

**MARK SCHEME for the October/November 2011 question paper
for the guidance of teachers**

9701 CHEMISTRY

9701/31

Paper 3 (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, 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.

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

Cambridge is publishing the mark schemes for the October/November 2011 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 AS/A LEVEL – October/November 2011	9701	31

Question	Sections	Indicative material	Mark	
1 (a)	PDO Recording	I Thermometer readings for all experiments recorded to 0.0 or 0.5°C. (At least one recorded to 0.5°C.)	1	[7]
	ACE Interpretation	II Calculation of all temperature changes correct.	1	
	MMO Quality	Award III for a temperature rise followed by constant temperature (within 0.5°C).	1	
		Award IV and V for a maximum rise within 0.5°C of supervisor.	1	
		Award IV for a maximum rise within 1.0°C of supervisor.	1	
		Award VI and VII for the experiment 3 temperature rise within 0.5°C of supervisor.	1	
(b)	PDO Layout	Award VI for the experiment 3 temperature rise within 1.0°C of supervisor.	1	[4]
		I Axes correct and labelled: temperature change/ T change/ ΔT and volume/vol/V (of) sodium hydroxide/NaOH/ FA 1 and correct units /°C or (°C) or 'in °C'; /cm ³ or (cm ³) (allow NaOH in cm ³)	1	
		II Scales chosen so that graph occupies at least half the available length for x- and y-axes.	1	
		III Plotting – all points accurate to within half a small square and in the correct square.	1	
(c)	ACE Interpretation	IV Draws two straight lines of best fit which intersect.	1	[1]
		Reads to nearest ½ square to 1 or 2 dp volume of FA 1 and temperature rise from intercept. Do not award if ΔT at intercept (or point) < max ΔT from table unless candidate has clearly indicated the max ΔT is anomalous.	1	

Page 3	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE AS/A LEVEL – October/November 2011	9701	31

(d)	ACE Conclusions	I The temperature/temperature change increases as more reaction/more hydrochloric acid/sodium hydroxide reacts/as more water formed. II The temperature/temperature change stays constant/decreases when all acid/limiting reagent has reacted/excess NaOH is added.	1 1	[2]
(e)	ACE Interpretation	I Volume used in calculation is 65 cm³ II Heat energy change calculated using candidate's value for ΔT correct to 3 or 4 sf	1 1	[2]
(f)	ACE Interpretation	$\frac{25 \times 2}{1000} = 0.05$	1	[1]
(g)	ACE Interpretation PDO Display	I <u>Candidate's answer to (e)</u> Candidate's answer to (f) II Correct calculation, conversion J to kJ and negative sign to 3 or 4 sf	1 1	[2]
(h)	ACE Conclusions	So that rise in temperature is proportional to increase in energy produced/change in volume gives different change in temperature for same energy produced/increase in volume requires increase in energy for same temperature rise.	1	[1]
(i)	PDO Display ACE Interpretation	I Number moles NaOH = number moles HCl (stated or clearly shown) II Calculates or expression for Concentration = $\frac{0.05 \text{ (ecf from (f))}}{\text{answer to (c)}/1000}$ If answer only, award mark if correct to 3 or 4 sf	1 1	[2]
(j)	ACE Improvements	Use more concentrated solutions. (allow use ≤ 5 cm ³ water each time) Ignore all references to heat energy losses.	1	[1]
(k)	ACE Conclusions	I Two straight intersecting lines (positive followed by zero gradient). II Same ΔT and V shown as in (b).	1 1	[2]
[Total: 25]				

Page 4	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE AS/A LEVEL – October/November 2011	9701	31

