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.

**5**

**(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 = $\dfrac{(10 - \text{moles of water in (h)})}{10} \times 100$

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

**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.
$(\text{mass of } Na_2CO_3.10H_2O = \text{mass of anhydrous } Na_2CO_3 \times \dfrac{286}{106})$

**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 = $\dfrac{\text{mass of water in (h)} - \text{mass of water lost in (f)}}{\text{mass of water calculated in (h)}} \times 100$

**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

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

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

**OR**

f calculating the mass of water lost in the experiment

g Calculating the moles of anhydrous$Na_2CO_3$ 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 $$\text{Moles of water lost} = \left(\frac{286 - M_r \text{ calculated in (g)}}{18}\right)$$

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

**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 $Na_2CO_3.xH_2O$ = $\dfrac{\frac{50}{18}}{\frac{50}{106}} = 5.89$

% 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 = $\frac{4.11}{10} \times 100 = 41.1\%$