JUNE 2004

GCE A AND AS LEVEL

MARK SCHEME

MAXIMUM MARK: 25

SYLLABUS/COMPONENT: 9701/03

CHEMISTRY
Practical 1

UNIVERSITY of CAMBRIDGE
International Examinations

Question 1

(a) Table 1.1

Give **one mark** if both weighings are to 2 dp or better, in the correct places in the table, and there is no error in subtraction.

Centres were instructed to provide between 1.70 g and 2.00 g of **FA 1**. *If a candidate's mass is clearly a value in this range* ***x10 or x 0.1*** *the mark for Table 1.1 will not be awarded but the "correct" value will be used in assessing the accuracy ratio*.

[1]

(b) Titration Table 1.1

Give **one mark** if all final burette readings (except any labelled Rough) are to 2 dp and the readings are in the correct places in the table.
Do not give this mark if "impossible" burette readings (e.g. 23.47 cm^3) are given (initial or final readings).

Give **one mark** if there are two titres within 0.10 cm^3 and a "correct" average has been calculated.
See instructions in (f) and examples in (g) of Standing Instructions.
The subtraction of a Rough value need only be checked when the Rough value has been included in the selection for calculating the average.
Do not give this mark if there is an error in subtraction or there is no indication of the titres used to calculate the average (ticks/calculation).

[2]

Accuracy

Check and correct if necessary the subtraction in Table 1.1 for the Supervisor. Use the rules in Standing Instructions to obtain a titration value for the Supervisor.

Calculate, correct to 2 decimal places, for each candidate:

$$\frac{\textbf{Supervisor's mass of } Na_2CO_3}{\textbf{Candidate's mass of } Na_2CO_3 \textbf{ (corrected if necessary)}} \times \textbf{Candidate's Titre (corrected if necessary)}$$

Compare the calculated value with the Titre value obtained by the Supervisor.
Assign accuracy marks as follows:
The spread penalty referred to in (g) may have to be applied using the table below

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Accuracy marks	
Mark	Difference from Supervisor
6	up to 0.20
5	0.20+ to 0.40
4	0.40+ to 0.60
3	0.60+ to 0.80
2	0.80+ to 1.00
1	1.00+ to 2.00
0	Greater than 2.00

Spread Penalty	
Range used / cm^3	Deduction
0.20+ to 0.25	1
0.25+ to 0.30	2
0.30+ to 0.40	3
0.40+ to 0.50	4
0.50+ to 0.70	5
Greater than 0.70	6

[6]

In all calculations, ignore evaluation errors if working is shown

(c) Give **one mark** for M_r **of** $Na_2CO_3 = 106$

and **one mark** for $\frac{\text{candidate's mass of } Na_2CO_3}{\text{a calculated } M_r \text{ for } Na_2CO_3} \times 4$

[2]

(d) Give **one mark** for **ans (c)** $\times \frac{25}{1000}$ **OR**

$$\frac{\text{candidate's mass of } Na_2CO_3}{\text{a calculated } M_r \text{ for } Na_2CO_3} \times \frac{1}{10}$$

[1]

(e) Give **one mark** for **answer to (d) x 2**

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[1]

(f) Give **one mark** for **answer to (e)** **x** $\frac{\textbf{1000}}{\textbf{candidate's titre}}$

and **one further mark** for a **FULLY CORRECT** answer to within 1% of the value calculated by the examiner **using the titre/mass used by the candidate**.

A candidate with an incorrect sub-section, who correctly starts a subsequent sub-section from first principles can gain the evaluation mark.

The correct value is given by: **1.887** **x** $\frac{\textbf{candidate's mass of sodium carbonate}}{\textbf{candidate's titre}}$

Do not award this evaluation mark if there are cancelling chemical errors or an M_r other than 106 is used in the calculation.
Ignore rounding to less than 3 significant figures providing evaluation has been shown to 3 significant figures or better.

Examiners should calculate the value, correct to 3 significant figures, and record it in a ring close to the candidate's value.

