

MARK SCHEME for the May/June 2007 question paper

9701 CHEMISTRY

9701/31

Paper 31 (Advanced Practical Skills 1),
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.

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Generic Mark Scheme for Papers 31 and 32

Skill		Breakdown of marks	
Manipulation, measurement and observation	16 marks	Successful <u>collection</u> of data and observations	8 marks
		<u>Decisions</u> relating to measurements or observations	8 marks
Presentation of data and observations	12 marks	<u>Recording</u> data and observations	5 marks
		<u>Display</u> of calculation and reasoning	3 marks
		Data <u>layout</u>	4 marks
Analysis, conclusions and evaluation	12 marks	<u>Interpretation</u> of data or observations and identifying sources of error	6 marks
		Drawing <u>conclusions</u>	5 marks
		Suggesting <u>improvements</u>	1 mark

Page 3	Mark Scheme	Syllabus	Paper
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Question	Sections	Indicative material	Mark	
1 (a)	(i) PDO Layout	Tabulates initial and final burette readings and volume added in each of the tables <i>Tabulation may be vertical or horizontal.</i> <i>Ignore absence of units</i> <i>Do NOT award this mark if any final and initial burette readings are inverted or 50 is used as the initial burette reading</i>	[1]	[6]
	(ii) PDO Recording	Both burette readings in the dilution table and <u>final and initial</u> burette readings for all accurate titres in the titration table recorded to the nearest 0.05 cm ³ . <i>Treat all titres as “accurate” unless labelled rough or 1st titre is to lower precision than subsequent titres</i>	[1]	
	(iii) MMO Collection	Follows instructions – Rough plus sufficient accurate titrations <i>Award this mark if there are three or more titres <u>OR</u> where two titres only have been recorded they are within 0.20 cm³ (neither labelled as rough).</i> <i>The first titre does not have to be labelled rough</i>	[1]	
	(iv) MMO Decisions	Has at least two uncorrected titres within 0.1 cm ³ Accuracy (v) and (vi) Give 2 marks if difference to Supervisor is 0.3 or less Give 1 of these two marks for a difference of 0.3+ to 0.5 Give 0 marks for a difference greater than 0.5	[1] [2]	
	(b) ACE Interpretation	Candidate selects/calculates appropriate “average” from any uncorrected titre values within 0.20 cm ³ .	[1]	
(c) (i) and (ii)	ACE Interpretation	Examiner checks each of the first four steps of the calculation. Award two marks if all steps are chemically correct. Withhold 1 mark for each chemical error – no negative marks. Count non-completed steps as chemical errors. $\frac{\text{vol diluted}}{1000} \times 0.50$ $\times \frac{\text{titre}}{250}$ $\times \frac{1}{2} \times \frac{1000}{25} \quad (\text{Potential 2 errors})$ $\times 106$	[2]	[5]
	(iii) PDO Display	Working shown in each step attempted	[1]	
	(iv)	3 or 4 significant figures in final answer given for each of the first four steps	[1]	
	(v)	Answer to last section is correctly evaluated to 3 sf using candidate's value to 4 th step. <i>(Answer may be from final answer to step 4 or use number carried on calculator)</i>	[1]	

Page 4	Mark Scheme	Syllabus	Paper
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Question	Sections	Indicative material	Mark	
(d)	ACE Interpretation	Smallest division correctly read from measuring cylinder and error estimated at $\frac{1}{2}$ smallest division	[1]	[2]
		Both % errors correctly calculated <i>[Award second mark ecf from smallest division and estimated error]</i>	[1]	
(e)	ACE Conclusions	Draws appropriate conclusion from (d) – supported by (experimental) evidence • compares consistency of two titres performed • comments on lower titre than in 1st experiment • compares % error for measuring cylinder and pipette • refers to liquid remaining in the measuring cylinder (allowed for in pipette) • measuring cylinder has large error – volumes added will vary (each time) leading to variable titres	[1]	[1]
(f)	ACE Improvement	Candidate suggests heating solution to drive off CO ₂ <i>(accept use of hot water only if linked to decreased solubility of carbon dioxide)</i>	[1]	[1]
			[Total: 16]	

