	[1]
(e)–(h)	PDO Display	Shows working in all sections attempted – <i>minimum of three sections required.</i> Significant figures in <u>final answers</u> . 2 or 3 sf in 1(e), 2 to 4 sf in 1(g), 3 sf only in 1(h) <i>minimum of three sections required.</i>	1 1	[2]
(e)	ACE Interpretation	Correctly calculates 2.0×10^{-2} mol of CuSO ₄ , and $\left(\frac{\text{mass zinc}}{65.4}\right)$ for each experiment. <i>Answers correctly rounded for the number of significant figures displayed.</i> Do not award this mark if there is an error in subtraction or there are missing balance readings in section (a).	1	[1]

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

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1 (a)	PDO Recording	Appropriate headings and units Balance readings <u>consistent</u> to 1 dp, to 2 dp or to 3 dp according to precision of balance used Examiner to check subtraction – do not penalise any error here – see section I(d)	1 1	[2]
(b)				
(c)	MMO Collection PDO Recording MMO Quality	(i) Total volume and temperature recorded for at least 2 different concentrations (ii) Total volume increased by 2.00 cm³ (± 0.10 cm³) for at least 3 different concentrations of solution Volumes must be recorded to 2 dp. (iii) Appropriate headings and units (iv) All temperatures recorded to 0.5 °C. Check mass of FB 1 on Supervisor and candidate scripts, particularly if Supervisor and candidate temperatures differ greatly. Round temperatures to nearest 0.5°C if necessary. Where there are repeated temperature readings, take the average correct to 1 decimal place (do not round). (v) & (vi) . Compare temperature at 14.00 cm³ with temperature recorded by the Supervisor. Award (v) & (vi) if within 2.5 °C Award (vi) only if temperature difference is > 2.5 °C and ≤ 5 °C (vii) & (viii) Compare temperature at 16.00 cm³ with temperature recorded by the Supervisor. Award (vii) & (viii) if within 2.5 °C Award (viii) only if temperature difference is > 2.5 °C and ≤ 5 °C	1 1 1 1 2 2	[8]

Acceptable form of units – illustrated for mass.

1. using the solidus. / g
2. using brackets. (g)
3. fully in words. mass of in grams
4. composite. mass of in g

Where the unit is not incorporated into the heading it must appear after every data entry.

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(d)	ACE Interpretation	Examiner to check solubility calculated for each volume of water. Use candidate's mass of FB 1 from (a). Correct rounding required for sig fig displayed. Give 2 marks if all four solubilities are correct. Give 1 of these 2 marks if three only are correct. <i>Deduct 1 mark from those to be awarded if</i> 1. <i>there is an error in subtraction in (a).</i> OR 2. <i>the mass recorded in (a) is less than 10 g or more than 30 g.</i> <u>No negative marks.</u>	2	[3]
	PDO Display	3 or 4 significant figures given in each answer given by the candidate	1	
(e)	PDO Layout	Plots solubility on y-axis and temperature on x-axis. Axes labelled (ignore incorrect or absent units) and points plotted over $\frac{1}{2}$ of each axis - (count large squares containing the points). <i>Consider</i> 1. Spread of the 4 experimental points alone or 2. Spread of the 4 experimental points and 42.5°C even if it is not possible to plot the point at 42.5 °C on the y-axis	1	[6]
	ACE Interpretation	Scales used are easy for examiner to use and enable all points to be plotted 4 °C/large square is acceptable. Penalise non-linear scales here. Correctly plots all solubility/temperature points. <i>Plotting to within $\frac{1}{4}$ small square – in the correct square.</i>	1	
		Attempts to draw a straight line or curve through plotted points (minimum of 3 points)	1	
		Plots appropriate curve through a minimum of 4 points. This is a mark for the quality of the line drawn and should be a <u>close</u> match to the plotted points. Look for: (i) good spread of points; (ii) even distribution of points either side of the line (3 on line, 1 off, OK); (iii) smooth curve or regular straight line	1	
		The solubility of FB 1 at 42.5 °C ($\pm \frac{1}{4}$ square) read from the graph. <i>Correct solubility recorded or correct solubility rounded to nearest gram recorded</i>	1	
(f)	ACE Conclusions	Give 1 mark for stating there is a higher solubility at higher temperature	1	[1]

