
CHEMISTRY

9701/33

Paper 3 Advanced Practical Skills

March 2017

MARK SCHEME

Maximum Mark: 40

Published

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 should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge will not enter into discussions about these mark schemes.

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Question	Answer	Marks
1(a)	M1 unambiguous recording of volume of oxygen gas with unit	1
	M2 volume of gas within 10% of the supervisor's value	1
1(b)(i)	correctly calculates V(a) ÷ 150 to 2–4 sig. fig.	1
1(b)(ii)	correctly calculates $\frac{\mathbf{V(a)}}{24.0 \times 1000}$ to 2–4 sig. fig.	1
1(b)(iii)	correctly uses (ii) × 2 AND answer to 2–4 sig. fig.	1
1(b)(iv)	shows working $\frac{\mathbf{(iii)} \times 1000}{150}$ AND answer to 2–4 sig. fig.	1
1(c)(i)	MnO ₂ in (ignition) tube / floating in weighing boat OR use a dropping funnel / syringe for H ₂ O ₂ AND subtract the liquid volume	1
1(c)(ii)	M1 $\frac{0.5 \times 100}{50} = 1.0\%$	1
	M2 × 3 = 3.0% (3.0 with no working shown scores [2].)	1
1(c)(iii)	(agree as) two readings to find volume of gas evolved are needed so there is twice the percentage error in the gas volume reading	1
1(d)	no change because MnO ₂ / FA 2 / solid is a catalyst	1

Question	Answer	Marks
2(a)	I initial and final burette readings and volume added recorded for rough titre AND accurate titre details tabulated	1
	II initial and final burette readings recorded and volume of FA 3 added recorded for each accurate titration <ul style="list-style-type: none"> all headings and units correct for accurate titrations <ul style="list-style-type: none"> initial / final (burette) reading / volume OR reading / volume at start / finish titre OR volume FA 3 added / used (cm³) OR /cm³ OR in cm³ by every entry 	1
	III all accurate burette readings are recorded to the nearest 0.05 cm ³	1
	IV final titre within 0.10 cm ³ of any previous accurate titre	1
	V, VI and VII award V, VI and VII for $\delta \leq 0.20 \text{ cm}^3$ award V and VI for $0.20 \text{ cm}^3 < \delta \leq 0.30 \text{ cm}^3$ award V for $0.30 \text{ cm}^3 < \delta \leq 0.50 \text{ cm}^3$	3
2(b)	mean titre correctly calculated from clearly selected values: <ul style="list-style-type: none"> candidate must average two (or more) titres where the total spread is $\leq 0.20 \text{ cm}^3$ working must be shown or ticks must be put next to the two (or more) accurate readings selected the mean should normally be quoted to 2 d.p. rounded to the nearest 0.01 <p><i>Note: the candidate's mean will sometimes be marked as correct even if it is different from the mean calculated by the examiner for the purpose of assessing accuracy.</i></p>	1
2(c)	M1 correctly calculates $\frac{0.030 \times (\mathbf{b})}{1000}$	1
	M2 correctly uses $(\mathbf{i}) \times 5/2$	1
	M3 correctly uses $(\mathbf{ii}) \times 1000/25$	1
	M4 all final answers to 3 or 4 sig. fig. (minimum two parts attempted)	1

Question	Answer			Marks
FA 5 is $C_6H_{12}O_6(aq)$; FA 6 is $(NH_4)_2Fe(SO_4)_2(aq)$; FA 7 is $NaNO_2(aq)$				
3(a)(i)–(iv)	see below			11
	<i>test</i>	FA 5	FA 6	FA 7
	(i) aqueous sodium hydroxide, then	no reaction / no ppt. AND	green ppt. AND insol in excess / turning brown 1	no reaction / no change / no ppt. AND
	warm gently	solution turns yellow / yellow-brown / brown 1	gas / NH_3 turns (damp red) litmus (paper) blue 1	no reaction / solution remains colourless 1
	aluminium foil and warm	effervescence with FA 5 or FA 7	AND	gas / NH_3 turns (damp red) litmus (paper) blue 1
	(ii) acidified aqueous potassium manganate (VII)	no reaction AND	purple decolourises / solution turns yellow AND	purple decolourises / turns colourless 1
	warm gently	purple decolourises / turns colourless 1		
	(iii) hydrogen peroxide		solution turns yellow / effervescence AND	no reaction / no change 1
			gas relights glowing splint 1	
	(iv) hydrochloric acid, then		no reaction / no change / no ppt.	brown gas / colourless bubbles / gas turning brown in air / blue solution
	$Ba^{2+}(aq)$		AND white ppt. 1	AND no reaction 1

Question	Answer			Marks
3(b)(i)		cation(s)	anion(s)	3
	FA 5	unknown	unknown	
	FA 6	Fe ²⁺ / iron(II) and NH ₄ ⁺ / ammonium	SO ₄ ²⁻ / sulfate	
	FA 7	unknown	NO ₂ ⁻ / nitrite	
3(b)(ii)	clearly shows the reagent and expected observation(s)			1
	add NH ₃ AND green ppt. AND insoluble in an excess of ammonia / turning brown (on standing)			1
3(b)(iii)	Fe ²⁺ (aq) + 2OH ⁻ (aq) → Fe(OH) ₂ (s) OR [Fe(H ₂ O) ₆] ²⁺ (aq) + 2NH ₃ (aq) → [Fe(OH) ₂ (H ₂ O) ₄](s) + 2NH ₄ ⁺ (aq)			1