UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Level

MARK SCHEME for the June 2005 question paper

9701 CHEMISTRY

9701/05 **Paper 5 (Practical Test), maximum raw mark 30**

This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which Examiners were initially instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began. Any substantial changes to the mark scheme that arose from these discussions will be recorded in the published *Report on the Examination*.

All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes must be read in conjunction with the question papers and the *Report on the Examination*.

- CIE will not enter into discussion or correspondence in connection with these mark schemes.

CIE is publishing the mark schemes for the June 2005 question papers for most IGCSE and GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.

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Grade thresholds for Syllabus 9701 (Chemistry) in the June 2005 examination.

	maximum mark available	minimum mark required for grade:		
		A	B	E
Component 5	30	21	19	12

The thresholds (minimum marks) for Grades C and D are normally set by dividing the mark range between the B and the E thresholds into three. For example, if the difference between the B and the E threshold is 24 marks, the C threshold is set 8 marks below the B threshold and the D threshold is set another 8 marks down. If dividing the interval by three results in a fraction of a mark, then the threshold is normally rounded down.

June 2005

GCE A LEVEL

MARK SCHEME

MAXIMUM MARK: 30

SYLLABUS/COMPONENT: 9701/05

CHEMISTRY
Paper 5 (Practical Test)

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1 (b) Check, and correct if necessary, the mass of **FB 2** used.
Give **one mark** if the mass has been correctly calculated. **[1]**

If either weighing in Table 1.1 is not recorded to 2 decimal places or better deduct one mark from the accuracy mark below.

(c) Check, and correct if necessary, the mass of carbon dioxide evolved.
(mass of flask + acid) + mass of **FB 2** - (mass of flask + solution after reaction)
Give **one mark** if the mass has been correctly calculated. **[1]**

ACCURACY - CANDIDATE SCRIPTS

Calculate the ratio $\frac{\textbf{mass of FB 2}}{\textbf{mass of carbon dioxide}}$ correct to 2 decimal places.

Record the candidate's ratio and the Supervisor's ratio, ringed, below Table 1.1.

Calculate the difference between the Supervisor's ratio and the candidate's ratio.
Award accuracy marks as follows:

Mark	Difference
3	Up to 0.10
2	0.10+ to 0.20
1	0.20+ to 0.50
0	Greater than 0.50

[3]

The theoretical ratio is 2.41 but some CO_2 dissolves in the acid so values between 2.65 and 2.70 are more likely to be recorded.

If a very large mass of carbon dioxide is recorded, check the 'hundreds' digit in the masses recorded and correct any error to provide an accuracy mark.

(d) Give **one mark** for $\frac{\textbf{candidate's mass of carbon dioxide}}{\textbf{44}}$ **[1]**

(e) Give **one mark** for $\frac{\textbf{candidate's mass of FB 2}}{\textbf{answer to (d)}}$ **[1]**

(f) Give **one mark** for $\frac{\textbf{[answer to (e) - 60]}}{\textbf{2}}$ **[1]**

Do NOT give the mark in (f) if a unit has been given in the final answer to (e) or (f).

Ignore reference to atomic mass units/amu.

[Total: 8]

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2 (a) ACCURACY - CANDIDATE SCRIPTS

(i) On the candidate's script circle the volume in Table 2.1 that produced the highest temperature for the Supervisor and the highest temperature recorded by the candidate.
Compare the volume of acid giving maximum temperature as recorded by the candidate and by the Supervisor.

Award a maximum of 2 accuracy marks as follows:

Mark	
2	Max temp at same volume of **FB 3** as Supervisor
1	Max temp at Supervisor's volume of **FB 3** ± 3 cm^3
0	Max temp at Supervisor's volume of **FB 3** ± more than 3 cm^3

Where a candidate has the same temperature for consecutive volumes, use the first value.
The expected maximum 30 or 33 cm^3

[2]

(ii) On the candidate's script check, and correct where necessary the ∆**t** value for the maximum temperature recorded.

Record the Supervisor's ∆**t** value, ringed, against the table and calculate the difference in the ∆**t** values between Supervisor and candidate.

Award accuracy marks as follows:

Mark	Difference in ∆t/°C
3	up to 0.50
2	0.50+ to 1.0
1	1.0 to 1.5
0	greater than 1.5

Reduce this accuracy mark by one mark if any thermometer reading lacks a decimal place. Record (actual accuracy mark -1) under Table 2.1 and the net accuracy mark in the mark column.

