Cambridge International AS & A Level

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Cambridge International Advanced Subsidiary and Advanced Level

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.

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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]

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	

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]**

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

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(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]

(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]**