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**CHEMISTRY**

**9701/36**

Paper 3 Advanced Practical Skills 2

**October/November 2017**

MARK SCHEME

Maximum Mark: 40

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**Published**

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This document consists of **7** printed pages.

Question	Answer	Marks
1(a)	<p><b>I</b> All the following data is recorded</p> <ul style="list-style-type: none"> <li>• burette readings <b>and</b> titre for rough titration</li> <li>• initial and final burette readings for <b>two</b> (or more) accurate titrations (<i>i.e.</i> 2 × 2 box).</li> </ul> <p><i>Headings and units are not required for this mark</i></p>	<b>1</b>
	<p><b>II</b> Headings and units correct for accurate titration table and headings match readings.</p> <ul style="list-style-type: none"> <li>• initial / start (burette) reading / volume</li> <li>• final / end (burette) reading / volume</li> <li>• titre <b>or</b> volume / <b>FB 2 and</b> used / added</li> <li>• units: (cm<sup>3</sup>) or / cm<sup>3</sup> or in cm<sup>3</sup> or cm<sup>3</sup> for each volume recorded</li> </ul>	<b>1</b>
	<p><b>III</b> All accurate burette readings to 0.05 cm<sup>3</sup>.</p> <p><i>Do not award this mark if:</i></p> <ul style="list-style-type: none"> <li>• 50.(00) is used as an initial burette reading;</li> <li>• more than one final burette reading is 50.(00);</li> <li>• any burette reading is greater than 50.(00).</li> </ul>	<b>1</b>
	<p><b>IV</b> The <b>final</b> accurate titre recorded is within 0.10 cm<sup>3</sup> of any other accurate titre.</p>	<b>1</b>
	<p>Examiner rounds any accurate burette readings to the nearest 0.05 cm<sup>3</sup>, checks subtractions and then selects the “best” titres using the hierarchy:</p> <ul style="list-style-type: none"> <li>• identical titres <i>then</i></li> <li>• accurate titres within 0.05 cm<sup>3</sup>, <i>then</i></li> <li>• accurate titres within 0.10 cm<sup>3</sup>, <i>etc.</i></li> </ul> <p>These best titres should be used to calculate the mean titre, expressed to nearest 0.01 cm<sup>3</sup>. Examiner compares candidate’s mean titre value with that of the Supervisor.</p>	

Question	Answer	Marks
1(a)	Award <b>V</b> and <b>VI</b> if $\delta \leq 0.30 \text{ cm}^3$	1
	Award <b>V</b> if $0.30 < \delta \leq 0.60 \text{ cm}^3$	1
1(b)	<p>Candidate must take the average of two (or more) titres that are within a total spread of not more than <math>0.20 \text{ cm}^3</math>.</p> <ul style="list-style-type: none"> <li>Working / explanation must be shown <b>or</b> ticks must be put next to the two (or more) accurate readings selected.</li> <li>The mean should be quoted to <b>2 dp</b>, and be rounded to nearest <math>0.01 \text{ cm}^3</math>. (e.g. <math>26.666 \text{ cm}^3</math> must be rounded to <math>26.67 \text{ cm}^3</math>)</li> </ul> <p>Two special cases, where the mean need not be to 2 dp:</p> <ul style="list-style-type: none"> <li>Allow mean expressed to 3 dp <b>only</b> for 0.025 or 0.075 (e.g. <math>26.325 \text{ cm}^3</math>)</li> <li>Allow mean if expressed to 1 dp, if <b>all</b> accurate burette readings were given to 1 dp <b>and</b> the mean is <b>exactly</b> correct. (e.g. <math>26.0</math> and <math>26.2 = 26.1</math> is allowed) (e.g. <math>26.0</math> and <math>26.1 = 26.1</math> is wrong – should be <math>26.05</math>)</li> </ul> <p><i>Do not award this mark if:</i></p> <ul style="list-style-type: none"> <li>The rough titre was used to calculate the mean.</li> <li>The candidate did only one accurate titration.</li> <li>Burette readings were incorrectly subtracted to obtain <b>any</b> of the accurate titre values.</li> <li>All burette readings used to calculate the mean were recorded as integers</li> </ul>	1
1(c)(i)	<p><b>Correctly calculates</b> number of moles of <math>\text{MnO}_4^- = \frac{0.02 \times \text{vol in (b)}}{1000}</math></p>	1
1(c)(ii)	<b>Correctly uses:</b> (i) $\times 5/2$ (to a minimum of 2 sf)	1