[3]

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In some Centres the Erratum slip was not received and the solutions prepared did not give a maximum temperature rise - the temperature continued to rise after each addition of acid.

If the Supervisor and the majority of candidates in a Centre have no maximum temperature rise award the <u>first</u> Accuracy marks (2 marks) as follows:

Calculate the difference in Δ**t** values for Supervisor and candidate after the addition of 24.00 cm^3 of **FB 4**. Record the Supervisor's value in a ring against the table in the usual way.

Give: **2 marks** for a difference up to 0.5 ^oC
1 mark for a difference of 0.5+ ^oC to 1.0 ^oC
0 marks for a difference $>$ 1.0 ^oC

Award the <u>second</u> Accuracy marks (3 marks) as before, comparing the Δt values at maximum temperature rise for candidate and Supervisor.

See later for changes to the mark scheme for the remainder of the question.

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Graph

(b) Give **one mark** if Δ**t** is plotted on the y-axis, the volume of **FB 4** on the x-axis; the axes have been labelled (including unit) and sensible linear scales have been selected.

Give **one mark** if the candidate's Δ**t** value at the maximum temperature recorded, and the Δ**t** value for the volumes immediately before and after it have been plotted correctly. If two of these values are identical check the plotting of the next value away from the maximum that gives three different values of Δ**t**.

The centre of the plotted point should be within ½ small square on either axis.

If any of the three points above have not been plotted, check the nearest appropriate point in its place.

Give **one mark** if two distinct, appropriate **smooth** curves (lines) have been drawn, one showing the temperature rising and the other the temperature falling. The lines must intersect.

Do **not** give this mark if lines join all plotted points or the curves are rounded to meet at a particular volume at the maximum Δ**t** value.

[3]

(c) Give **one mark** for reading the end-point from the graph (within ½ small square on either axis). This mark can be given from a rounded maximum or from the mid-point of a plateau.

This mark is not available where the candidate has recorded and plotted stepwise Δt values for each addition of acid. **[1]**

(d) Give **one mark** for $\dfrac{\mathbf{50}}{\mathbf{candidate's\ end\text{-}point\ from\ (c)}} \times \mathbf{1.5}$

or equivalent two stage calculation **[1]**

(e) Give **one mark** for **3.0 - answer to (d)** **[1]**

(f) Give **one mark** for $\dfrac{\mathbf{42.40}}{\mathbf{answer\ to\ (e)}} \times \mathbf{2}$ **or** $\dfrac{\mathbf{42.40}}{\left(\dfrac{\mathbf{answer\ to\ (e)}}{\mathbf{2}}\right)}$

and $\mathbf{A_r} = \dfrac{\mathbf{[answer\ above\ -\ 60]}}{\mathbf{2}}$

Ignore units in this calculation **[1]**

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Where the Erratum slip had not been received and the Supervisor and majority of candidates at a Centre did not obtain a maximum temperature - the temperature continuing to rise after each addition of acid - mark the remainder of the question as below.

Graph

Give **one mark** if Δ**t** is plotted on the y-axis, the volume of **FB 4** on the x-axis; the axes have been labelled (including unit) and sensible linear scales have been selected.

Give **one mark** if the candidate's value for Δ**t** at 12 cm^3, 18 cm^3 and 24 cm^3 have been plotted correctly. The centre of the plotted point should be within ½ small square on each axis.

Give **one mark** for a smooth curve showing a good fit to the plotted points. **[3]**

(c) This mark is not available. **[0]**

(d) Give **one mark** for $\frac{\textbf{50}}{\textbf{candidate's end - point from (c)}}$ **x 1.5**

or equivalent two stage calculation. **[1]**

(e) Give **one mark** for **3.0 - answer to (d)** **[1]**

(f) Give **one mark** for $\frac{\textbf{42.40}}{\textbf{answer to (e)}}$ **x 2** or $\frac{\textbf{42.40}}{\left(\frac{\textbf{answer to (e)}}{\textbf{2}}\right)}$

AND

Give **one <u>additional</u> mark** for $A_r = \frac{\textbf{[answer above - 60]}}{\textbf{2}}$ **[2]**

[Total: 12]

3 ANALYSIS AND EVALUATION

(a) Give **one mark** if errors of the appropriate size are indicated for the thermometer used.

-10 °C to 110 °C by 1 degree	Error (±) 0.5 °C
0 °C to 50 °C by 0.5 degree	Error (±) 0.25 °C
0 °C to 50 °C by 0.2 degree	Error (±) 0.1 °C

Units are not required.

