

MARK SCHEME for the October/November 2007 question paper

9701 CHEMISTRY

9701/31

Paper 31 (Practical 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.

All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

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 2007 question papers for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.



Page 2	Mark Scheme	Syllabus	Paper
	GCE A/AS LEVEL – October/November 2007	9701	31

Generic Mark Scheme

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 4	Mark Scheme	Syllabus	Paper
	GCE A/AS LEVEL – October/November 2007	9701	31

Question	Sections	Indicative material	Mark	
	Accuracy Calculate (vol of FA 1 x time) for expt 1 and the two additional expts with greatest volume of FA 1 . (<i>Round all times to the nearest second</i>) Record the Vt values against the appropriate expt on the candidate's script.			
1 (b) contd.	MMO Decisions	(viii) and (ix) Award both of these marks if two of the Vt values are within 10% of the larger of the closest pair. <i>[Award point (ix) but <u>not</u> point (viii) for a difference of 10+% to 20%]</i>	2	[11]
		(x) and (xi) Award both of these marks if candidate's time for expt 1 is within 10% of that obtained by the Supervisor. <i>[Award point (xi) but <u>not</u> point (x) for a difference of 10+% to 20%]</i>	2	
	Where experiment 1 has been repeated, assess accuracy using the time on page 3. Use the value on page 4 when checking the graph.			
1 (c)	PDO Layout	Ignore labels – check which numerical values have been plotted Ignore omission of negative signs; direction of numbers on axes etc.		
		Plots a rate ($1/t$ or $(\log 1/t)$) on y-axis and a concentration (volume of FA 1 or $(\log \text{volume of FA 1})$) on x-axis <i>If labels correct but numbers on scale indicate a different quantity do not award this mark</i>	1	
		Easy to use scales chosen with plotted points covering more than $\frac{1}{2}$ of each available axis	1	
		A point must be plotted for each experiment performed – <i>take care where expts 1&2 have been omitted from the main results table</i> All points plotted to within $\frac{1}{2}$ small square and in the correct half of a small square	1	

Page 6	Mark Scheme	Syllabus	Paper
	GCE A/AS LEVEL – October/November 2007	9701	31

Question	Sections	Indicative material	Mark	
1 (e)	ACE Interpretation	Explains that uncertainty is less when change is rapid (or converse) Estimated errors expt 1 number of seconds ≤ 3 s. expt 2 number of seconds ≥ 3 s, up to a maximum of 10 s. error for expt 2 > error for expt 1 Candidate's uncertainties correctly expressed as % of reaction time. Error may be carried forward.	1 1 1	[3]
1 (f)	ACE Improvements	Has: constant volumes of FA 1, variable volume of FA 2, water to keep total volume constant at 55 cm³ Record the total volume for each experiment to the left of the table.	1	[1]
1 (g)	PDO Display	Uses experimental data to make appropriate comment, from experimental results, as to how rate varies with acid concentration. <i>[Do not give this mark where mixtures selected in (f) are not appropriate]</i> <i>Little change in reaction time is expected. The rate increases slightly as the concentration of acid is doubled etc.</i> <i>Where an acceptable qualitative statement has been given ignore any incorrect attempt at a quantitative/mathematical expression.</i>	1	[1]
			Qn 1 Total 25	

Page 7	Mark Scheme	Syllabus	Paper
	GCE A/AS LEVEL – October/November 2007	9701	31