FA 3 is Na ₂ S ₂ O ₅ (s); FA 4 is Na ₂ CO ₃ (s); FA 5 is Na ₂ SO ₄ (s); FA 6 is Pb(NO ₃) ₂ (s) and (aq)				
2 (a)	MMO Decisions	(i) I Any named mineral acid or formula or (acidified) potassium dichromate Do not allow any reagent suitable for testing cations or more than one reagent.	1	[6]
	PDO Recording	(ii) II Tabulates evidence of 3 tests carried out with no repeat headings. Only consider observations with acid or dichromate.	1	
	MMO Collection	III Bubbles/effervescence in FA 4 .	1	
		IV Slower effervescence in FA 3 than FA 4 or FA 3 turns green and FA 5 stays orange if dichromate used.	1	
	MMO Decisions	V Appropriate test with positive result used to test for either gas.	1	
	ACE Conclusions	VI All three ions correct from suitable observations. FA3 is a sulfite. FA4 is a carbonate. FA5 is a sulfate. (or correct formulae)	1	
(b)	MMO Collection	(i) I FA 4 + FA 6 white ppt and FA 5 + FA 6 white ppt. II FA 6 + NaOH white ppt, soluble in excess sodium hydroxide. III Brown gas IV Gas relights glowing splint. V Yellow residue or crackling/decrepitating. VI Gas identified as oxygen or as NO ₂ from observations.	1	[6] [1] [2]
	ACE Conclusions	(ii) Lead/Pb ²⁺ provided correct observations with FA 6 + NaOH and FA 6 + FA 5 (sulfate).	1	
	ACE Conclusions	(iii) I Add HCl / H ₂ SO ₄ / KI / K ₂ CrO ₄ / NH ₃ *	1	
	MMO Decisions	II white ppt/white ppt/yellow ppt/yellow ppt/white ppt insoluble in excess. * If not Pb ²⁺ in (ii) but one of Al ³⁺ , Ba ²⁺ , Ca ²⁺ , Zn ²⁺ allow suitable reagent mark: K ₂ CrO ₄ for Ba ²⁺ and NH ₃ for the other three. However, observation must be correct for Pb²⁺ .	1	
	MMO Collection			
[Total: 15]				

**MARK SCHEME for the October/November 2011 question paper
for the guidance of teachers**

9701 CHEMISTRY

9701/33

Paper 3 (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, 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.

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

Cambridge is publishing the mark schemes for the October/November 2011 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 AS/A LEVEL – October/November 2011	9701	33

Question	Sections	Indicative material	Mark	
1 (a)	PDO Recording	I Thermometer readings for all experiments recorded to 0.0 or 0.5°C. (At least one recorded to 0.5°C.)	1	[7]
	ACE Interpretation	II Calculation of all temperature changes correct.	1	
	MMO Quality	Award III for a temperature rise followed by constant temperature (within 0.5°C).	1	
		Award IV and V for a maximum rise within 0.5°C of supervisor.	1	
		Award IV for a maximum rise within 1.0°C of supervisor.	1	
		Award VI and VII for the experiment 3 temperature rise within 0.5°C of supervisor.	1	
		Award VI for the experiment 3 temperature rise within 1.0°C of supervisor.	1	
(b)	PDO Layout	I Axes correct and labelled: temperature change/ T change/ ΔT and volume/vol/V (of) sodium hydroxide/NaOH/ FA 1 and correct units /°C or (°C) or 'in °C'; /cm ³ or (cm ³) (allow NaOH in cm ³)	1	[4]
		II Scales chosen so that graph occupies at least half the available length for x- and y-axes.	1	
		III Plotting – all points accurate to within half a small square and in the correct square.	1	
		IV Draws two straight lines of best fit which intersect.	1	
(c)	ACE Interpretation	Reads to nearest ½ square to 1 or 2 dp volume of FA 1 and temperature rise from intercept. Do not award if ΔT at intercept (or point) < max ΔT from table unless candidate has clearly indicated the max ΔT is anomalous.	1	[1]

Page 3	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE AS/A LEVEL – October/November 2011	9701	33

(d)	ACE Conclusions	I The temperature/temperature change increases as more reaction/more hydrochloric acid/sodium hydroxide reacts/as more water formed.	1	[2]
		II The temperature/temperature change stays constant/decreases when all acid/limiting reagent has reacted/excess NaOH is added.	1	
(e)	ACE Interpretation	I Volume used in calculation is 65 cm ³	1	[2]
		II Heat energy change calculated using candidate's value for ΔT correct to 3 or 4 sf	1	
(f)	ACE Interpretation	$\frac{25 \times 2}{1000} = 0.05$	1	[1]
(g)	ACE Interpretation	I <u>Candidate's answer to (e)</u> Candidate's answer to (f)	1	[2]
	PDO Display	II Correct calculation, conversion J to kJ and negative sign to 3 or 4 sf	1	
(h)	ACE Conclusions	So that rise in temperature is proportional to increase in energy produced/change in volume gives different change in temperature for same energy produced/increase in volume requires increase in energy for same temperature rise.	1	[1]
(i)	PDO Display	I Number moles NaOH = number moles HCl (stated or clearly shown)	1	[2]
	ACE Interpretation	II Calculates or expression for Concentration = $\frac{0.05 \text{ (ecf from (f))}}{\text{answer to (c)}/1000}$ If answer only, award mark if correct to 3 or 4 sf	1	
(j)	ACE Improvements	Use more concentrated solutions. (allow use $\leq 5 \text{ cm}^3$ water each time) Ignore all references to heat energy losses.	1	[1]
(k)	ACE Conclusions	I Two straight intersecting lines (positive followed by zero gradient).	1	[2]
		II Same ΔT and V shown as in (b).	1	
	[Total: 25]			