The answer given must relate to the graduations given on page 4. **[1]**

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(b) Give **one mark** for an answer that indicates the acid is in excess (precise measurement of volume not necessary). **[1]**

(c) Give **one mark** for need to saturate the acid with carbon dioxide before carrying out the experiment or similar argument.

Give **one mark** for answers such as:
to ensure that all the CO_2 produced is collected/measured, **or**
so that all the CO_2 liberated will be from the X_2CO_3, **or**
so that no more CO_2 dissolves (in the acid) during the experiment **or**
explaining that a reduction in the mass of carbon dioxide evolved or volume of carbon dioxide collected will lead to a higher inaccurate value of M_r or A_r. **[2]**

(d) For **each** major error identified:

Give **one mark** for stating the nature of the error **(E mark)**.

This mark is given for identifying any deficiency/variable that will have an influence on the calculated value of M_r.
e.g. Solubility of CO_2 in water/temperature changes alter the volume of gas collected.

Give **one mark** for indicating a suitable method of eliminating the error **(M mark)**.

This mark is for a **practical** way of rectifying the deficiency/keeping the variable constant.
e.g. Collect the gas in a gas syringe/use of a water bath to control temperature.

Give **one mark** for explaining how the error will be eliminated/reduced **by the method selected (P mark)**.

This mark must be for an explanation based on the **method selected**.
e.g. No water involved in collection to dissolve the gas/knowing the temperature pV=nRT can be used in calculating moles of gas.

Some candidates may miss the idea of saturating the HC*l* with CO_2 in test (c) but give an error in (c) that would score one or more marks from section (d).
These marks may be awarded unless the same error has been repeated on page 10.

If the idea of saturating the acid with CO_2 is given on p10 rather than on p8 the marks can be awarded retrospectively.

The three marks in each section may be found at any point in a candidate's answer.

The error will often be found within the explanation.

Annotate each mark as shown in the table which lists some possible answers.
Other acceptable answers that meet the criteria above may be seen.

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	Error ✓E	Method ✓M	Explanation ✓P
1	Loss of gas at start of experiment	Carbonate placed inside flask before mixing *If dropping funnel used…*	Sealed system Needs to compensate for acid added
2	Poor measurement of volume using measuring cylinder	Replace cylinder with burette or gas syringe	Greater accuracy of scales
3	Solubility of CO_2 in (collecting) water	Use gas syringe to collect the gas	No water in collecting apparatus
		Raise temperature of the water in the trough	Solubility of CO_2 decreases at higher temperatures
		Use an alternative solvent	CO_2 insoluble in the solvent
		Saturate (collecting) water with CO_2	*All of gas collected as no more can dissolve*
4	Gas collected in measuring cylinder is not at atmospheric pressure	Equalise water levels inside and outside of measuring cylinder	Read volume at atmospheric pressure
5	*Gas collected contains water vapour*	*Dry gas (but must not then be collected over water)*	Suitable drying agent suggested *(even if dried and collected over water)*
		Use gas syringe to collect the gas	*No water in collecting apparatus*
6	*water contained in gas or vapour pressure of water <u>varies</u> with temperature*	Lower temperature	
		Control temperature - *appropriate method described*	Make adjustment for svp to pressure of gas for controlled temperature
7	Gas collected contains water vapour which contributes to the gas pressure	Correct for pressure for svp or Use a solvent with low vapour pressure	(Temperature and) pressure readings necessary and correction from table
8	Volume of gas varies with changes in pressure	Need to measure temperature of water bath and atmospheric pressure	Moles of gas calculated using pV=nRT
9	Volume of gas varies with changes in temperature or Temperature not known/measured	Use a constant temperature water bath	Apply pV=nRT
10	Solid is damp or Reference to 0.35% water from the assay	Dehydrate/heat the solid	Lower volume of CO_2 or too great a mass if not dried
11	CO_2 is a non-ideal gas	Use modified gas equation	
12	Solubility of carbon dioxide in water varies with temperature	Maintain a constant temperature - *appropriate method described*	Use data to obtain to correct for dissolved carbon dioxide at the constant temperature
13	Reference to the solid only being 99% pure. <u>The purity must be quoted from the assay</u>		Explaining: that carbonate impurities would increase carbon dioxide or unreactive components reduce carbon dioxide

2 x [3]

[Total: 10]

[Total for Paper: 30]

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