Question	Sections	Indicative material	Mark	
FA 3 is aqueous ammonium sulphite (<i>ammonium chloride + sodium sulphite</i>), FA 4 is aqueous sodium nitrite, FA 5 is aqueous barium nitrate, FA 6 is aqueous manganese(II) sulphate,				
2 (a)	MMO Decisions	Chooses named dilute acid as single reagent for identifying nitrite and chooses BaCl_2 / $\text{Ba}(\text{NO}_3)_2$ ($\text{Ba}^{2+}(\text{aq})$ or aqueous solution containing Ba^{2+} acceptable) together with HCl/HNO_3 (not H_2SO_4) as reagents for identifying sulphate/sulphite	1	[1]
2 (b)	MMO Collection	Award the C3 marks only from observations in the table. No retrospective marks. Give one mark for a brown gas evolved from FA 4 with any acid Give one mark for one of the following for FA 6: 1. a white ppt with Ba^{2+} insoluble in hydrochloric or nitric acid, 2. a white ppt with Ba^{2+} insoluble in unnamed acid, 3. precipitate whose colour has not been described insoluble in named acid other than H_2SO_4 Give one mark for one of the following for FA 3: 1. a white ppt with Ba^{2+} soluble in hydrochloric or nitric acid, 2. a white ppt with Ba^{2+} soluble in unnamed acid, 3. precipitate whose colour has not been described soluble in named acid other than H_2SO_4 <i>If sulphuric acid is <u>stated in the table in (b)</u> award one observation mark only, if the barium salt is added <u>before</u> the acid and a white ppt is obtained with FA 6 and with FA3.</i> OR Give one mark for adding HCl/HNO_3 and <u>detecting SO_2</u> (dichromate turning green) from FA 3 Give one mark for adding $\text{Ba}^{2+}(\text{aq})$ and observing a white ppt with FA 6 and no ppt with FA 3. <i>Do not give the first of these marks if dichromate is added to the acidified mixture (additional reagent) but allow conclusions from that test)</i>	1 1 1 (1) (1)	

Page 8	Mark Scheme	Syllabus	Paper
	GCE A/AS LEVEL – October/November 2007	9701	31

Question	Sections	Indicative material	Mark	
2 (b) contd	ACE Conclusions	Give one mark each if the ions are correctly identified (No evidence is required in this section for the identification of the ions) Mark conclusions consequentially to observations FA 4 – nitrite FA 6 – sulphate FA 3 – sulphite		1 1 1
	ACE Interpretation	Gives appropriate evidence for identification of two of the ions. This mark can be awarded for <u>correct</u> anions where no observations are tabulated.		1 [7]
2 (c)	MMO Collection	FA 6 – observes off-white ppt insoluble in excess with both NaOH and NH ₃ (aq)	1	
		FA 5 – observes white ppt in (iii) and white ppt soluble in HCl in (iv) <i>Ignore any ppt with NaOH/NH₃.</i>	1	
		FA 3 – positive test for alkaline <u>gas</u> described with FA 3 only .	1	[3]
2 (d)	ACE Conclusions	Give two marks if all ions are correctly identified. FA 6 – Mn ²⁺ (from off-white ppt with NaOH and NH ₃ (aq)) or off white ppt with NaOH or NH ₃ (aq) soluble in excess) FA 5 – Ba ²⁺ (if observation mark given in (c) or white ppt with H ₂ SO ₄ and no ppt with NH ₃ (aq)) FA 3 – NH ₄ ⁺ (from ammonia/alkaline gas on warming with NaOH) <i>Give one of these two marks for 2 correct ions Mark conclusions consequentially to observations, e.g. Fe³⁺ from brown ppt for FA 6. Do <u>not</u> allow Ca²⁺ or Mg²⁺ in place of Ba²⁺.</i>	1 1	
	ACE Interpretation	Gives appropriate evidence (minimum – as above) for identification of two of the ions. Evidence for Ca ²⁺ (from reaction with OH ⁻) may be allowed here	1	[3]
	If a candidate does not record any practical work for sections (iii) and (iv), ions such as Ca ²⁺ , Mg ²⁺ or Zn ²⁺ may be credited from appropriate observations with NaOH and NH ₃ (aq)			
2 (e)	MMO Decisions	Selects CrO ₄ ²⁻ or Cr ₂ O ₇ ²⁻ as additional reagent (No cation or “aqueous ion” required)	1	[1]
			Qn 2 Total 15	

MARK SCHEME for the October/November 2007 question paper

9701 CHEMISTRY

9701/32

Paper 32 (Practical 2), 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.