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(g)	ACE Conclusions	States that process is endothermic. Uses knowledge of equilibria to explain why it is endothermic. e.g. Refers to absorption of <u>heat energy</u> to dissolve potassium nitrate or States that a rise in temperature shifts equilibrium to the right. (or words to that effect). <i>Beware answers that simply repeat information given in (f).</i>	1 1	[2]
(h)	ACE Interpretation	Give 1 mark for each acceptable source of inaccuracy. <i>Evaporation of water;</i> <i>Supercooling;</i> <i>Thermal time lag in thermometer;</i> <i>Difficulty in seeing crystals form;</i> <i>Time delay in seeing crystals and reading thermometer;</i> <i>Some solid forms on side of tube – not initial</i> FB 1; <i>Precision of thermometer;</i> not human error	2	[2]
(i)	ACE Improvement PDO Display	Outlines steps necessary to determine solubility, (<i>weigh solution, evaporate, weigh residue</i>) Shows working for calculating the solubility. $\frac{\text{mass of solid}}{(\text{mass of solution} - \text{mass of solid})} \times 100$ or $\frac{\text{mass of solid}}{\text{mass of water}} \times 100$	1 1	[2]
Qn 1	Total			[26]

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FB 2 is $\text{Fe}_2(\text{SO}_4)_3(\text{s})$; FB 3 is $\text{ZnO}(\text{s})/\text{Na}_2\text{SO}_3(\text{s})$; FB 4 is $\text{CaSO}_3(\text{s})$ [Na_2SO_3]				
2 (a)	MMO Collection	Observes: colourless solution with FB 4 , yellow, orange or brown solution with FB 2 . Describes <u>one</u> of the following <u>gas tests</u> :	1	[2]
	MMO Decisions	(i) Potassium dichromate(VI) used in testing for SO_2 with FB 3 or FB 4 . (orange to green in colour); (ii) Blue litmus turning red on warming with hydrochloric acid; (iii) Limewater used to test gas – no change in the limewater.	1	
(b)	PDO Recording MMO Collection	(i) All observations in a single table. <i>There must be no repetition of "headings".</i> (ii) Reports addition of reagents to excess whenever a precipitate is formed on first addition of the reagent. (iii) and (iv) Give 2 marks for correct observations for all 3 cations with both reagents <i>Give 1 of these 2 marks for 2 of the three observations correct.</i> FB 2 – red brown or brown ppt (insol in excess not required but <u>con</u> if either ppt is soluble in excess) with both reagents FB 3 – white ppt soluble in excess with both reagents FB 4 – no ppt with either reagent.	1 1 2	[5]
	ACE Conclusions	(v) Give one mark for conclusions that match observations. <u>minimum observation required</u> FB 2 – Fe^{3+} ; red-brown/brown colour of each precipitate FB 3 – Zn^{2+} ; white ppt with each reagent and ppt with NH_3 soluble in excess of aqueous ammonia FB 4 – two of Ba^{2+} or Ca^{2+} or NH_4^+ from no ppt with either reagent If conclusions fit observations for more than one pair of ions – allow this mark.	1	
(c)	MMO Decisions	Selects appropriate reagent to distinguish between <u>any</u> pair of cations identified in (b) . For $\text{Ba}^{2+}/\text{Ca}^{2+}$ – accept H_2SO_4 or chromate/dichromate; For $\text{Ba}^{2+}/\text{NH}_4^+$ – accept H_2SO_4 or chromate/dichromate or gas turns red litmus blue with NaOH (warming not required); For $\text{Ca}^{2+}/\text{NH}_4^+$ – accept gas turns red litmus blue with NaOH (warming not required)	1	[1]

