Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CHEMISTRY **9701/03**

Paper 3 Advanced Practical Skills **For Examination from 2016**

SPECIMEN MARK SCHEME

2 hours

MAXIMUM MARK: 40

This document consists of **6** printed pages.

CAMBRIDGE International Examinations

Question	Sections	Indicative material	Mark
1 (a)	PDO Recording	Both balance readings and the correctly calculated mass of marble chips are recorded.	1
		Both balance readings are recorded to the same level of precision **and** all volumes are recorded to the same level of precision.	1
	MMO Quality	δV decreases with time (δV = (V at 2 min) – (V at 1 min) > (V at 3 min) – (V at 2 min) etc.) (Allow δV = 0 for t = 9→10 min)	1 [3]
(b) (i)	PDO Layout	Scales chosen so that graph occupies more than half the available length for *x*- and *y*-axes and *y*-axis labelled volume or V/cm^3 or (cm^3) and *x*-axis labelled time or *t* / minutes or min.	1
		All points plotted to within half a small square in the *y*-direction and the centre of the dot/cross on the line in the *x*- direction.	1 [2]
(ii)		Appropriate line of best fit drawn.	1 [1]
(iii)	PDO Display	Appropriate tangent drawn on graph (line must be at least 10 cm long) and triangle drawn to obtain values for the gradient.	1
	ACE Interpretation	Correctly calculates the gradient of the tangent drawn.	1 [2]
(iv)	ACE Conclusions	Curve (of decreasing gradient) indicates rate of reaction decreasing.	1
		Factor: acid concentration decreasing with time **or** surface area of marble chip decreasing with time	1
		Explanation: less frequent collisions **because** fewer (acid) particles/H^+ (ions) per unit volume **or** fewer surface particles/sites for reaction	1 [3]
(c)	ACE Interpretation	One of: CO_2/gas lost before bung replaced (smaller volume than expected); CO_2 slightly soluble in water (smaller volume than expected); delay in starting stopwatch (greater volume than expected); inserting the bung displaces air (greater volume than expected)	1

Question	Sections	Indicative material	Mark
(c) (cont.)	ACE Improvements	Improvement must match inaccuracy. One of: arrange marble chips in flask so mixing is carried out after bung replaced; use gas syringe/saturate water with CO_2 before experiment; observe clock with second hand sweep/ask for assistance; check volume of air displaced before experiment and subtract	1 [2]
Qn 1		**Total**	**13**

Question	Sections	Indicative material	Mark
2 (a) (i)	MMO Collection	Initial and final burette readings recorded for dilution, volume of **FA 2** diluted recorded **and** the value is between 9 and 12 cm^3.	1 [1]
(ii)	PDO Layout	Volume given for rough titre **and** accurate titre details tabulated. (Minimum 2 × 2 boxes)	1
	MMO Collection	Initial and final burette readings recorded for rough and accurate titres **and** titre volumes recorded.	1
	PDO Recording	Headings and units correct for accurate titration. Initial/final (burette) reading/volume or reading/volume at start/finish and titre or volume/**FA 4** added/used **and**/cm^3 or (cm^3).	1
		All accurate burette readings to 0.05 cm^3 (for dilution and accurate titration).	1
	MMO Decisions	Has two uncorrected accurate titres within 0.1 cm^3. Do not award if, having performed two titres within 0.1 cm^3, a further titration has been performed that is more than 0.1 cm^3 from the closer of the original 2 titres unless a further titration has been carried out which is within 0.1 cm^3 of any of the others. Do not award if titres from burette readings to 0 dp are used (apart from use of 0 for initial reading).	1
Examiner rounds any accurate burette readings to the nearest 0.05 cm^3, checks subtractions and then select the **'best' titres** for Supervisor and candidate using the hierarchy *two identical titres; titres within 0.05 cm^3; titres within 0.1 cm^3; etc.* to calculate mean correct to 0.01 cm^3. Write ringed Supervisor value on candidate's script. Calculate scaled candidate titre $= \frac{\text{candidate mean titre} \times \text{candidate volume diluted}}{\text{Supervisor volume diluted}}$ Record calculated value, difference from Supervisor, δ, and any spread penalty on the candidate's script.			
	MMO Quality	Award 3 marks for $\delta \leq 0.20\ cm^3$. Award 2 marks for $0.20\ cm^3 < \delta \leq 0.40\ cm^3$. Award 1 mark for $0.40\ cm^3 < \delta \leq 0.60\ cm^3$. Apply **spread penalty** of –1 from the Quality marks as follows: titres selected (by Examiner) differ ≥ 0.50 cm^3.	3 [8]
(b)	ACE Interpretation	Check mean titre correctly calculated to 2 dp from clearly selected values (ticks or working) and correct subtractions. Candidate must average two (or more) **accurate** titres that are within 0.20 cm^3 of each other.	1 [1]
(c) (i)	ACE Interpretation	Correctly calculates 0.1 × 25/1000 **and** same answer for moles of HCl	1 [1]
(ii)		Correctly calculates **(i)** × 250/volume in **(b)**	1 [1]

Question	Sections	Indicative material	Mark
(iii)	ACE Conclusions	Correctly calculates **(ii)** × 1000/volume diluted in **(a)**	1 [1]
(iv)	PDO Display	All final answers recorded to 3 or 4 sf	1 [1]
Qn 2		**Total**	**14**

Question	Sections	Indicative material	Mark
		FA 5 is $CuSO_4(aq) + NaNO_2(aq)$	
3 (a)	MMO Collection	Green solution forms blue ppt with NaOH insoluble in excess	1
		(Green solution forms) (pale) blue ppt with NH_3 dissolving in excess to give dark blue solution	1
		(Pale) brown gas evolved **or** (colourless) gas evolved turning brown in air	1
		Purple solution decolourised	1
		Mixture turns dark blue/black with starch	1 [5]
(b)	MMO Decisions	Selects $AgNO_3$ **and** $BaCl_2$ or $Ba(NO_3)_2$ (or in words)	1
	PDO Layout	Tabulates test and observations (no repeated headings)	1
	MMO Collection	No reaction with $AgNO_3$ (not just dash)	1
		White ppt with $BaCl_2$ or $Ba(NO_3)_2$	1 [4]
(c)	ACE Conclusions	Identifies **three** ions: cation, Cu^{2+} **and** anions, SO_4^{2-} and NO_2^- (one cation **and** one anion correct = 1 mark)	2
	ACE Interpretation	Cu^{2+} from blue ppt with both NaOH and NH_3 **or** blue ppt with NH_3 forming deep blue solution with excess NH_3	1
		SO_4^{2-} from white ppt with $BaCl_2$ or $Ba(NO_3)_2$ **or** NO_2^- from brown gas forming with acid (allow from slight effervescence with acid)	1 [4]
Qn 3		**Total**	**13**