CAMBRIDGE
INTERNATIONAL EXAMINATIONS

NOVEMBER 2002

GCE Advanced Level

MARK SCHEME

MAXIMUM MARK : 30

SYLLABUS/COMPONENT :9701 /5

CHEMISTRY
(PRACTICAL)

UNIVERSITY of CAMBRIDGE
Local Examinations Syndicate

Question 1

(a) Accuracy

Comparing experiments 2 and 3.

The Examiner calculates for each experiment the value of **(Volume of FA 1 x time in seconds)**.
Record the values **above** the respective columns.
Subtract the smaller from the larger and then calculate:

$$\textbf{\% Difference} = \frac{\textbf{Larger (Vxt) - Smaller (Vxt)}}{\textbf{Larger (Vxt)}} \times 100$$ **(Record this % on the script)**

Award accuracy marks as follows

(If the times for experiment 1 and experiment 2 differ by more than 10% of larger, work with the value that will give the better accuracy mark)

% Difference	*Mark*
Up to 5%	5
5+% to 10%	4
10+% to 15%	3
15+% to 20%	2
20+% to 30%	1

5

Comparing experiments 2 and 4.

(If the times for experiment 1 and experiment 2 differ by more than 10% of larger, work with the value that will give the better accuracy mark)

The Examiner calculates for each experiment the value of **(Volume of FA 2 x time in seconds)**.
Record the values **below** the respective columns.
Subtract the smaller from the larger and then calculate:

$$\textbf{\% Difference} = \frac{\textbf{Larger (Vxt) - Smaller (Vxt)}}{\textbf{Larger (Vxt)}} \times 100$$ **(Record this % on the script)**

Award accuracy marks as follows

% Difference	*Mark*
Up to 5%	5
5+% to 10%	4
10+% to 15%	3
15+% to 20%	2
20+% to 30%	1

5

Compare experiments 2 and 3

(b) (i)	Give **one mark** for	**FA 2** (**X**) and **FA 3** (Iodine), ignore water.
(ii)	Give **one mark** for	**FA 1** (Sulphuric acid), **not** water.
(iii)	Give **one mark** for	a qualitative statement linking change in rate to changed volume/concentration of acid
	Give **one mark** for	a semi-quantitative statement relating rate (not time) and volume/concentration that is **supported by the practical results.** To accept a statement that doubling the volume/concentration doubles the rate, a minimum of three marks must have been awarded for accuracy.
	Give **one mark** for	a quantitative statement in mathematical form or a statement as to Order of Reaction that is **supported by the practical results.** To accept a statement of Rate ∝ [Acid] **or** First Order (with respect to acid), a minimum of 3 marks must have been awarded for accuracy.

5

If FA 2 is given as the variable in b(ii) and FA 1 in c(ii); marks may still be awarded for b(iii) and c(iii) as the reaction is first order for each reagent.

Compare experiments 2 and 4

(c) (i)	Give **one mark** for	**FA 1** (Sulphuric acid) and **FA 3** (Iodine), ignore water
(ii)	Give **one mark** for	**FA 2** (**X**), **not** water.
(iii)	Give **one mark** for	a qualitative statement linking change in rate to changed volume/concentration of **X**
	Give **one mark** for	a semi-quantitative statement relating rate (not time) and volume/concentration that is **supported by the practical results.** To accept a statement that doubling the volume/concentration doubles the rate, a minimum of three marks must have been awarded for accuracy.
	Give **one mark** for	a quantitative statement in mathematical form or a statement as to Order of Reaction that is **supported by the practical results.** To accept a statement of Rate ∝ [**X**] **or** First Order (with respect to **X**), a minimum of 3 marks must have been awarded for accuracy.

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(d) Give **one mark** if

Volume of **FA 1** = 20 cm^3

Volume of **FA 2** = 20 cm^3 **(Allow multiples of these volumes)**

Volume of **FA 3** < 4 cm^3

Volume of **water** = (4.0 – Volume of **FA 3**) cm^3

1

Total for Question 1 **21**

2 **Assessment of Planning Skills**

Numbered sequence and Table of Results

Give **one mark** for each of the following points.
They may be found in the text on page 4 or in the table of results on page 5.