Page 4	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE AS/A LEVEL – October/November 2011	9701	33

FA 3 is Na ₂ S ₂ O ₅ (s); FA 4 is Na ₂ CO ₃ (s); FA 5 is Na ₂ SO ₄ (s); FA 6 is Pb(NO ₃) ₂ (s) and (aq)				
2	(a)	MMO Decisions	(i) I Any named mineral acid or formula or (acidified) potassium dichromate Do not allow any reagent suitable for testing cations or more than one reagent.	1
		PDO Recording	(ii) II Tabulates evidence of 3 tests carried out with no repeat headings. Only consider observations with acid or dichromate.	1
		MMO Collection	III Bubbles/effervescence in FA 4 .	1
			IV Slower effervescence in FA 3 than FA 4 or FA 3 turns green and FA 5 stays orange if dichromate used.	1
		MMO Decisions	V Appropriate test with positive result used to test for either gas.	1
		ACE Conclusions	VI All three ions correct from suitable observations. FA3 is a sulfite. FA4 is a carbonate. FA5 is a sulfate. (or correct formulae)	1
				[6]
(b)		MMO Collection	(i) I FA 4 + FA 6 white ppt and FA 5 + FA 6 white ppt.	1
			II FA 6 + NaOH white ppt, soluble in excess sodium hydroxide.	
			III Brown gas	
			IV Gas relights glowing splint.	
			V Yellow residue or crackling/decrepitating.	
		ACE Conclusions	VI Gas identified as oxygen or as NO ₂ from observations.	
		ACE Conclusions	(ii) Lead/Pb ²⁺ provided correct observations with FA 6 + NaOH and FA 6 + FA 5 (sulfate).	1
		MMO Decisions	(iii) I Add HCl / H ₂ SO ₄ / KI / K ₂ CrO ₄ / NH ₃ *	1
		MMO Collection	II white ppt/white ppt/yellow ppt/yellow ppt/white ppt insoluble in excess.	1
			* If not Pb ²⁺ in (ii) but one of Al ³⁺ , Ba ²⁺ , Ca ²⁺ , Zn ²⁺ allow suitable reagent mark: K ₂ CrO ₄ for Ba ²⁺ and NH ₃ for the other three. However, observation must be correct for Pb²⁺ .	
				[2]
				[Total: 15]

**MARK SCHEME for the October/November 2011 question paper
for the guidance of teachers**

9701 CHEMISTRY

9701/34

Paper 3 (Advanced Practical Skills 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, 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.

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

Cambridge is publishing the mark schemes for the October/November 2011 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 AS/A LEVEL – October/November 2011	9701	34

Question	Sections	Indicative material	Mark	
1 (a)	MMO Collection	I Performs experiment and records all sensible thermometer readings.	1	[8]
	PDO Collection	II Records all thermometer readings to 0.0/0.5 °C.	1	
	ACE Interpretation	III Correctly calculates the temperature rises.	1	
	MMO Quality	Award IV , V and VI for a ΔT within 0.5 °C of Supervisor's result. Award IV and V for a ΔT within 1.0 °C of Supervisor's result. Award IV only for a ΔT within 1.5 °C of Supervisor's result.	3	
	Calculate result for 35 cm ³ by multiplying candidate's result for 30 cm ³ of FB 1 by 0.75, round up to the nearest 0.5 °C.		2	
	Award VII and VIII if candidate's temperature rise for 35 cm ³ FB 1 is within 0.5 °C of calculated value. Award VII only if ΔT is within 1.0 °C			
(b)	PDO Display	I Axes labelled: temperature/T change or ΔT and volume/Vol/V sodium hydroxide/NaOH and correct units /°C or (°C) or 'in °C', /cm ³ or (cm ³). II Suitable scales chosen so that the points, if plotted, would occupy at least half the available length for x- and y-axes. <i>Do not award if 50 cm³ not included.</i> III Plotting – accurate to within half a small square and in the correct square. IV Draws two straight lines of best fit which intersect. <i>Allow coming to a point (not curved). Does not have to go through (0,0).</i>	1 1 1 1	[4]