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(d)	MMO Collection	Observes white ppt with BaCl_2 , soluble in HCl with FB 3 and FB 4 .	1	[3]
		Observes white; off-white or cream (but not yellow) ppt with BaCl_2 , and FB 2 and ppt insoluble on adding acid (ignore any colour change in the precipitate)	1	
	ACE Conclusion	Conclusion matching observations. Expected ions - sulfate in FB 2 , sulfite in FB 3 and FB 4 . <u>Formulae must be correct.</u>	1	
(e)	ACE Conclusion	Explains that BaCl_2 must be added first to form the precipitate (whose solubility is then tested with acid) or Addition of BaCl_2 to acidified solution will give no ppt even if sulfite present. <i>Allow wtte.</i>	1	[1]
(f)	MMO Collection	Observes one of the following when aqueous potassium iodide is added to the solution of FB 2 . A darker solution than in (a) if there is no reference to colour change; <i>Acceptable solution colours are in the range: yellow, orange, red-brown, brown (but not red).</i> accept red-brown or brown solution formed; accept grey or black precipitate AND blue, blue-black, black, purple colour (solution or solid) when starch is added.	1	[2]
	ACE Conclusion	Identifies FB 2 as an oxidant/oxidising agent or iodide as a reductant/reducing agent or converse.. or states that it is a redox reaction. <i>This mark can be given from either observation.</i>	1	
Qn 2	Total		[14]	

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1 (a)	PDO Layout MMO Collection	Three weighings recorded unambiguously (words needed) Mass used between 1.80 g and 2.00 g (for all experiments) Mass decreases after heating in a single experiment attempted (no repeat experiment allowed) (ignore heating to constant mass)	1 1 1	[3]
(b)	ACE Interpretation	Correct subtraction from experimental results in (a) for mass of water lost and for mass of residue (correct for any experiment attempted or for an average)	1	[1]
(c)	PDO Display ACE Interpretation	Shows working using values from (b) (can be ecf): $\frac{\text{mass of salt}}{151.9}$ and $\frac{\text{mass of water}}{18}$ or candidate's value of M_r Correct calculation of each value and must have between 2 and 4 sf and correct rounding (NO ecf from incorrect M_r but ecf allowed from masses used in first part)	1 1	[2]
(d)	ACE Interpretation PDO Display	Values from (c) shown in correct calculation or ratio or value of correct calculation showing dp and correct rounding for sf shown Value of x for fully correct answer given as an integer allow 0.5 to go up or down (ecf allowed) (If correct integer shown but no expression or calculation is shown award second mark only)	1 1	[2]

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(e)	PDO Layout PDO Recording	(i) Tabulates minimum of two pairs of burette readings or at least two titres (lines not needed) (ii) Records initial and final burette readings and volume of FA3 run from the burette (Do not award if readings inverted or final is 50. 50.0, 50.00 more than once, or initial value is 50.00) (iii) Appropriate headings and units for data given. (Only acceptable headings are: initial/final, first/second (burette) reading; reading at start/finish; volume added/used or <i>wwte</i>; titre. Only acceptable presentation of units is: solidus / cm^3; brackets (cm^3) or "volume in cubic centimetres" or "volume in cm^3") If units not included with heading, every entry in table must have a correct unit.	1	
	MMO Decisions MMO Quality	(iv) All burette readings other than that labelled rough recorded consistently (to nearest 0.05 cm^3) (v) Two uncorrected titres within 0.1 cm^3 (can include rough) (vi), (vii), (viii) and (ix) Check and correct titre subtractions where necessary. (If there are any showing greater precision than to 0.05, correct to the nearest 0.05 cm^3) Examiner selects the best mean titre (treat as accurate unless labelled rough or to fewer dp but if rough is ticked or selected by candidate it can be considered) and compared to Supervisor: Apply a hierarchy: 2 identical, titres within 0.05 cm^3, titres within 0.10 cm^3 etc. Award (vi), (vii), (viii) and (ix) for: a titre within 0.20 cm^3 Award (vi), (vii), (viii) only for: a titre of $0.20+ \text{ cm}^3$ to 0.30 cm^3 Award (vi) and (vii), only for: a titre of $0.30+ \text{ cm}^3$ to 0.50 cm^3 Award (vi) only for: a titre of $0.50+ \text{ cm}^3$ to 0.80 cm^3 Apply spread penalty as follows: titres selected by examiner differ > 0.2 but $\leq 0.5 \text{ cm}^3 = -1$; titres $> 0.5 \text{ cm}^3 = -2$ from the marks awarded in (vi) to (ix) (no negative marks). Apply a spread penalty of -2 if only one titration is performed or a single value is selected by examiner (e.g. rough + one other)	1 1 1 1 1 4	
	MMO Decisions	(x) Selects (and ticks) at least two titres for calculation of mean titre (some indication must be made of which ones used). The spread of any titres used must not exceed 0.20 cm^3 (continued)	1	