Page 5	Mark Scheme	Syllabus	Paper
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Question	Sections	Indicative material	Mark	
2 (a)	PDO Layout	Tabulates all experimental readings for at least one experiment. (mass of empty weighing bottle, mass of bottle + solid, mass of bottle + residual solid, initial temperature, final temperature) and ΔT and m	[1]	[4]
	PDO Recording	Tabulated values are in a single table covering both experiments Table has correct labels and units (<u>only g and °C</u>)	[1] [1]	
	MMO Collection	All weighings recorded with consistent precision to at least 1 dp and all temperature readings recorded to 1 dp only.	[1]	
(b)	MMO Collection	Give one mark if difference between candidate's $\Delta T/m$ values, is within $0.1\text{ }^{\circ}\text{C g}^{-1}$	[1]	[2]
		Give one mark if the difference between mean $\Delta T/m$ value for Supervisor and closer $\Delta T/m$ value of candidate, is within $0.1\text{ }^{\circ}\text{C g}^{-1}$	[1]	
(c)	MMO Decisions	Candidate <u>refers to</u> his/her experimental values to arrive at an appropriate comment as to whether the experiment should be further repeated <i>[The answer must be based on the reliability (consistency) of the two experiments performed]</i>	[1]	[1]
(d)	ACE Interpretation	Examiner calculates to 3sf the mean $\Delta T/m$ value from the candidate's $\Delta T/m$ values for each experiment. Give 1 mark if the candidate's answer to (d) is within 1% of examiner calculated mean $\Delta T/m \times 61.59$.	[1]	[1]
			[Total: 8]	

Page 6	Mark Scheme	Syllabus	Paper
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Question	Sections	Indicative material	Mark	
FA 6 is solid basic zinc carbonate, FA 7 is solid copper(II) chloride				
3 (a)	PDO Layout	Tabulates observations for FA 6 and FA 7	[1]	[4]
	MMO Collection	Observes and records blue or green solution with FA 7 and colourless solution with FA 6	[1]	
	MMO Decisions	Selects lime water in test for gas with FA 6	[1]	
	ACE Conclusion	Identifies carbon dioxide as gas evolved from test with limewater <i>Evidence for CO₂ may also be found in the conclusion for the anion and can be awarded retrospectively</i>	[1]	
(b)	PDO Layout	Tabulates observations <i>This table should show clearly rows/columns for NaOH and NH₃ as reagents and FA 6/FA 7. The table does not need lines to be drawn – clearly laid out and headed blocks of text are acceptable</i>	[1]	[6]
	PDO Recording	All observations in a single table <i>The key feature to look for is reagent information – it should only appear once for each reagent and cover FA 6 and FA7</i>	[1]	
		Full observations for reagents to excess	[1]	
	MMO Collection	Records white ppt soluble in excess NaOH and excess NH ₃ for FA 6	[1]	
		For FA 7 records a blue ppt with NaOH and a <u>lighter/paler</u> blue ppt with ammonia	[1]	
		For FA 7 records (blue/white only) ppt soluble in excess ammonia to form a deep/dark blue <u>solution</u> .	[1]	

Page 7	Mark Scheme	Syllabus	Paper
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Question	Sections	Indicative material	Mark	
(c)	ACE Conclusions	Cation in FA 6 Summarises evidence for Zn^{2+} from solubility of white ppt in $\text{NH}_3(\text{aq})$ <i>Mark the conclusions for FA 6 consequentially for incorrect observations.</i> Cation in FA 7 Summarises evidence for Cu^{2+} from blue ppt with $\text{NaOH}(\text{aq})$ and $\text{NH}_3(\text{aq})$ or <u>deep/dark blue</u> colour of solution with excess $\text{NH}_3(\text{aq})$ Anion in FA 6 Summarises evidence for CO_3^{2-} from (a).	[1] [1] [1]	[3]
(d)	MMO Decisions	<i>Expected observations are required</i> Test 1 Selects AgNO_3 or other soluble silver salt to test for chloride Addition of $\text{Ag}^+(\text{aq})$ or a solution containing Ag^+ or silver(I) ions is acceptable Selects aqueous ammonia – added to ppt with NH_3 Test 2 Selects soluble lead salt e.g. $\text{Pb}(\text{NO}_3)_2$ as reagent Addition of $\text{Pb}^{2+}(\text{aq})$ or a solution containing Pb^{2+} or lead(II) ions is acceptable Give one of the last two marks if Ag^+ and Pb^{2+} only are given.	[1] [1] [1]	[3]
			[Total: 16]	

MARK SCHEME for the May/June 2007 question paper

9701 CHEMISTRY

9701/32

Paper 32 (Advanced Practical Skills 2),
maximum raw mark 40

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Skill		Breakdown of marks	
Manipulation, measurement and observation	16 marks	Successful <u>collection</u> of data and observations	8 marks
		<u>Decisions</u> relating to measurements or observations	8 marks
Presentation of data and observations	12 marks	<u>Recording</u> data and observations	5 marks
		<u>Display</u> of calculation and reasoning	3 marks
		Data <u>layout</u>	4 marks
Analysis, conclusions and evaluation	12 marks	<u>Interpretation</u> of data or observations and identifying sources of error	6 marks
		Drawing <u>conclusions</u>	5 marks
		Suggesting <u>improvements</u>	1 mark

