
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.

Question	Sections	Indicative material	Mark
1 (a)	PDO Recording	Both balance readings and the correctly calculated mass of marble chips are recorded.	1
	MMO Quality	Both balance readings are recorded to the same level of precision and all volumes are recorded to the same level of precision.	1
		δV decreases with time ($\delta V = (V \text{ at } 2 \text{ min}) - (V \text{ at } 1 \text{ min}) >$ ($V \text{ at } 3 \text{ min}) - (V \text{ at } 2 \text{ min})$ etc.) (Allow $\delta V = 0$ for $t = 9 \rightarrow 10$ 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 $t/\text{minutes}$ 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
(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
<p>Examiner rounds any accurate burette readings to the nearest 0.05 cm³, checks subtractions and then select the 'best' titres for Supervisor and candidate using the hierarchy</p> <p><i>two identical titres; titres within 0.05 cm³; titres within 0.1 cm³; etc.</i></p> <p>to calculate mean correct to 0.01 cm³.</p> <p>Write ringed Supervisor value on candidate's script. Calculate scaled candidate titre</p> $= \frac{\text{candidate mean titre} \times \text{candidate volume diluted}}{\text{Supervisor volume diluted}}$ <p>Record calculated value, difference from Supervisor, δ, and any spread penalty on the candidate's script.</p>			
	MMO Quality	Award 3 marks for $\delta \leq 0.20 \text{ cm}^3$. Award 2 marks for $0.20 \text{ cm}^3 < \delta \leq 0.40 \text{ cm}^3$. Award 1 mark for $0.40 \text{ cm}^3 < \delta \leq 0.60 \text{ cm}^3$. Apply spread penalty of -1 from the Quality marks as follows: titres selected (by Examiner) differ $\geq 0.50 \text{ cm}^3$.	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 $0.1 \times 25/1000$ 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) \times 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 $\text{CuSO}_4(\text{aq}) + \text{NaNO}_2(\text{aq})$			
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 $\text{Ba}(\text{NO}_3)_2$ (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 $\text{Ba}(\text{NO}_3)_2$	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 SO_4^{2-} from white ppt with BaCl_2 or $\text{Ba}(\text{NO}_3)_2$ or NO_2^- from brown gas forming with acid (allow from slight effervescence with acid)	1 1 [4]
Qn 3		Total	13