

CHEMISTRY

9701/33

Paper 3 Advanced Practical Skills 1

May/June 2016

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.

Cambridge is publishing the mark schemes for the May/June 2016 series for most Cambridge IGCSE[®], Cambridge International A and AS Level components and some Cambridge O Level components.

| | | |
|--------|--|----------------|
| Page 2 | Mark Scheme | Syllabus Paper |
| | Cambridge International AS/A Level – May/June 2016 | 9701 |

| Question | Indicative material | Mark | Total |
|----------|---|------|-------|
| 1 (a) | I Two burette readings and titre value given for the rough titre and initial and final burette readings for two (or more) accurate titrations | 1 | |
| | II Titre values recorded for accurate titrations and Appropriate headings for the accurate titration table and cm ³ units. <ul style="list-style-type: none"> initial / start burette reading / volume / value final / end burette reading / volume / value titre or volume / FA 3 and used / added unit: / cm³ or (cm³) or in cm³ (for each heading) | 1 | |
| | III All accurate burette readings are to the nearest 0.05 cm ³ . <i>Do not award this mark if:</i> <ul style="list-style-type: none"> 50.(00) is used as an initial burette reading more than one final burette reading is 50.(00) any burette reading is greater than 50.(00) there is only one accurate titration. | 1 | |
| | IV There are two uncorrected accurate titres within 0.10 cm ³ <ul style="list-style-type: none"> Do not award this mark if, having performed two titres within 0.10 cm³, a further titration is performed which is more than 0.10 cm³ from the closer of the initial two titres, unless a further titration, within 0.10 cm³ of any other, has also been carried out. Do not award the mark if any “accurate” burette readings (apart from initial 0 cm³) are given to zero dp. | 1 | |
| | V, VI and VII Examiner rounds any burette readings to the nearest 0.05 cm ³ , checks subtractions and then select the “ best ” titres using the hierarchy: <ul style="list-style-type: none"> two (or more) accurate identical titres, <i>then</i> two (or more) accurate titres within 0.05 cm³, <i>then</i> two (or more) accurate titres within 0.10 cm³, <i>etc.</i> These best titres should be used to calculate the mean titre, expressed to nearest 0.01 cm ³ . Examiner calculates the difference (δ) between the mean titres obtained by the candidate and the Supervisor. Accuracy marks are awarded as shown. Award V, VI and VII for $\delta \leq 0.20$ (cm ³) Award V and VI for $0.20 < \delta \leq 0.40$ (cm ³) Award V, only, for $0.40 < \delta \leq 0.80$ (cm ³) | 3 | |
| | | | [7] |

| | | |
|--------|--|----------------|
| Page 3 | Mark Scheme | Syllabus Paper |
| | Cambridge International AS/A Level – May/June 2016 | 9701 |

| Question | Indicative material | Mark | Total |
|-------------------|---|------|-------------|
| (b) | <p>Candidate must take the average of two (or more) titres that are within a total spread of not more than 0.20 cm³. 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 cm³.</p> <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 cm³) • Allow mean 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>Note: the candidate's mean will sometimes be marked correct even if it was different from the mean calculated by the Examiner for the purpose of assessing accuracy.</p> | 1 | [1] |
| (c) (i) | $(1.06/40) \times 4 = 0.106$ | 1 | [5] |
| (ii) | Correctly calculates $n(\text{NaOH}) = 0.106 \times (25/1000) = 0.00265$ and | 1 | |
| (iii) | $n(\text{HCl}) = 0.00265$ | | |
| (iv) | concentration FA 3 = $0.00265 \times 1000/(\mathbf{b})$ | 1 | |
| | concentration FA 2 = concentration FA 3 $\times 10$ | 1 | |
| | All answers correct to 3 or 4 sf (minimum of 3 parts attempted) | 1 | |
| Question 1 | | | [13] |
| 2 (a) | <p>Table for results with</p> <ul style="list-style-type: none"> • Unambiguous headings and correctly displayed units • Balance readings recorded to same no of dp • One or two measuring cylinder readings recorded (does not have to include volume collected) • Unit: / g or (g) or in g (for each heading), allow grams/grammes for g and / cm³ or (cm³) or in cm³ (for each heading) • Calculates volume of gas/mass FA 4 to 3 sf. | 1 | [2] |
| | Calculated value within 20% of supervisor value | 1 | |
| (b) (i) | Correctly calculates • $n(\text{gas}) = \text{correct vol gas} \div 24\,000$ to minimum 2 sf and | 1 | |
| (ii) | • same number of moles of M ₂ CO ₃ | | |
| (iii) | $M_r = \text{correct mass from (a)} \div (\mathbf{ii})$ | 1 | |

| | | |
|--------|--|----------------|
| Page 4 | Mark Scheme | Syllabus Paper |
| | Cambridge International AS/A Level – May/June 2016 | 9701 33 |