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(e) continued	PDO Display	(xi) Correct mean displayed to same number of decimal places as burette readings (If any burette reading is to 2 dp then mean to 2 dp; if two titres 0.05 apart then 0.025 or 0.075 is acceptable; similarly if titres recorded to 1 dp then 0.05; to no dp then to 0.5. If three titres used giving mean of 0.033... or 0.066... then allow mean to nearest 0.05)	1	[11]
(f)	ACE Interpretation	Maximum error for single reading of burette given as 0.05 cm ³ (even if readings recorded to 1 dp) Correct calculation to 2 sf (minimum) showing correct rounding of maximum % error $\frac{2 \times \text{candidate's error}}{\text{titre}} \times 100$ or allow $\frac{0.10}{\text{titre}} \times 100$ if 0.1 in first box.	1 1	[2]
(g)	ACE Conclusions	Mark (g) and (h) as a single unit (Mass loss is too high) Candidate suggests spitting or decomposition or overheating/heating too long (The latter will not gain any other mark unless a consequence of overheating is given.)	1	[1]
(h)	ACE Improvement	Use of lid or gentle heating (at first) – to reduce spitting/loss of solid or reduced temperature or heat for a shorter time – to prevent decomposition <u>Explains</u> that mass loss is too high or wtte (e.g. some solid spits out) and how modification will reduce this or a realisation that something other than water is lost.	1 1	[2]
Qn 1	Total			[24]

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FA 5 is NaNO₂(aq); FA 6 is NaCl (aq); FA 7 is KI; FA 8 is distilled water				
2 (a)	MMO Decisions	Chooses a named (dilute) strong acid to identify the nitrite (name could be in (b)). and Chooses silver nitrate or lead nitrate to identify the chloride and iodide (Ag ⁺ _(aq) or aqueous solution of silver ions accepted, ditto lead ions)		[1]
(b)	MMO Collection	(i) Records a brown gas from FA 5 and acid and no reaction with second reagent. (ii) Records a colourless or blue solution on adding acid to FA5 (iii) Records a white precipitate when Ag⁺ or Pb²⁺ is added to FA 6 and no reaction with acid (iv) Records a yellow precipitate when Ag⁺ or Pb²⁺ is added to FA 7 and no reaction with acid. If acid alone used and all four observations are correct (i) and (ii) and identity mark (v) can be awarded. If AgNO₃ or Pb(NO₃)₂ only used and all four observations are correct then can award (iii) and (iv) and identity mark (vi). If a white ppt is recorded with FA5 and all other observations are correct award (iii) and (iv) but then deduct one observation mark for the FA5 result. (Annotate the paper near the boxes.) Mark (vi) would be available to a candidate concluding both FA5 and FA6 are Cl⁻ and FA7 is I⁻. If a spurious reagent is chosen in (a) ignore and mark other (if correct) as single reagent. If three reagents are used, mark the observations for acid and the first of Ag⁺ or Pb²⁺ mentioned in (a). Deduct one mark (from (i) – (iv)) if erroneous observation with FA8 or test not done. A dash is similarly penalised (once, at the first opportunity)	1 1 1 1	
	ACE Conclusions	(v) and (vi) are consequent on observations (v) Identifies nitrite in FA 5 Allow from effervescence or bubbling from FA5 + acid only.	1	
		(vi) Identifies chloride in FA 6 (only, unless single reagent as above) and iodide in FA 7	1	
	ACE Interpretation	(vii) Gives appropriate evidence for identification of all three ions (consequential on observations) (Brown gas with acid + FA5 needed here.)	1	[7]
(c)	MMO Decisions	Add (aqueous) ammonia to the precipitate formed with silver nitrate or Add (aqueous) lead nitrate or silver nitrate (to a fresh sample of) the solution Do not penalise lack of (aq) with an ion if already penalised in (a)	1	[1]
Qn 2	Total			[9]