Page 3	Mark Scheme	Syllabus	Paper
	GCE A/AS LEVEL – May/June 2007	9701	32

Question	Sections	Indicative material	Mark	
1 (a) (i)	PDO Layout	Tabulates initial and final burette readings and volume added in each of the tables <i>Tabulation may be vertical or horizontal.</i> <i>Ignore absence of units</i> <i>Do NOT award this mark if any final and initial burette readings are inverted or 50 is used as the initial burette reading</i>	[1]	
(ii)	PDO Recording	Both burette readings in the dilution table and <u>final and initial</u> burette readings for all accurate titres in the titration table recorded to the nearest 0.05 cm ³ . <i>Treat all titres as “accurate” unless labelled rough or trial</i>	[1]	
(iii)	MMO Collection	Follows instructions – Rough plus sufficient accurate titrations <i>Award this mark if there are three or more titres <u>OR</u> where two titres only have been recorded they are within 0.20 cm³ (neither labelled as rough).</i> <i>The first titre does not have to be labelled rough</i>	[1]	
(iv)	MMO Decisions	Has at least two uncorrected titres within 0.1 cm ³ Accuracy (v) and (vi) Give 2 marks if difference to Supervisor is 0.3 or less Give 1 of these two marks for a difference of 0.3+ to 0.5 Give 0 marks for a difference greater than 0.5	[1] [2]	[6]
(b)	ACE Interpretation	Candidate selects/calculates appropriate “average” from any uncorrected titre values within 0.20 cm ³ .	[1]	[1]
(c) (i)(ii)	ACE Interpretation	Examiner checks each of the first four steps of the calculation. Award two marks if all steps are chemically correct. Withhold 1 mark for each chemical error – no negative marks. Count non-completed steps as chemical errors. step 1 $\frac{\text{titre}}{1000} \times 0.0120$ step 2 $\times 5$ step 3 $\times \frac{1000}{25}$ step 4 $\times \frac{250}{\text{volume diluted}}$	[2]	
(iii)	PDO Display	Working shown in each step attempted	[1]	
(iv)		3 or 4 significant figures in final answer given for each of the first four steps	[1]	
(v)		Answer to last section is correctly evaluated to 4 sf for (candidate’s value to 4 th step $\times 392$). <i>(Answer may be from final answer to step 4 or using number carried on calculator).</i>	[1]	[5]

Page 4	Mark Scheme	Syllabus	Paper
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Question	Sections	Indicative material	Mark	
(d)	ACE Improvement	Candidate suggests heating solution to eliminate air OR suggests practical way of storing water without air re-dissolving • Storing in a full bottle (no air space) • Ignore and reference to vacuum (pump)	[1]	[1]
(e)	ACE Interpretation	Smallest division correctly read from burette and error estimated at $\frac{1}{2}$ smallest division <i>Burettes are graduated at 0.1 cm^3</i>	[1]	[1]
(f)	ACE Interpretation	Doubles error in reading to get maximum possible error	[1]	[1]
(g)	ACE Conclusions	Explains that errors are identical (in the same direction) (and cancel).	[1]	[1]
			[Total: 16]	

Page 5	Mark Scheme	Syllabus	Paper
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Question	Sections	Indicative material	Mark	
2 (a)	MMO Decisions	Calculates the minimum mass of NaHCO_3 needed to give an excess. (10.08 g) <i>Do not penalise rounding to 10.1 g if 10.08 has been shown in calculation</i>	[1]	[1]
(b)	PDO Layout	Tabulates all experimental readings: (mass of empty weighing bottle, mass of bottle + solid, mass of bottle + residual solid, initial temperature, final temperature) and ΔT .	[1]	[6]
	PDO Recording	Single table covering both experiments	[1]	
		Table has correct labels and units (<u>only g and °C</u>)	[1]	
	MMO Collection	All weighings recorded with consistent precision to at least 1 dp and all temperature readings recorded to 1 dp only	[1]	
		Give one mark if difference between (all) candidate's ΔT values, as calculated by the Examiner , is within 0.5 °C	[1]	
		Give one mark if the difference between mean ΔT value for Supervisor and closer/closest ΔT value of candidate, as calculated by the Examiner , is within 0.5 °C	[1]	
(c)	ACE Interpretation	Examiner calculates to 1 decimal place the mean ΔT value from the candidate's ΔT values for each experiment. Give 1 mark if the candidate's answer to (d) is within 1% of (examiner calculated mean $\Delta T \times 4.3$) and the correct sign (+) is given.	[1]	[1]
			[Total: 8]	