| Question | Indicative material | Mark | Total |
|-------------------|--|------|-------------|
| (iv) | $A_r = (M_r - 60)/2$ to minimum 2 sf | 1 | [4] |
| | Group 1 element identified as one with the closest A_r and an explanation e.g <i>as it is the nearest</i> | 1 | |
| (c) (i) | % error = $(1 \times 100)/\text{vol gas collected}$ (if only volume collected shown in (a)) or $(1 \times 100)/\text{final reading}$ (when initial reading is zero) or $(2 \times 100)/\text{vol gas collected}$ (if 2 readings) | 1 | [5] |
| (ii) | Reason: gas dissolves (in water/solution)/reacts with water/water absorbs CO_2 | 1 | |
| | Modification: use a gas syringe/saturate water with carbon dioxide/use hot water/use less water in tub/use smaller volume of more concentrated acid/use oil (other non-aqueous solvent) instead of water | 1 | |
| | Reason: gas escapes before stopper inserted/stopper not inserted quickly enough. | 1 | |
| | Modification: viable means of keeping solid and acid separate before being added/use larger lumps of solid/use more (excess) of a lower concentration of acid | 1 | |
| Question 2 | | | [11] |

| | | |
|--------|--|----------------|
| Page 5 | Mark Scheme | Syllabus Paper |
| | Cambridge International AS/A Level – May/June 2016 | 9701 |

FA 5 is HCO₂H; FA 6 is CH₃CO₂H; FA 7 is C₂H₅OH; FA 8 is C₆H₁₂O₆; FA 9 is Zn(NO₃)₂·6H₂O;
FA 10 is NaNO₃

| | | | | | |
|-----------|---|---|---|--|-----|
| 3 (a) (i) | FA 5 | FA 6 | FA 7 | FA 8 | 4 |
| | Fizz / bubbles / effervescence | Fizz / bubbles / effervescence | no change | no change | |
| | Gas turns limewater milky / cloudy white / white ppt / chalky | Gas turns limewater milky / cloudy white / white ppt / chalky | No reaction / no change | No reaction / no change | |
| | Silver / black / dark grey and mirror / solid / ppt | No reaction / no change / no silver mirror | No reaction / no change / no silver mirror | Silver / black / dark grey and mirror / solid / ppt | |
| | Purple to colourless or solution / MnO ₄ ⁻ / manganate (VII) decolourised / disappeared | No reaction or remains / turns purple or pink | Purple to colourless or solution / MnO ₄ ⁻ / manganate(VII) decolourised / disappeared | Purple to colourless or solution / MnO ₄ ⁻ / manganate (VII) decolourised / disappeared | |
| (ii) | (-)CO ₂ H / carboxylic acid | | | | 1 |
| (iii) | (-)CHO / aldehyde / alkanal or alkene / C=C | | | | 1 |
| (iv) | Oxidation of organic compound / reduction of MnO ₄ ⁻ / redox or if alkene in (iii) then electrophilic addition | | | | 1 |
| (v) | (-)OH / (1° / 2°) alcohol / alkanol / hydroxy or alkene / C=C | | | | 1 |
| (vi) | Add Na to give effervescence / hydrogen / gas which pops with lighted splint, or Add PCl ₅ / SOCl ₂ to give misty fumes / steamy fumes / HCl, or Add carboxylic acid AND (conc) sulfuric acid to produce fruity / sweet smell or if alkene in (v) Br ₂ decolourised / brown to colourless | | | | 1 |
| | | | | | [9] |

| | | |
|--------|--|----------------|
| Page 6 | Mark Scheme | Syllabus Paper |
| | Cambridge International AS/A Level – May/June 2016 | 9701 / 33 |

| | | | | | |
|-------------------|--|--|--|---|-------------|
| (b) (i) | | FA 9 | FA 10 | 4 | |
| | NaOH | No marking points for observations here | | | |
| | Al | Effervescence / fizz / bubbles | Effervescence / fizz / bubbles | | |
| | | Fizz / gas / ammonia turns litmus blue | Fizz / gas / ammonia turns litmus blue | | |
| heat | Any 2 from: <ul style="list-style-type: none"> • Melts / dissolves / becomes liquid • Condensation / steam / water vapour • Brown gas / gas turns litmus red • Gas relights glowing splint • Solid turns yellow | Any 1 from: <ul style="list-style-type: none"> • Bubbles • Gas relights glowing splint • Melts / dissolves and to yellow (liquid / solution) | | | |
| (ii) | Nitrate / nitrite | | | 1 | |
| (iii) | Add named acid and (observe) brown gas for nitrite or Add (acidified) potassium manganate(VII) / KMnO_4 and purple to colourless / decolourised for nitrite | | | 1 | |
| (iv) | No reaction for either so anion in each is nitrate / NO_3^- | | | 1 | [7] |
| Question 3 | | | | | [16] |