Page 6	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE A/AS LEVEL – October/November 2009	9701	33

Question	Sections	Indicative material	Mark	
FA 9 is Pb(NO₃)₂, FA 10 is K₂CrO₄				
3 (a)	MMO Collection	White ppt formed in tests (i) and (ii) and yellow ppt in test (v) (no variation on white; ppts not soluble in excess acid) Solution changes from yellow to orange (both colours and 'solution' needed) in (iii) (Solution) changes to green or blue (blue/green, cyan, turquoise but no orange or orange–brown as final colour) in (iv) Ignore state	1 1 1	[3]
(b)	ACE Conclusions	FA 9 contains the cation Pb ²⁺ or lead II (all three ppts must be in (a) but ignore any PbCl ₂ ppt redissolving; no Ba ²⁺ unless no ppt with HCl) (White) ppt with both HCl and H ₂ SO ₄ given as evidence or yellow ppt with FA10 named as chromate or CrO ₄ ²⁻	1 1	[2]
(c)	ACE Conclusions	States that ethanol is being oxidised or is reducing agent or reduces FA10 Ethanol oxidised to ethanal or alcohol oxidised to aldehyde or chromate VI reduced to chromium III or dichromate reduced to chromium III	1 1	[2]
Qn 3	Total			[7]

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

9701 CHEMISTRY

9701/34

Paper 34 (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.

CIE is publishing the mark schemes for the October/November 2009 question papers for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.



Page 2	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE A/AS LEVEL – October/November 2009	9701	34

Question	Sections	Indicative material	Mark	
1	(a) PDO Layout MMO Collection	Three weighings recorded unambiguously Mass used between 2.50 g and 2.70 g (for all experiments; checked by examiner) Mass decreases after heating in a single experiment (ignore heating to constant mass)	1 1 1	[3]
	(b) ACE Interpretation	Correct subtraction from experimental results in (a) for mass of water lost and for mass of residue (Correct for any experiment or for average)	1	[1]
	(c) PDO Display	Shows working using values in (b) (can be ecf): $\frac{\text{mass of salt}}{159.6}$ and $\frac{\text{mass of water}}{18}$ (or candidate's values for M_r) Correct calculation of each value and must have between 2 and 4 sf and correct rounding (NO ecf from incorrect M_r)	1 1	[2]
	(d) ACE Interpretation PDO Display	Values from (c) shown in correct calculation or ratio or correct evaluation from calculation (no calculation or ratio) showing dp and correct rounding for dp shown Value of x given as an integer allow 0.5 to go up or down. (Ecf allowed) Correct answer alone (integer) and no expression or calculation shown can only gain the second mark.	1 1	[2]
	(e) PDO Layout PDO Recording MMO Decisions MMO Quality	(i) Tabulates minimum of the burette readings or minimum of two titres (lines not needed) (ii) Records initial and final burette readings and volume of FB 3 run from burette (Don't award if readings inverted or final is 50, 50.0 or 50.00 more than once) (iii) Appropriate headings and units for data given. (<i>Only acceptable headings: initial/final or 1st/2nd (burette) reading; reading at start/finish; volume added; volume used; titre. Only acceptable presentation of units is solidus /cm³; brackets (cm³) or "volume in cubic centimetres" or "volume in cm³"</i>) If units not included with heading, every entry in table must have a correct unit. (iv) All burette readings other than that labelled "rough" recorded consistently to nearest .05cm ³ (v) Two uncorrected titres within 0.1 cm ³ (can include rough) (vi), (vii), (viii) and (ix) Check and correct titre subtractions where necessary. Examiner selects the best mean titre (treat as accurate unless labelled "rough" or to fewer dp) and compares to Supervisor: <i>Apply a hierarchy: 2 identical, titres within 0.05 cm³, titres within 0.10 cm³ etc.</i> Award (vi), (vii), (viii) and (ix) for: a titre within 0.20 cm ³	1 1 1 1 1 4	