Page 3	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE AS/A LEVEL – October/November 2011	9701	34

(c)	ACE Interpretation	(i) I Reads to nearest ½ square temperature rise to 1 dp at point of intersection. Do not award if intersection < largest ΔT.	1	[7]
		(ii) II Reads to nearest ½ square volume of FB 1 to 1 dp or nearest 0.5 cm ³ at point of intersection.	1	
		(iii) III Correctly calculates moles of sodium hydroxide [volume of FB 1 in (ii) × 1.5/1000] to 2 to 4 sf.	1	
		(iv) IV Heat energy produced = 50 × 4.3 × temperature rise from (i)	1	
		V Correct answer calculated to 3 or 4 sf. <i>ecf from incorrect volume</i>	1	
		(v) VI $\frac{\text{candidate's answer to (iv)}}{\text{candidate's answer to (iii)}}$	1 1	
		VII Negative sign and answer in kJ to 2 to 4 sf	1	
(d)	ACE Interpretation	Identifies a source of error e.g. precision of thermometer, precision of measuring cylinder*	1	[2]
	ACE Improvements	Suggests thermometer with smaller scale divisions (0.1°C), use of burette*	1	
(e)	ACE Interpretation	(i) I Calculates or expression for the volume of FB 2 which reacts [50 – (c)(ii)].	1	[4]
		II Correctly calculates the concentration of H ⁺ in mol dm ^{–3} (≥ 2 sf) [(c)(iii) × 1000/{50 – (c)(ii)}].	1	
	PDO Display Decisions	(ii) III Divides the answer from (i) by 2	1	
		(iii) IV Describes test and result for sulfate ion. White ppt with (aq) barium chloride or nitrate	1	
	[Total: 25]			

* e.g.	1 st mark	2 nd mark
	use more sensitive thermometer	0.5, 0.2, 0.1°C or smaller % error
	smaller divisions in measuring cylinder	burette or decrease % error
	use burette as more accurate	
	cup has little water, use dry cup	
	10 cm^3 too small to take T, start with 20 cm^3	

Page 4	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE AS/A LEVEL – October/November 2011	9701	34

	FB 3 is Na ₂ CO ₃ (aq); FB 4 is Na ₂ CrO ₄ (aq); FB 5 is NaBr; FB 6 is MnO ₂				
2 (a)	PDO Recording MMO Collection	(i) I All observations in a single table (2 × 3) No repeat of headings & ≥ 4 boxes filled. Observations for both tests on each solution are correct. II FB 3 III FB 4 IV FB 5	1 1 1 1		

Solution	H ₂ SO ₄	Pb(NO ₃) ₂
FB 3	bubbling/effervescence and CO ₂ identified by test (allow gas turns limewater milky)	white ppt
FB 4	turns orange/orange (solution) forms (not ppt but not CON for identity)	yellow ppt
FB 5	no change/no reaction [not “ – “]	white ppt

	ACE Conclusions	V FB 3 carbonate/CO ₃ ²⁻ from effervescence or positive limewater test	1	
		VI FB 4 chromate(VI)/chromate/CrO ₄ ²⁻ from either observation but no CON obs	1	[6]
	MMO Decisions Collection	(ii) I Addition of (aq) silver nitrate to FB 5 . ecf on obs in table if no ppt with FB 5 + Pb²⁺	1	
		II Cream ppt (white ppt loses II and III) If NH ₃ used obs must be correct.	1	
	ACE Conclusions	III FB 5 bromide/Br ⁻ from cream ppt (or off-white ppt insol or partially soluble in NH ₃)	1	[3]
(b)	MMO Collection	(i) I (bubbling/effervescence and) gas rekindles glowing splint	1	
		(ii) II filtrate is yellow/qualified yellow/yellowish green/light brown and produces a red-brown/brown/rust/black (not red) ppt with aqueous sodium hydroxide	1	
		(iii) III filtrate is green/qualified green	1	
		IV filtrate turns purple/pink (with acid)	1	
	ACE Conclusions	V (i) FB 6 is a catalyst <i>Allow O₂ formed or H₂O₂ decomposes if glowing splint test correct.</i>	1	
		VI (ii) FB 6 is an oxidant/oxidising agent/is reduced.	1	[6]
	[Total: 15]			

**MARK SCHEME for the October/November 2011 question paper
for the guidance of teachers**

9701 CHEMISTRY

9701/35

Paper 3 (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, 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.

