Cambridge International AS & A Level

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CHEMISTRY **9701/33**

Paper 3 Advanced Practical Skills 1 **May/June 2016**

MARK SCHEME

Maximum Mark: 40

Published

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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. • initial / start burette reading / volume / value • final / end burette reading / volume / value • titre **or** volume / **FA 3 and** used / added • unit: / cm^3 **or** (cm^3) **or** in cm^3 (for each heading)	1	
	III All **accurate** burette readings are to the nearest 0.05 cm^3. *Do **not** award this mark if:* • *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 • *Do **not** award this mark if, having performed two titres within 0.10 cm^3, a further titration is performed which is more than 0.10 cm^3 from the closer of the initial two titres, **unless** a further titration, within 0.10 cm^3 of any other, has also been carried out.* • *Do **not** award the mark if any "accurate" burette readings (apart from initial 0 cm^3) 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: • two (or more) accurate identical titres, *then* • two (or more) accurate titres within 0.05 cm^3, *then* • two (or more) accurate titres within 0.10 cm^3, *etc.* 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 $\delta \leqslant 0.20$ (cm^3) Award **V** and **VI** for $0.20 < \delta \leqslant 0.40$ (cm^3) Award **V**, only, for $0.40 < \delta \leqslant 0.80$ (cm^3)	3	[7]

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Question	Indicative material	Mark	Total
(b)	Candidate must take the average of two (or more) titres that are within a total spread of not more than 0.20 cm^3. 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. Two special cases, where the mean need not be to 2 dp: • Allow mean expressed to 3 dp **only** for 0.025 or 0.075 *(e.g. 26.325 cm^3)* • 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)* ***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.*	1	[1]
(c) (i)	(1.06/40) × 4 = 0.106	1	
(ii) **(iii)**	Correctly calculates n(NaOH) = 0.106 × (25/1000) = 0.00265 **and** n(HC*l*) = 0.00265	1	
(iv)	concentration **FA 3** = 0.00265 × 1000/**(b)**	1	
	concentration **FA 2** = concentration **FA 3** × 10	1	
	All answers correct to 3 or 4 sf *(minimum of 3 parts attempted)*	1	[5]
Question 1			**[13]**
2 (a)	Table for results with • 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** / cm^3 **or** (cm^3) **or** in cm^3 (for each heading) • Calculates volume of gas/mass **FA 4** to 3 sf.	1	
	Calculated value within 20% of supervisor value	1	[2]
(b) (i) **(ii)**	Correctly calculates • n(gas) = correct vol gas ÷ 24 000 to minimum 2 sf **and** • same number of moles of M_2CO_3	1	
(iii)	M_r = correct mass from **(a)** ÷ **(ii)**	1	

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Question	Indicative material	Mark	Total
(iv)	A_r = (M_r -60)/2 to minimum 2 sf Group 1 element identified as one with the closest A_r **and** an explanation e.g *as it is the nearest*	1 1	[4]
(c) (i)	% error = (1 × 100)/vol gas collected (if only volume collected shown in **(a)**) **or** (1 × 100)/final reading (when initial reading is zero) **or** (2 × 100)/vol gas collected (if 2 readings)	1	
(ii)	**Reason:** gas dissolves (in water/solution) / reacts with water / water absorbs CO_2 **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 1	
	Reason: gas escapes before stopper inserted / stopper not inserted quickly enough. **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 1	[5]
Question 2			**[11]**

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FA 5 is HCO_2H; **FA 6** is CH_3CO_2H; **FA 7** is C_2H_5OH; **FA 8** is $C_6H_{12}O_6$; **FA 9** is $Zn(NO_3)_2.6H_2O$; **FA 10** is $NaNO_3$

3 (a) (i)

FA 5	**FA 6**	**FA 7**	**FA 8**
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

4

(ii) (–)CO_2H / 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]

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(b) (i)

	FA 9	FA 10
NaOH	No marking points for observations here	
A*l*	Effervescence / fizz / bubbles	Effervescence / fizz / bubbles
	Fizz / gas / ammonia turns litmus blue	Fizz / gas / ammonia turns litmus blue
heat	Any 2 from: • Melts / dissolves / becomes liquid • Condensation / steam / water vapour • Brown gas / gas turns litmus red • Gas relights glowing splint • Solid turns yellow	Any 1 from: • Bubbles • Gas relights glowing splint • Melts / dissolves **and** to yellow (liquid / solution)

4

(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]**

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