Page 6	Mark Scheme	Syllabus	Paper
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Question	Sections	Indicative material	Mark	
FB 6 is iron(III) chloride; FB 7 is chromium(III) iodide ($\text{CrCl}_3 / \text{KI}$); FB 8 is cobalt(II) sulphate				
3 (a) (i)	PDO Layout	Presents tests, <u>techniques</u> and observations clearly <i>To gain this mark there should be some reference in the table to washing at least one precipitate</i>	[1]	[7]
(ii)	PDO	All observations in a single table	[1]	
(iii)	Recording MMO Decisions	Selects silver nitrate or other soluble silver salt as reagent Addition of $\text{Ag}^+(\text{aq})$ or a solution containing Ag^+ or silver(I) ions is acceptable	[1]	
(iv)		Uses (aqueous) ammonia with the silver halide precipitates	[1]	
(v)		Filters or decants to obtain ppt (as soln is coloured not easy to see ppt) <i>Reference to separating precipitate and solution for at least one of FB 6 or FB 7</i>	[1]	
(vi)	MMO Collection	Records yellow ppt insoluble in ammonia with FB 7 and white ppt soluble in ammonia with FB 6	[1]	
(vii)	ACE Conclusions	Uses observations to make consequential deductions as to halide ions present. <i>Candidates should identify Cl^- in FB 6 and I^- in FB 7 (no halide in FB 8) but mark other halides correct providing observations are completely correct for these ions If AgNO_3 and $\text{Pb}(\text{NO}_3)_2$ selected as reagents <u>only</u> points (i), (ii), (iii) and (v) can awarded</i>	[1]	
(b)	MMO Decisions	Selects barium chloride or barium nitrate (Addition of $\text{Ba}^{2+}(\text{aq})$ or a solution containing Ba^{2+} or barium ions is acceptable] <u>and</u> hydrochloric (or nitric) acid as reagents <i>not sulphuric acid</i>	[1]	[3]
	MMO Collection	Records white ppt with BaCl_2 , insoluble in acid for <u>only FB 8 or</u> White ppt with BaCl_2 and no SO_2 (gas turning dichromate(VII) green) when FB 8 tested with HCl .	[1]	
	ACE Conclusion	Uses observations to make consequential conclusion for sulphate or sulphite if the white precipitate with BaCl_2 is observed to dissolve when acid is added Marks in this section may be awarded for testing a single solution providing $\text{Ag}^+(\text{aq})$ has been added to <u>all three solutions</u> and the halides identified If <u>sulphuric acid or an unspecified acid</u> is added after BaCl_2 , one mark maximum can be awarded in the section for a white ppt insoluble in acid. No marks if the acid is added before BaCl_2	[1]	

Page 7	Mark Scheme	Syllabus	Paper
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Question	Sections	Indicative material	Mark	
(c)	PDO Layout	Tabulates observations <i>[This table should show clearly rows/columns for NaOH and NH₃ as reagents and FB6/FB7/FB8. The table does not need lines to be drawn – clearly laid out and headed blocks of text are acceptable]</i>	[1]	[4]
	PDO Recording	All observations reported to reagent added in excess	[1] [1]	
	MMO Collection	Give one mark each for correct observations for <u>TWO</u> of the following FB 6 – (Fe ³⁺), FB 7 (Cr ³⁺), and FB 8 (Co ²⁺). FB 6 – <u>red-brown</u> /(brown/rusty) ppt, insoluble in excess with both NaOH and NH ₃ . FB 7 – <u>grey-green</u> ppt with NaOH and NH ₃ . ppt soluble in excess NaOH (to give a dark green solution) ppt insoluble in excess NH ₃ . FB 8 – blue ppt with NaOH, (possibly turning pink) or brown with excess of the reagent. The ppt is insoluble. Blue ppt with NH ₃ , expected to be insoluble in excess reagent of concentration used but (possibly dissolving to form a yellow/brown solution).	[1]	
(d)	ACE Conclusions	Correctly identifies and gives evidence for Fe ³⁺ in FB 6 Minimum evidence – red-brown ppt with NaOH and with NH ₃ Cr ³⁺ in FB 7 Minimum evidence – grey-green ppt with NaOH and with NH ₃ OR grey-green ppt with NaOH, soluble in excess to form a green solution	[1]	[2]
		Recognises transition metal cation from various colour changes of precipitates Where FB 8 is included as one of the identified ions (probably incorrectly as Cu ²⁺) <u>the transition metal cation may be awarded for Cr³⁺</u> from the colour of the precipitate with NaOH and NH ₃	[1]	
			[Total: 16]	