[2]

Total for Question 1 [15]

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2 **FA 4** is a mixture of: **FA 5** (Na_2SO_3 which is soluble in water) and
FA 6 ($CaCO_3$ which is insoluble in water)

Tests on Filtrate

	Test	*Observations*	
(a)	To 1 cm depth of the filtrate in a test-tube, add 1 cm depth of aqueous barium chloride;	White precipitate *Accept white solution if a precipitate of unspecified colour has also formed (no contrary colours permitted)*	
	followed by 2 cm depth of dilute hydrochloric acid	Precipitate dissolves/disappears **or** colourless/clear/transparent solution *Ignore any reference to slight white "haziness" left in the solution or to evolution of gas.* Both parts of the observation are needed for the **one mark** to be awarded.	**[1]**
(b)	To 1 cm depth of the filtrate in a test-tube, add 1 cm depth of acidified aqueous potassium dichromate(VI).	(Solution turns) green **not** blue/green **one mark** *Do not penalise green precipitates*	**[1]**
(c)	To 1 cm depth of the filtrate in a test-tube, add 2 cm depth of dilute hydrochloric acid. Warm the solution and identify the gas given off. Empty and wash away the contents of the tube at the end of this test.	(Gas with reducing properties) *A suitable test must be described:* turns chromate/dichromate green (blue/green is acceptable here) or decolourises manganate(VII) **or** (Acidic gas) turns a named indicator an appropriate colour **one mark** ***(Allow this mark on addition of HCl in test (a) if not given in (c))*** ***Ignore any lime-water test or reference to CO_2*** *(some $CaCO_3$ may pass through the filter paper)*	**[1]**
(d)	To 1 cm depth of the filtrate in a test-tube, add 2 cm depth of aqueous iodine.	(Iodine) decolourised **or** colourless solution **or** stated diminishing colour (eg. brown to yellow) **one mark**	**[1]**

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Give **one mark** for identifying the anion as sulphite/SO_3^{2-}

providing two pieces of evidence are given in the conclusion that refer to correct observations or there is equivalent unambiguous reference to tests in the table.

i. white precipitate with barium chloride
ii dichromate(VI) turns green in test (b)
iii iodine decolourised
one from
iv acid/base indicator colour change in (c)
v dichromate(VI) turns green in (c)

[1]

Observation marks may be awarded in the supporting evidence section where the candidate refers back to a specified test. (Beware of contrary statements)

Give **one mark** for stating that the anion behaves in **(b)** and **(d)** as a:
reductant / reducing agent / reducer / oxidisable species (providing a mark has been given in **(b)** or **(d)**).

[1]

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Tests on Residue

	Test	*Observations*	
(e)	Add 2 cm depth of hydrochloric acid to the residue (FA 6) in the boiling-tube. Use the solution formed in the following tests (f) and (g).	(Gas evolved:) *A suitable test must be described:* turning lime water milky/cloudy/turbid/chalky **one mark**	**[1]**
(f)	To 1 cm depth of the solution remaining after test (e) add aqueous sodium hydroxide.	White precipitate, insoluble in excess *Both parts of observation needed* **one mark**	**[1]**
(g)	To 1 cm depth of the solution remaining after test (e) add aqueous ammonia.	No precipitate / no reaction / solution remains colourless / clear solution (remains **but not formed**) **One mark**	**[1]**

Observation marks may again be awarded in the supporting evidence section where the candidate refers back to a specified test. (<u>Beware of contrary statements</u>)

Give **one mark** if the cation and the anion match the results in tests **(e)**, **(f)** and **(g)**. **and** there is supporting evidence in the conclusion for each ion.

The **anion** is CO_3^{2-} *Allow carbonate from effervescence, fizzing or rapid evolution of gas*

The **cation** is Ca^{2+}

Matched observations:

Test (f)	*Test (g)*	*Allowable deduction*
Unqualified White ppt *Do not allow if the ppt was soluble in excess NaOH*	No ppt	Ca^{2+}
White ppt insol in excess	White ppt insol in excess	Mg^{2+}
White ppt insol in excess	White ppt sol in excess	No cation matches
White ppt sol in excess	White ppt insol in excess	Al^{3+} or Pb^{2+}
White ppt sol in excess	White ppt sol in excess	Zn^{2+}
No ppt	White ppt insol in excess	No cation matches
No ppt	White ppt sol in excess	No cation matches
No ppt	No ppt	Ba^{2+}

[1]

Total for Question 2 = [10]

Total for Paper = [25]

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