Record the **letter** of the point being awarded close to the scoring point in the script and tick, ✓, the box in the margin to show the particular point has been considered.

a weighing a suitable container – **only one of the following**
test-tube, boiling-tube, crucible, evaporating dish/basin

b weighing container + sample - **Not weighing solid alone or into the container**

c heating and re-weighing after heating

d any evidence of re-heating and weighing again

e (heating) to constant mass (stated or described)

5

Give **one mark** for each of the following points.
They may be found in the text on page 4 or in the table of results on page 5.

f calculating the mass of water lost in the experiment

g calculating moles of water/anhydrous sodium carbonate using 18/106 correctly

h calculating moles of water per mole of anhydrous sodium carbonate

i % water lost on standing = $\frac{(10 - \text{moles of water in (h)})}{10} \times 100$

or = $100 - \left(\frac{\text{moles of water in (h)}}{10} \times 100\right)$

OR

f calculating the mass of water lost in the experiment

g calculating the mass of $Na_2CO_3.10H_2O$ that would give the mass of anhydrous solid left at the end of the experiment.
(mass of $Na_2CO_3.10H_2O$ = mass of anhydrous $Na_2CO_3 \times \frac{286}{106}$)

h Calculating the mass of water in the mass of $Na_2CO_3.10H_2O$ calculated in **(g)**.
(mass in (g) - mass of anhydrous sodium carbonate)

i % water lost on standing = $\frac{\text{mass of water in (h)} - \text{mass of water lost in (f)}}{\text{mass of water calculated in (h)}} \times 100$

OR

f calculating the mass of water lost in the experiment

g Calculating, from practical results, the % of water in $Na_2CO_3.xH_2O$ and calculating, from formula, the % of water in $Na_2CO_3.10H_2O$.

h Calculating moles of water per mole of anhydrous sodium carbonate

$$\left(\frac{\% \text{ water}}{18} \Big/ \frac{\% \text{ anhydrous sodium carbonate}}{106} \right)$$ for $Na_2CO_3.xH_2O$.

i % water lost on standing = $\frac{(10 - \text{moles in (h)})}{10} \times 100$

OR

f calculating the mass of water lost in the experiment

g Calculating the moles of anhydrousNa_2CO_3 remaining. $\left(\frac{\text{mass of } Na_2CO_3}{106} \right)$ and

M_r for $Na_2CO_3.xH_2O$. $\left(\frac{\text{mass of } Na_2CO_3.xH_2O}{\text{moles of anhydrous } Na_2CO_3} \right)$

h Moles of water lost = $\left(\frac{286 \text{ - } M_r \text{ calculated in (g)}}{18} \right)$

i % water lost on standing = $\frac{(\text{moles of water in (h)})}{10} \times 100$

Other variations of the calculation may be encountered – try to fit the method to the steps in (g), (h), (i) above.

4

Total for Question 2 is 9

Total for Paper 30.

Turn over for Examples

In all these calculations assume that 10.0g or $Na_2CO_3.xH_2O$ is heated and produces 5.0g of anhydrous Na_2CO_3.

Method 1

$\frac{5.0}{106.0} = 0.0472$ moles of anhydrous sodium carbonate, $\frac{5.00}{18.0} = 0.2778$ moles of water

$\frac{0.2778}{0.0472} = 5.89$ moles of water / mole of sodium carbonate

% water lost on standing = $\frac{10 - 5.89}{10} \times 100 = 41.1\%$

Method 2

5.0 g of Na_2CO_3 left after heating

This came from $\frac{286}{106} \times 5.0 = 13.49$ g of $Na_2CO_3.10H_2O$

Mass of water = (13.49 - 5.0) = 8.49 g

% water lost on standing = $\frac{(8.49 - 5.00)}{8.49} \times 100 = 41.11\%$

Method 3

% water in $Na_2CO_3.xH_2O$ = $\frac{5.0}{10.0} = 50\%$ % water in $Na_2CO_3.10H_2O$ = $\frac{180.0}{286.0} = 62.9\%$

Moles of water/mole of sodium carbonate

In $Na_2CO_3.xH_2O$ = $\dfrac{50/18}{50/106} = 5.89$

% Water lost on standing = $\frac{(10 - 5.89)}{10} \times 100 = 41.1\%$

Method 4

Moles of Na_2CO_3 and hence $Na_2CO_3.xH_2O$ = $\frac{5.0}{106} = 0.0472$ moles

M_r of $Na_2CO_3.xH_2O$ = $\frac{10.0}{0.0472} = 212$

Moles of water lost on standing = $\frac{286 - 212}{18} = 4.11$ moles

% of water lost on standing = $\frac{4.11}{10} \times 100 = 41.1\%$