

**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

Page 1	Mark Scheme	Syllabus	Paper
	A Level Examinations – November 2002	9701	5

**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:

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

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)**

<i>% Difference</i>	<i>Mark</i>
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:

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

Award accuracy marks as follows

<i>% Difference</i>	<i>Mark</i>
Up to 5%	5
5+% to 10%	4
10+% to 15%	3
15+% to 20%	2
20+% to 30%	1

5

Page 2	Mark Scheme	Syllabus	Paper
	A Level Examinations – November 2002	9701	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  $\propto$  [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  $\propto$  [**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

$$\text{Volume of FA 1} = 20 \text{ cm}^3$$

$$\text{Volume of FA 2} = 20 \text{ cm}^3$$

$$\text{Volume of FA 3} < 4 \text{ cm}^3$$

$$\text{Volume of water} = (4.0 - \text{Volume of FA 3}) \text{ cm}^3$$

(Allow multiples of these volumes)

1

Total for Question 1

21

Page 3	Mark Scheme	Syllabus	Paper
	A Level Examinations – November 2002	9701	5

## 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  $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$  that would give the mass of anhydrous solid left at the end of the experiment.

$$(\text{mass of } \text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O} = \text{mass of anhydrous } \text{Na}_2\text{CO}_3 \times \frac{286}{106})$$

- h Calculating the mass of water in the mass of  $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$  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**

Page 4	Mark Scheme	Syllabus	Paper
	A Level Examinations – November 2002	9701	5

- f calculating the mass of water lost in the experiment
- g Calculating, from practical results, the % of water in  $\text{Na}_2\text{CO}_3 \cdot x\text{H}_2\text{O}$  and calculating, from formula, the % of water in  $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$ .
- h Calculating moles of water per mole of anhydrous sodium carbonate

$$\left( \frac{\% \text{ water}}{18} \div \frac{\% \text{ anhydrous sodium carbonate}}{106} \right) \text{ for } \text{Na}_2\text{CO}_3 \cdot x\text{H}_2\text{O}.$$

- 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  $\text{Na}_2\text{CO}_3$  remaining.  $\left( \frac{\text{mass of } \text{Na}_2\text{CO}_3}{106} \right)$  and

$$M_r \text{ for } \text{Na}_2\text{CO}_3 \cdot x\text{H}_2\text{O}. \left( \frac{\text{mass of } \text{Na}_2\text{CO}_3 \cdot x\text{H}_2\text{O}}{\text{moles of anhydrous } \text{Na}_2\text{CO}_3} \right)$$

- h 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**

Page 5	Mark Scheme	Syllabus	Paper
	A Level Examinations – November 2002	9701	5

In all these calculations assume that 10.0g of  $\text{Na}_2\text{CO}_3 \cdot x\text{H}_2\text{O}$  is heated and produces 5.0g of anhydrous  $\text{Na}_2\text{CO}_3$ .

**Method 1**

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

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

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

**Method 2**

5.0 g of  $\text{Na}_2\text{CO}_3$  left after heating

$$\text{This came from } \frac{286}{106} \times 5.0 = 13.49 \text{ g of } \text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$$

$$\text{Mass of water} = (13.49 - 5.0) = 8.49 \text{ g}$$

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

**Method 3**

$$\% \text{ water in } \text{Na}_2\text{CO}_3 \cdot x\text{H}_2\text{O} = \frac{5.0}{10.0} = 50\%$$

$$\% \text{ water in } \text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O} = \frac{180.0}{286.0} = 62.9\%$$

Moles of water/mole of sodium carbonate

$$\text{In } \text{Na}_2\text{CO}_3 \cdot x\text{H}_2\text{O} = \frac{\frac{50}{18}}{\frac{50}{106}} = 5.89$$

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

**Method 4**

$$\text{Moles of } \text{Na}_2\text{CO}_3 \text{ and hence } \text{Na}_2\text{CO}_3 \cdot x\text{H}_2\text{O} = \frac{5.0}{106} = 0.0472 \text{ moles}$$

$$M_r \text{ of } \text{Na}_2\text{CO}_3 \cdot x\text{H}_2\text{O} = \frac{10.0}{0.0472} = 212$$

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

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