All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

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 2007 question papers for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.



Page 2	Mark Scheme	Syllabus	Paper
	GCE A/AS LEVEL – October/November 2007	9701	32

Generic Mark Scheme

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 – October/November 2007	9701	32

Question	Sections	Indicative material	Mark	
Round all recorded times in Supervisor and candidate scripts to the nearest second. List on the Supervisor's script the rounded times for experiments 1 and 2 for each candidate.				
1 (a)	MMO Collection	Performs experiments and records times for each reaction. Follows instructions. Award this mark if the reaction time for experiment 2 is within 20% of that obtained for experiment 2 by the Supervisor (or the majority of candidates in the Centre).	1 1	[2]
1 (b)	PDO Recording	(i) Single table for all experiments performed. <i>(Experiments 1 and 2 must be included; minimum for table is volume and time for experiments 1 and 2)</i> <i>A single table has no repetition of headings.</i> (ii) Table has been drawn up in advance. <i>(must have minimum of 4 experiments tabulated)</i> – does not have to include experiments 1 and 2) – volumes of FB 4 are sequential. Experiments 1 and 2 may be entered first or last. (iii) Table includes columns for volume of FB 4 or log(volume of FB 4), time, $1/t$ or $\log(1/t)$. <i>Ignore other columns</i> <i>or if total volume in experiment $\neq 81$</i> (iv) Ignore log columns All other columns correctly labelled with <u>appropriate unit</u> (2007 syllabus). Accept t but not T for time heading Accept cm^3, dm^3, s, s^{-1}, $1/\text{s}$ as units for units accept: <i>unit after solidus, unit in bracket or in words e.g. / cm^3; (cm^3) or volume in cubic centimetres</i> but not volume cm^3 <i>If the unit is not included in the column heading, every entry in the column must have a unit.</i> (v) All times recorded to nearest second	1 1 1 1 1	

Page 4	Mark Scheme	Syllabus	Paper
	GCE A/AS LEVEL – October/November 2007	9701	32

Question	Sections	Indicative material	Mark	
	Accuracy Calculate (vol of FB 4 x time) for experiment 1 and the two additional experiments with greatest volume of FB 4 . (<i>Round all times to the nearest second</i>) Record the Vt values against the appropriate experiment on the candidate's script.			
1 (b) contd.	MMO Decisions	(vi) At least 3 mixtures – in addition to experiment 1 and experiment 2.	1	[11]
		(vii) Volumes of FB 4 chosen are uniformly spaced over the whole range	1	
		(viii) and (ix) Award both of these marks if two of the Vt values are within 10% of the larger of the closest pair. <i>[Award point (ix) but <u>not</u> point (viii) for a difference of 10+% to 20%]</i>	2	
		(x) and (xi) Award both of these marks if candidate's time for experiment 1 is within 10% of that obtained by the Supervisor. <i>[Award point (xi) but <u>not</u> point (x) for a difference of 10+% to 20%]</i>	2	
	Where experiment 1 has been repeated, assess accuracy using the time on page 3. Use the value on page 4 when checking the graph.			
1 (c)	PDO Layout	Ignore labels – check which numerical values have been plotted Ignore omission of negative signs; direction of numbers on axes etc.		
		Plots a rate ($1/t$ or $(\log 1/t)$) on y-axis and a concentration (volume of FB 4 or $(\log \text{volume of FB 4})$) on x-axis <i>If labels correct but numbers on scale indicate a different quantity do not award this mark</i>	1	
		Easy to use scales chosen with plotted points covering more than $\frac{1}{2}$ of each available axis	1	

Page 5	Mark Scheme	Syllabus	Paper
	GCE A/AS LEVEL – October/November 2007	9701	32

