

---

**CHEMISTRY**

**9701/36**

Paper 3 Advanced Practical Skills 2

**October/November 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 International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the October/November 2017 series for most Cambridge IGCSE<sup>®</sup>, Cambridge International A and AS Level components and some Cambridge O Level components.

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 <b>not</b> 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>. <i>Do <b>not</b> award this mark if:</i></p> <ul style="list-style-type: none"> <li>• <i>50.(00) is used as an initial burette reading;</i></li> <li>• <i>more than one final burette reading is 50.(00);</i></li> <li>• <i>any burette reading is greater than 50.(00).</i></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>Do <b>not</b> award this mark if:</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> <b>(c)(ii) – (f)(iii)</b>	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 <b>(c)</b> , <b>(f)</b> and <b>(g)</b> 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>