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

Cambridge is publishing the mark schemes for the October/November 2011 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 AS/A LEVEL – October/November 2011	9701	35

Question	Sections	Indicative material	Mark	
1 (a)	PDO Layout Recording	I Pairs of thermometer readings and time unambiguously recorded. <i>Minimum of three pairs.</i>	1	[5]
		II Correct headings and units. <i>Units must have solidus: /s; brackets: (s); or describe in words: time in seconds or time in s, solidus/°C; or brackets (°C); or describe in words: temperature in °C.</i> <i>No repeats of unit in table to individual readings.</i>	1	
		III Time recorded to 1 second and temperature to 0.5°C. (Must have at least one at 0.5°C.)	1	
	MMO Decisions	IV Five (minimum) different experiments carried out.	1	
		V Initial temperatures span the range specified in the question. At least 1 at or below 40°C, at least 1 above 50°C and no two within 3°C (minimum 3 readings). If more than 5 readings can be within 3°C.	1	
(b)	ACE Interpretation	I Correct means and rates for highest 2 temperatures and lowest 2 temperatures. <i>Use candidate's times (not corrected).</i>	1	[6]
	PDO Display MMO Quality	II 1000/time recorded 3–4sf.	1	
	Calculate log rate for chosen temperatures. Calculate $\frac{\log \text{rate } 2 - \log \text{rate } 3}{T_2 - T_3}$ to 3 significant figures (factor A). Calculate $(T_1 - T_2) \times \text{factor A}$ and add this to log rate 2. Compare this value with candidate's log rate for T1 and calculate δ .			
	If $\delta > 0.05$ but ≤ 0.10 award III ,		1	
	If $\delta \leq 0.05$ award III and IV .		1	
	Repeat for $(T_3 - T_4) \times \text{factor A}$ and subtract from log rate T3.			
	If $\delta > 0.05$ but ≤ 0.10 award V ,		1	
	If $\delta \leq 0.05$ award V and VI .		1	
	If 3 experiments, use slowest 2 for 'standard' and award Q marks for fastest (maximum 2)			

Page 3	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE AS/A LEVEL – October/November 2011	9701	35

(c)	PDO Layout	(i) I All points plotted to use at least 5 large squares on vertical axis and 4 on horizontal axis including position of 20°C.	1	[4]
	ACE Interpretation	II x-axis to allow extrapolation to 20°C. III An appropriate line of best fit is drawn. (ii) IV Correct value to 0.5°C or 1 dp of 1000/t from graph (<i>ignore units</i>).	1 1 1	
(d)	PDO Display	Uses temperature values 10 apart from graph and quotes rates/chooses rates that are doubled and quotes temperatures.	1	[2]
	ACE Conclusions	Relevant comment on data made. This can come from experimental results.	1	
(e)	ACE Interpretation	(i) Fastest reaction/first reaction.	1	[2]
		(ii) Expression for % error ecf from (i).	1	
(f)	ACE Interpretation	Temperature change is not the same for each run of the mixture/ FA 2 not at the same temperature as FA 1 before mixing/difficulty of gauging same level of colour/cannot start clock and pour solutions at same time/reusing boiling tubes could affect concentration. <i>Not: human error/heat loss or gain/human reaction time.</i>	1	[1]
(g)	ACE Improvements	Use of thermostatically controlled water bath/data logger for colour intensity/colorimeter/get help from another student. <i>Improvement must correspond to error specified.</i> <i>Not: automatic timer.</i>	1	[1]
(h)	ACE Improvements	Same volume FA 2 .	1	[3]
		Change volume of FA 1 and keep total volume constant by adding water for several volumes of FA 1 .	1	
		All experiments carried out at the same temperature.	1	
	[Total: 24]			

Page 4	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE AS/A LEVEL – October/November 2011	9701	35