Question	Sections	Indicative material	Mark	
1 (c) contd.	PDO Layout	A point must be plotted for each experiment performed – <i>take care where experiments 1 and 2 have been omitted from the main results table)</i> All points plotted to within ½ small square and in the correct half of a small square	1	[4]
		Appropriate straight line drawn through the points. (<i>This does not have to be a “best-fit” line but must show correlation to the points plotted. Do not award this mark if there is clearly a better line that could have been drawn through the points)</i> A minimum of three points that lie close to the line are required – <i>no anomalous point is permitted where three points only have been plotted.</i> Do not award this mark if the line is drawn through points “bunched” in less than 20 x 20 small squares.	1	
		If a candidate has only performed experiments 1 and 2 or if data has only been plotted for 2 experiments, points L4, L5 and L6 but not L7 can be awarded.		
1 (d)	PDO Display	Construction lines drawn on the graph. <i>The hypotenuse of the constructed “triangle” should cover at least half of the length of the line drawn by the candidate.</i>	1	[3]
		Correctly reads (to nearest ½ small square) the coordinates from the graph <i>Accept values from the table if the line is drawn through the point.</i> <i>Do not penalise reuse of values for an incorrectly plotted point</i>	1	
	ACE Interpretation	Calculates gradient correctly to at least 1 decimal place using the values read from the graph by the candidate.	1	
		Where data for two experiments only has been plotted, the Display marks only may be awarded. Do not award the Display mark for reading coordinates if either value is taken from the table.		

Page 6	Mark Scheme	Syllabus	Paper
	GCE A/AS LEVEL – October/November 2007	9701	32

Question	Sections	Indicative material	Mark	
1 (e)	ACE Interpretation	Give one mark for an error of $\pm 0.25 \text{ cm}^3$ when reading a 25 cm^3 measuring cylinder Estimated and % errors 20 cm^3 in 25 cm^3 measuring cylinder: Correct % for error above. 1.00 cm^3 in burette: <i>single burette reading</i> 0.05 cm^3 or 0.10 cm^3 <i>two burette readings</i> 5% or 10% 20.00 cm^3 in burette: <i>single burette reading</i> 0.05 cm^3 or 0.10 cm^3 <i>two burette readings</i> 0.25% or 0.5% Consequential on calculations. <i>Measuring 1.00 cm^3 from burette should be most significant error.</i>	1 1 1	[3]
1 (f)	ACE Improvements	Has: Volume of FB 4 $< 20 \text{ cm}^3$, variable volume of water, water to keep total combined volume (FB 4 and water) constant at 40 cm^3. Record the volume of (FB 4 + water) for each experiment to the left of the table.	1	[1]
1 (g)	PDO Display	Uses experimental data to make appropriate comment, from experimental results, as to how rate varies with concentration of KI. <i>[Do not give this mark where mixtures selected in (f) are not appropriate, i.e. the volume of (FB 4 + water) $\neq 40 \text{ cm}^3$]</i> <i>Where an acceptable qualitative statement has been given ignore any incorrect attempt at a quantitative/mathematical expression.</i>	1	[1]
Qn 1	Total		25	

Page 7	Mark Scheme	Syllabus	Paper
	GCE A/AS LEVEL – October/November 2007	9701	32

