
CHEMISTRY

9701/36

Paper 3 Advanced Practical Skills 2

October/November 2017

MARK SCHEME

Maximum Mark: 40

Published

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

| Question | Answer | Marks |
|----------|--|----------|
| 1(a) | <p>I All the following data is recorded</p> <ul style="list-style-type: none"> • burette readings and titre for rough titration • initial and final burette readings for two (or more) accurate titrations (<i>i.e.</i> 2×2 box). <p><i>Headings and units are not required for this mark</i></p> | 1 |
| | <p>II Headings and units correct for accurate titration table and headings match readings.</p> <ul style="list-style-type: none"> • initial / start (burette) reading / volume • final / end (burette) reading / volume • titre or volume / FB 2 and used / added • units: (cm³) or / cm³ or in cm³ or cm³ for each volume recorded | 1 |
| | <p>III All accurate burette readings to 0.05 cm³.</p> <p><i>Do not award this mark if:</i></p> <ul style="list-style-type: none"> • <i>50.(00) is used as an initial burette reading;</i> • <i>more than one final burette reading is 50.(00);</i> • <i>any burette reading is greater than 50.(00).</i> | 1 |
| | <p>IV The final accurate titre recorded is within 0.10 cm³ of any other accurate titre.</p> | 1 |
| | <p>Examiner rounds any accurate burette readings to the nearest 0.05 cm³, checks subtractions and then selects the “best” titres using the hierarchy:</p> <ul style="list-style-type: none"> • identical titres <i>then</i> • accurate titres within 0.05 cm³, <i>then</i> • accurate titres within 0.10 cm³, <i>etc.</i> <p>These best titres should be used to calculate the mean titre, expressed to nearest 0.01 cm³. Examiner compares candidate’s mean titre value with that of the Supervisor.</p> | |

| Question | Answer | Marks |
|----------|--|-------|
| 1(a) | Award V and VI if $\delta \leq 0.30 \text{ cm}^3$ | 1 |
| | Award V 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 0.20 cm^3.</p> <ul style="list-style-type: none"> Working / explanation must be shown or ticks must be put next to the two (or more) accurate readings selected. The mean should be quoted to 2 dp, and be rounded to nearest 0.01 cm^3. (e.g. 26.666 cm^3 must be rounded to 26.67 cm^3) <p>Two special cases, where the mean need not be to 2 dp:</p> <ul style="list-style-type: none"> Allow mean expressed to 3 dp only for 0.025 or 0.075 (e.g. 26.325 cm^3) Allow mean if expressed to 1 dp, if all accurate burette readings were given to 1 dp and the mean is exactly correct. (e.g. 26.0 and $26.2 = 26.1$ is allowed) (e.g. 26.0 and $26.1 = 26.1$ is wrong – should be 26.05) <p><i>Do not award this mark if:</i></p> <ul style="list-style-type: none"> The rough titre was used to calculate the mean. The candidate did only one accurate titration. Burette readings were incorrectly subtracted to obtain any of the accurate titre values. All burette readings used to calculate the mean were recorded as integers | 1 |
| 1(c)(i) | <p>Correctly calculates number of moles of $\text{MnO}_4^- = \frac{0.02 \times \text{vol in (b)}}{1000}$</p> | 1 |
| 1(c)(ii) | Correctly uses: (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 cm^3 , checks subtractions and then selects the “best” titres using the hierarchy: <ul style="list-style-type: none"> • identical titres <i>then</i> • accurate titres within 0.05 cm^3, <i>then</i> • accurate titres within 0.10 cm^3, <i>etc.</i> These best titres should be used to calculate the mean titre, expressed to nearest 0.01 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) | Correctly uses mean in (i) and number of moles of NaOH = $\frac{0.04 \times \text{vol in (i)}}{1000}$ in (ii) and moles $(\text{COOH})_2 = (\text{ii})/2$ in (iii) | 1 |
| 1(g)(i) | Correctly uses (c)(ii) – (f)(iii) | 1 |
| 1(g)(ii) | Correctly uses mass $(\text{COONa})_2 = (\text{g})(\text{i}) \times 134$ | 1 |
| 1(g)(iii) | Correctly uses mass $(\text{COOH})_2 = (\text{f})(\text{iii}) \times 90$ | 1 |

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

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

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