

MARK SCHEME for the May/June 2010 question paper
for the guidance of teachers

9701 CHEMISTRY

9701/31

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

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

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

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Question 1 Round all thermometer readings to the nearest 0.5°C.

Question	Sections	Indicative material	Mark	
1 (a)	PDO Recording	(i) Presents data in single table of results – <i>to include volume of FA 2, initial and final temperatures and temperature change.</i>	1	
		(ii) All columns correctly labelled with appropriate unit shown. <i>Must use solidus, brackets or describe unit fully in words. If units not included in column headings every entry must have the correct unit shown.</i>	1	
	MMO Collection	(iii) All thermometer readings recorded to 0.5°C	1	
		(iv) Follows instructions – uses 10, 20, 30, 40, 50 cm ³ of FA 2 + two additional volumes	1	
	MMO Decisions	(v) One extra volume of FA 2 on either side of the maximum for the first five expts. or Two extra volumes between identical values for the first five expts. or Two extra volumes the same side as the next highest reading.	1	
	MMO Quality	(vi) and (vii) Check and correct ΔT where necessary. <i>(If multiple readings for max. T then apply hierarchy: take value of consistent readings; take average and correct to nearest 0.5°C)</i> Compare temp rise with that obtained by the Supervisor (<i>Expected value is 14.0°C</i>) For 30 cm ³ FA 2 : Award (vi) and (vii) for a temp rise of 0.0°, 0.5°, 1.0°C <i>Award (vi) only for a difference of 1.5°C</i>	2	
	MMO Quality	(viii) and (ix) Check and correct ΔT where necessary. Compare temp rise with that obtained by the Supervisor (<i>Expected value is 13.5°C</i>) For 40 cm ³ FA 2 : Award (viii) and (ix) for a temp rise of 0.0°, 0.5°, 1.0°C <i>Award (viii) only for a difference of 1.5°C</i>	2	[9]

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Question	Sections	Indicative material	Mark	
(h)	ACE Interpretation	<p>Uses the expression: (answer from (c) + 10) $\times 4.3 \times \Delta T$ read from graph</p> <p>Divides the answer above by answer to (f)(i) and gives answer in kJ mol^{-1} with –ve sign <i>Do not award this second mark unless candidate has calculated (a volume of soln $\times 4.3 \times \Delta T$)</i></p>	1 1	[2]
(i)	ACE Improvements	<p><u>Advantage</u> of burette: Lower % error or more accurately calibrated (<i>must refer to or infer scale/graduations/markings/divisions</i>)</p> <p><u>Disadvantage</u> of burette: Takes longer to add the FA 2</p>	1 1	[2]
(j)	ACE Interpretation	<p>Candidate gives two of the following as significant sources of error. Heat loss (to the surroundings) Thermometer graduated at 1°C intervals Drying of cup/thermometer Initial temps of both solutions should be taken <i>Other acceptable sources of error may be seen.</i></p>	1	[1]
(k)	ACE Interpretation	<p>(i) Maximum error in reading a 1°C graduated thermometer is given as 0.5°C</p> <p>(iii) Calculates answer in $\frac{\text{answer in (k)(i)} \times 2}{\text{answer in (k)(ii)}} \times 100\%$</p>	1 1	[2]
	Total			[26]

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Question 2

Question	Sections	Indicative material	Mark	
FA 3 is $\text{BaCl}_2(\text{aq})$; FA 4 is $\text{MgBr}_2(\text{aq})$ [$\text{MgCl}_2 + \text{NaBr}$]; FA 5 is $\text{CaI}_2(\text{aq})$ [$\text{CaCl}_2 + \text{NaI}$]; FA 6 is $\text{K}_2\text{CrO}_4(\text{aq})$				
2 (a)	MMO Decisions	Chooses silver nitrate/ $\text{Ag}^+(\text{aq})$ /solution containing Ag^+ ions followed by (aqueous) ammonia.	1	[1]
(b)	PDO Recording	Results for three solutions and the two reagents from (a) (or three reagents if (a) : ' $\text{Ag}^+ + \text{NH}_3$ ', Pb^{2+}) if recorded in a single table (<i>no repetition of solutions or reagents</i>)	1	[2]
	MMO Collection	Give one mark for correct observations with FA 3 , FA 4 and FA 5 . FA 3 – white ppt with Ag^+ , soluble in $\text{NH}_3(\text{aq})$ FA 4 – cream ppt with Ag^+ , partially soluble or insoluble in $\text{NH}_3(\text{aq})$ (allow “creamy” not “creamy white”) FA 5 – yellow ppt with Ag^+ , insoluble in $\text{NH}_3(\text{aq})$ If Ag^+ and Pb^{2+} in (a) , all observations must be correct (ignore any ‘extra’ NH_3 if not in (a)) (Pb^{2+} : white, white, yellow ppts respectively)	1	
(c)	ACE Conclusion	Mark consequentially on observations in (b) Expected conclusion Identifies FA 3 as solution containing Cl^- from “white ppt with Ag^+ (soluble in $\text{NH}_3(\text{aq})$) given as evidence. <i>Mark consequentially – ecf allowed here.</i> <i>(No retrospective to observations)</i>	1	[1]
(d)	MMO Collection	Mark each of the boxes and see whether correct columns or rows give the better mark. Award the better mark. See table below for the expected observations	1 1 1	[3]

	FA 3	FA 4	FA 5
+ $\text{NaOH}(\text{aq})$	ignore	white ppt	white ppt or “cloudiness”
+ $\text{NH}_3(\text{aq})$	no ppt (allow reference to “cloudiness”/“slight white ppt”)	white ppt	no ppt/no change/ no reaction
+ FA 6	yellow ppt	no ppt/no change/ no reaction/yellow soln	no ppt/no change/ no reaction/yellow soln

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(e)	MMO Collection	Records (yellow) <u>solution turning orange</u> (or <i>wtte</i> , e.g. orange solution forms)	1	[1]
(f)	ACE Conclusions	Mark consequentially on observations in (d) and (e) Expected conclusions: Anion in FA 6 is chromate, CrO_4^{2-} , from yellow soln turning orange in (e) or yellow ppt with FA 3 in (d) <i>provided FA 3 not also identified from (d) and FA 3 contains Ba^{2+} from observations with NaOH and NH_3 (or just NaOH if obs with FA 4 and FA 5 are correct with it) or FA 6 in (d)</i>	1	[1]
FA 7 is a tertiary alcohol; FA 8 is an aldehyde; FA 9 is a ketone; FA 10 is a primary alcohol				
(g)	MMO Collection	One mark for two correct observations with FA 7 One mark for correct observations with FA 8 and FA 9 One mark for two correct observations with FA 10 See table below for expected observations	1 1 1	[3]

reagent	observations			
	FA 7	FA 8	FA 9	FA 10
acidified dichromate	no reaction		no reaction	(colour change to green/blue-green/cyan/turquoise (solution not ppt)
2,4-DNPH	no reaction	yellow ppt	yellow ppt	
Tollens' reagent	no reaction	silver mirror or black/grey solution or ppt		no reaction

(h)	ACE Conclusions	No ecf from (g) FA 7 contains the tertiary alcohol from <u>no reaction with all three reagents</u> or <u>no reaction</u> with dichromate and 2,4-DNPH provided there is no CON in the observation with Tollens' FA 8 contains the aldehyde from the silver (mirror), black or grey precipitate or solution with ammoniacal silver nitrate Allow from brown ppt if it is the only positive result with Tollens'.	1 1	[2]
	Total			[14]