Question	Sections	Indicative material	Mark																								
FB 5 is aqueous nickel(II) sulphate, FB 6 is aqueous copper(II) chloride, FB 7 is aqueous chromium(III) chloride, FB 8 is solid 2-hydroxybenzoic acid (salicylic acid)																											
2 (a)	MMO Decisions	Chooses BaCl ₂ /Ba(NO ₃) ₂ and HCl/HNO ₃ (not H ₂ SO ₄) as reagents	1	[3]																							
	MMO Collection	Records white ppt with BaCl ₂ , insoluble in HCl for FB 5 only (obs for FB 6 and FB 7 not required) <i>If acid is not specified – give this mark only if barium salt is added before the acid</i>	1																								
	ACE Conclusion	Concludes that FB 5 contains the sulphate ion Allow deduction from addition of barium salt without addition of acid <i>If no observations recorded this mark can be awarded if it is clear that the barium salt and appropriate acid are added to all three solutions.</i>	1																								
2 (a) alt	MMO Decisions	Chooses AgNO ₃ and aqueous ammonia	1																								
	MMO Collection	Records white ppt with AgNO ₃ , soluble in aqueous ammonia for FB 6 and FB 7 (obs for FB 5 not required)	1																								
	ACE Conclusion	Concludes that FB 5 contains the SO ₄ ²⁻ ion (by elimination) <i>Allow deduction from addition of silver salt without addition of aqueous ammonia</i>	1																								
2 (b)	MMO Collection	Give one mark for the following observations on adding <table><tr><td></td><td>NH₃</td><td>NaOH</td></tr><tr><td>FB 5</td><td>green ppt</td><td>green ppt</td></tr><tr><td>FB 6</td><td>blue ppt</td><td>blue ppt</td></tr><tr><td>FB 7</td><td>grey-green ppt</td><td>grey-green ppt</td></tr></table> Give one mark for the following observations on adding excess reagent (excess is needed in recorded observation except where no ppt is recorded, correctly or incorrectly, on first addition of reagent) <table><tr><td></td><td>NH₃</td><td>NaOH</td></tr><tr><td>FB 5</td><td>(soluble) – blue solution</td><td>insoluble</td></tr><tr><td>FB 6</td><td>(soluble) – dark blue solution</td><td>insoluble</td></tr><tr><td>FB 7</td><td>insoluble</td><td>(soluble) – dark green solution</td></tr></table> Where only one reagent has been used, one of the C3 marks above may be awarded for fully correct observations on adding the reagent to excess.		NH ₃	NaOH	FB 5	green ppt	green ppt	FB 6	blue ppt	blue ppt	FB 7	grey-green ppt	grey-green ppt		NH ₃	NaOH	FB 5	(soluble) – blue solution	insoluble	FB 6	(soluble) – dark blue solution	insoluble	FB 7	insoluble	(soluble) – dark green solution	1
			NH ₃	NaOH																							
FB 5	green ppt	green ppt																									
FB 6	blue ppt	blue ppt																									
FB 7	grey-green ppt	grey-green ppt																									
	NH ₃	NaOH																									
FB 5	(soluble) – blue solution	insoluble																									
FB 6	(soluble) – dark blue solution	insoluble																									
FB 7	insoluble	(soluble) – dark green solution																									

Page 8	Mark Scheme	Syllabus	Paper
	GCE A/AS LEVEL – October/November 2007	9701	32

Question	Sections	Indicative material	Mark	
2 (b) contd	ACE Conclusions	FB 7 contains Cr^{3+} FB 6 contains Cu^{2+}	1 1	[5]
	ACE Interpretation	Gives appropriate evidence for identification of the ions Minimum evidence for Cu^{2+} blue ppt with NaOH and with $\text{NH}_3(\text{aq})$ or dark blue solution with excess $\text{NH}_3(\text{aq})$ Minimum evidence for Cr^{3+} grey-green ppt with NaOH and with $\text{NH}_3(\text{aq})$ or dark green solution with excess NaOH	1	
2 (c) (i) (ii) (iii)	MMO Decisions	Describes test for hydrogen	1	
	MMO Collection	Records a positive test for hydrogen Hydrogen/ H_2 identified from “pop” alone	1	
	MMO Collection	(Solid dissolves in NaOH), white ppt on adding HCl, dissolves (again) in NaOH <i>Allow his mark if precipitate intensifies on adding acid and diminishes on adding NaOH</i>	1	
	MMO Collection	Evidence (from smell) of ester formation. <i>Accept linament, hospital, antiseptic smell but not sweet or fruity</i>	1	
	ACE Conclusions	Give one mark for concluding that FB 8 is an acid or solution is acidic	1	
		Give one mark for (aromatic) organic acid or carboxylate/carboxylic functional group	1	
	ACE Interpretation	Give one mark for any evidence supporting the conclusion of an acid/organic acid – flammable gas from reaction with magnesium, – solubility in NaOH; insolubility in HCl – ester formation (<i>allow from sweet or fruity smell</i>)	1	
Qn 2	Total		15	[7]