Question	Answer	Marks
1(d)	$(\text{COOH})_2(\text{aq}) + 2\text{NaOH}(\text{aq}) \rightarrow (\text{COONa})_2(\text{aq}) + 2\text{H}_2\text{O}(\text{l})$	1
1(e)	Table clearly showing 2 (or more) accurate initial and final volumes and titres. Subtraction for titres must be correct.	1
	Examiner rounds any accurate burette readings to the nearest $0.05 \text{ cm}^3$ , checks subtractions and then selects the “best” titres using the hierarchy: <ul style="list-style-type: none"> <li>• identical titres <i>then</i></li> <li>• accurate titres within <math>0.05 \text{ cm}^3</math>, <i>then</i></li> <li>• accurate titres within <math>0.10 \text{ cm}^3</math>, <i>etc.</i></li> </ul> These best titres should be used to calculate the mean titre, expressed to nearest $0.01 \text{ cm}^3$ . Examiner compares candidate’s mean titre value with that of the Supervisor.	
	Award 3 marks if $\delta \leq 0.20 \text{ cm}^3$ .	1
	Award 2 marks if $0.20 < \delta \leq 0.40 \text{ cm}^3$ .	1
	Award 1 mark if $0.40 < \delta \leq 0.60 \text{ cm}^3$ .	1
1(f)(i), (ii) and (iii)	<b>Correctly uses</b> mean in (i) <b>and</b> number of moles of NaOH = $\frac{0.04 \times \text{vol in (i)}}{1000}$ in (ii) <b>and</b> moles $(\text{COOH})_2 = (\text{ii})/2$ in (iii)	1
1(g)(i)	<b>Correctly uses</b> (c)(ii) – (f)(iii)	1
1(g)(ii)	<b>Correctly uses</b> mass $(\text{COONa})_2 = (\text{g})(\text{i}) \times 134$	1
1(g)(iii)	<b>Correctly uses</b> mass $(\text{COOH})_2 = (\text{f})(\text{iii}) \times 90$	1

Question	Answer	Marks
1(g)(iv)	<b>Correct expression</b> $\frac{(g)(iii)}{(g)(ii) + (g)(iii)} \times 100$ (or correct answer)	<b>1</b>
	<b>Significant figures mark</b> Answers to (c), (f) and (g) all to 3 or 4 sf (Minimum 6 answers attempted)	<b>1</b>
1(h)(i)	No change <ul style="list-style-type: none"> <li>• since the number of moles of acid stays the same, <b>or</b></li> <li>• as the water will not react, <b>or</b></li> <li>• as the mole ratio stays the same, <b>or</b></li> <li>• as the concentration of acid (<b>FB 1</b>) stays the same</li> </ul>	<b>1</b>
1(h)(ii)	% mass of acid decreases as there is now water as part of the total mass <b>or</b> $M_r$ of (hydrated) acid increases so multiply moles by bigger number so % mass of (hydrated) acid increases	<b>1</b>
1(i)	Would be more accurate since the titre volume is bigger so smaller percentage error.	<b>1</b>

Question	Answer	Marks
<b>FB 5</b> is $\text{MnCl}_2(\text{aq})$ , <b>FB 6</b> is $(\text{NH}_4)_2\text{Fe}(\text{SO}_4)_2(\text{aq})$ , <b>FB 7</b> is $\text{KMnO}_4(\text{aq})$ , <b>FB 8</b> is $\text{KMnO}_4(\text{s})$		
2(a)(i)	sodium hydroxide buff / pale or light brown / fawn / beige / off-white ppt	<b>1</b>
	hydrogen peroxide (turns) dark brown / black solid / ppt	<b>1</b>
	effervescence / bubbling / fizz <b>and</b> gas relights glowing splint	<b>1</b>
2(a)(ii)	green ppt insoluble in excess	<b>1</b>
2(a)(iii)	brown ppt insoluble in excess	<b>1</b>
2(a)(iv)	<b>purple</b> to colourless (allow purple to (pale) yellow / <b>pale</b> orange)	<b>1</b>
2(a)(v)	brown solid / ppt	<b>1</b>
2(a)(vi)	yellow / brown (solution) <b>and</b> blue-black / black / dark blue with starch	<b>1</b>
2(b)	<b>FB 5</b> manganese / Mn / $\text{Mn}^{2+}$ / Mn(II)	<b>1</b>
	<b>FB 6</b> iron / Fe / $\text{Fe}^{2+}$ / Fe(II)	<b>1</b>
	<b>FB 7</b> manganese / Mn / Mn(VII)	<b>1</b>
2(c)	(iodide ions are) oxidised to iodine / (iodide ions) lose electrons to form iodine / $2\text{I}^- \rightarrow \text{I}_2 + 2\text{e}^{(-)}$	<b>1</b>
2(d)(i)	Gas relights glowing splint	<b>1</b>
2(d)(ii)	Green solution / liquid	<b>1</b>

Question	Answer	Marks
2(e)(i)	<b>Tests:</b> (aqueous) silver nitrate <b>and</b> (aqueous) barium nitrate / chloride	<b>1</b>
	white ppt with Ba <sup>2+</sup> and insoluble in named acid (not sulfuric acid) <b>and</b> no ppt with Ag <sup>+</sup>	<b>1</b>
2(e)(ii)	anion = sulfate / SO <sub>4</sub> <sup>2-</sup>	<b>1</b>