FA 3 is BaCl ₂ or Ba(NO ₃) ₂ ; FA 4 is H ₂ SO ₄ ; FA 5 is NH ₄ Cl + Na ₂ SO ₃					
2	(a)	MMO Decisions	(i) I Selects named reagent involving CrO ₄ ²⁻ or CO ₃ ²⁻ (solution) or magnesium.	1	
		PDO Layout	(ii) II Tabulates evidence of three tests carried out with no repeat headings (irrespective of reagents).	1	
		MMO Collection	III FA 3 yellow ppt or white ppt or no change.	1	
			IV FA 4 (yellow solution turns) orange or effervescence or effervescence.	1	
			V FA 5 yellow solution/no reaction/no reaction.	1	
			<i>Do not allow NaOH for I but allow observations to include T rise for FA 4. If acid as reagent can score only II. Acidified potassium dichromate is 1 reagent. Do not credit as reagent but credit all observations FA 3 yellow ppt, FA 4 no change, FA 5 green.</i>		
					[5]
	(b)	MMO Collection	I FA 3 + FA 4 white ppt.	1	
			II FA 4 + FA 5 no reaction or slow effervescence.	1	
			III FA 5 + FA 3 white ppt.	1	
			IV ppt insoluble in HCl in (i) and soluble in HCl in (iii).	1	
					[4]
	(c)	MMO Collection	Mark vertical columns FA 3 no ppt/ignore faint/slight white ppt. FA 5 no ppt and gas/ammonia turning red litmus blue on warming. FA 4 no visible reaction. Cross out any identified as acid in (a) (iii).	2	

Page 5	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE AS/A LEVEL – October/November 2011	9701	35

(d)	ACE Conclusions	All conclusions must follow observations. For each unknown. One mark for ion and one mark for satisfactory evidence. FA 3 must be Ba^{2+} or Ca^{2+} to gain credit. FA 3 if CrO_4^{2-} in (a) (i), Ba^{2+} (1). Evidence: yellow ppt or white ppt with FA 4/H_2SO_4 and no ppt/(faint) white ppt with NaOH (1) (Must have 2 pieces of evidence.) If CrO_4^{2-} not used in (a) (i) Ba^{2+} and/or Ca^{2+} (1). Evidence: faint white/no ppt NaOH and white ppt with FA 4/sulfuric acid/no NH_3 when heated with NaOH (1). (Must have 2 pieces of evidence.). FA 5 NH_4^+ (1). Evidence: formation NH_3 in (c) (1). SO_3^{2-} (1). Evidence: formation SO_2 in (a) or (b) (1).	1 1 1 1	[4]
(e)	MMO Decisions	Cream ppt (not off white) with AgNO_3 (partially soluble/insoluble in aq NH_3)	1	[1]
[Total: 16]				

**MARK SCHEME for the October/November 2011 question paper
for the guidance of teachers**

9701 CHEMISTRY

9701/36

Paper 3 (Advanced Practical Skills 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, 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.

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

Cambridge is publishing the mark schemes for the October/November 2011 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 AS/A LEVEL – October/November 2011	9701	36

Question	Sections	Indicative material	Mark	
1 (a)	PDO Layout	Constructs a table for results to show volume FB 1 , volume distilled water and time.	1	[3]
	PDO Recording	Correct headings and units. <i>Units must have solidus: /s; brackets: (s); or describe in words: time in seconds or time in s. Units of volume: cm³ with solidus etc. as above.</i> All recorded readings must have units. If units in headings they must not be repeated for each individual reading.	1	
		All times recorded to 1 second. Volumes of FB 1 and water to 1 or 0.05 cm ³ .	1	
(b)	MMO Decision	Two additional volumes of propanone chosen both of which are less than 20 cm ³ . <i>These must not be more than one in the region 20–14, 14–8 and < 8 and not within 1 cm³ of the original values.</i>	1	[2]
	MMO Collection	In both additional experiments water is added to make a total of 20 cm ³ . <i>Some FB 1 must be used.</i>	1	
(c)	PDO Display	(i) Working shown and answer = 5×10^{-5} mol.	1	[2]
		(ii) Working shown and answer = $(5 \times 10^{-5}) / 0.050 = 1 \times 10^{-3}$ ecf from (i) .	1	
(d)	ACE Interpretation	Calculates the rate correctly using ans (c) (ii) $\times 10^5$ / time. <i>Answers given to minimum 2 sig figs.</i>	1	[2]
	PDO Recording	Units for rate given as mol dm ⁻³ s ⁻¹ .	1	

Page 3	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE AS/A LEVEL – October/November 2011	9701	36