Page 4	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE A/AS LEVEL – October/November 2009	9701	34

Question	Sections	Indicative material	Mark	
2 (a)	MMO Collection	(i) For FB 6 NaOH – a white ppt* insoluble in excess NH ₃ (aq) – white ppt insoluble in excess	1	
		(ii) For FB 7 NaOH – a white ppt soluble in excess NH ₃ (aq) – white ppt insoluble in excess	1	
		(iii) For FB 8 NaOH – a white ppt insoluble in excess NH ₃ (aq) – no precipitate	1	
	ACE Conclusions	(iv) FB 7 contains Al ³⁺	1	
		(v) FB 6 contains Mg ²⁺	1	
		(vi) FB 8 contains Ca ²⁺ ecf only for these ions and from white ppts only (iv), (v), (vi) cannot be awarded if any of the relevant observations are incorrect	1	
	ACE Interpretation	(vii) Gives appropriate evidence for identification of at least two ions (any 2). Minimum statement required: Al ³⁺ – (white) ppt soluble in excess NaOH; Mg ²⁺ – (white) ppt insoluble in excess NaOH and (white) ppt with NH ₃ ; Ca ²⁺ – no ppt with NH ₃ . No colour ppt other than white but colour of ppt may be taken from observations	1	[7]
(b)	MMO Decisions	Add (aqueous) barium chloride** (nitrate) and three correct observations	1	
	MMO Collection	Any white precipitate (from above) insoluble in HCl or HNO ₃ (Acid name may be in 1 st part of answer)	1	[2]
Qn 2	Total			[9]

*solid (formed)

**Ba²⁺_(aq) or aqueous barium ions

FB 9 is NaNO₃

Page 5	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE A/AS LEVEL – October/November 2009	9701	34

Question	Sections	Indicative material	Mark	
3 (a)	MMO Collection	Gas evolved relights a glowing splint in test (i) No reaction/no gas given off in test/only (see) solid dissolving (ii) <u>Gas</u> turning red litmus blue evolved on heating with NaOH and Aluminium foil in test (iii)	1 1 1	
	ACE Conclusion	Oxygen evolved or NO ₂ evolved from brown gas in (i) and ammonia gas evolved in (iii) based on correct observations (no ecf)	1	[4]
	(b) ACE Conclusions	Nitrogen and oxygen ecf allowed for (i) if also hydrogen from "pops with lighted splint"	1	[1]
	(c) ACE Conclusions	States that aluminium foil is a reductant/reducing agent	1	[1]
(d)	MMO Decisions	No reaction if nitrate Colourless gas, turning brown in air or brown gas if nitrite Link back to (b) if single ion given (e.g. if only NO ₃ ⁻ in (b) then give mark for "no reaction")	1	[1]
Qn 3	Total			[7]