(e)	PDO Layout	I Rate on y-axis and volume on x-axis. Axes clearly labelled.	1	
		II Uniform scale chosen to use at least 6 large squares on y-axis and 4 on x-axis. This can include 0,0 if point plotted or line extrapolated. Ignore extrapolation > 20.	1	
		III Plotting of points. Points to be within ½ small square and in correct square. All recorded values should be plotted.	1	
		IV Draws a line of best fit.	1	
	MMO Quality	Award V and VI for $\delta = \pm 3$ s	1	
		Award V only for $\delta = \pm 6$ s	1	
		Award VII and VIII for $\delta = \pm 8$ s	1	[8]
		Award VII only for $\delta = \pm 16$ s	1	
(f)	ACE Conclusion	Notes linear relationship/(directly) proportional/ reaction is 1 st order with respect to propanone. Rate increases as concentration (volume) increases would score one.	2	[3]
	ACE Improvement	Other volumes of iodine and repeat for varying volumes of propanone/repeat values for each run/carry out all experiments again/repeat any anomalous results/use burettes for FB 2 OR FB 3/ carry out relevant specified experiments/use a colorimeter/use starch to show colour change/ minimise intervals in volumes used. <i>Do not allow: carry out more experiments/use other volumes of propanone/do experiments again/effects of changing conditions.</i>	1	
(g)	MMO Decision	Uses 5 cm ³ of iodine solution with extra 5 cm ³ of distilled water.	1	[2]
	ACE Interpretation	Uses the expression (c) (ii)/2 and time from (g). <i>Time must be different from that in (d).</i>	1	
(h)	ACE Conclusion	Makes logical statement to compare rate with corresponding rate in (d).	1	[1]

Page 4	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE AS/A LEVEL – October/November 2011	9701	36

(i)	ACE Interpretation	Uncertainty in each measurement is $0.05 \text{ cm}^3/0.1 \text{ cm}^3$ is overall burette error. $\frac{0.10}{20.0} \times 100 = 0.50\%$ 0.50 alone scores 2 $\frac{0.05}{20.0} \times 100 = 0.25\%$ scores 1	1 1	[2]
[Total: 25]				

FB 4 is H_2SO_4 ; FB 5 is $\text{Pb}(\text{NO}_3)_2$; FB 6 is $(\text{NH}_4)_2\text{CO}_3$				
2 (a)	MMO Decision MMO Collection	(i) Named reagent involving CrO_4^{2-} or CO_3^{2-} solution/ Mg. <i>Allow NaOH only if increase in T for FB 4 is used.</i> (ii) FB 4 gives orange solution/ FB 4 gives effervescence/ / FB 4 gives effervescence <i>Gas liberated not allowed unless test for gas given.</i> FB 5 gives yellow ppt/white ppt/no reaction/black ppt. FB 6 gives yellow solution/no reaction/no change.	1 3	[4]
(b)	MMO Collection	FB 4 + FB 5 and FB 5 + FB 6 white ppt. FB 6 + FB 4 effervescence/bubbling. Gas turns limewater milky/cloudy/chalky.	1 1 1	[3]
(c)	PDO Recording	Presents information in a table to include both reagents and excess of each. <i>Ignore anything described as the acid in (a). No additional reagents allowed.</i> FB 5 gives white ppt soluble in excess NaOH and white ppt insol in excess $\text{NH}_3(\text{aq})$. FB 6 gives no reaction with either NaOH or $\text{NH}_3(\text{aq})$. (Warms FB 6 + NaOH and tests) gas/ammonia turns damp red litmus blue. FB 4 no change scores 1.	1 1 1 1	[4]

Page 5	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE AS/A LEVEL – October/November 2011	9701	36

(d)	ACE Conclusions	All conclusions must follow observations. For each unknown. One mark for ion and one mark for satisfactory evidence. FB 5 If CrO_4^{2-} in (a), Pb^{2+} (1) Evidence: yellow ppt and white ppt with NaOH or NH_3 (1) or if not CrO_4^{2-} in (a) Al^{3+} or Pb^{2+} (both needed) (1) Evidence NH_3 (ignore NaOH) (1) One of Al^{3+} or Pb^{2+} can score MP 2. FB 6 NH_4^+ / CO_3^{2-} (1) Evidence: formation of NH_3/CO_2 from appropriate tests (1) or FB 6 Ba^{2+} or NH_4^+ (both needed) (1) Evidence: no ppt both NaOH and NH_3 (1)	1 1 1 1	[4]
	[Total: 15]			