UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Level

MARK SCHEME for the November 2004 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 November 2004 question papers for most IGCSE and GCE Advanced Level syllabuses.

UNIVERSITY of CAMBRIDGE
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Grade thresholds taken for Syllabus 9701 (Chemistry) in the November 2004 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.

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November 2004

GCE A LEVEL

MARK SCHEME

MAXIMUM MARK: 30

SYLLABUS/COMPONENT: 9701/05

CHEMISTRY
Paper 5 (Practical Test)

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1 Table of results - Table 1.1

Give **one** mark if all times are given to the nearest second.

*Do **not** give this mark if timings are given to 0.1 or 0.01 s*

*Do **not** give this mark if the stop-clock has been read as minute.second e.g. 1.07*

The Examiner:

Rounds all times to the nearest second if necessary, and

Converts times that are clearly in minute.second format to seconds. e.g. 1.07 becomes 67 s

(The shortest time recorded should be approaching 60 seconds). **1**

Accuracy Marks

For each of the Experiments 1 - 3 a (volume x time) value is calculated.

For *Experiment* 1, the Examiner calculates **(50 x time in seconds)**

Record this value in the margin to the left of Table 1.1 and alongside *Experiment 1.*

For *Experiment 2,* the Examiner calculates **(40 x time in seconds)**

Record this value in the margin to the left of Table 1.1 and alongside *Experiment 2.*

For *Experiment 3,* the Examiner calculates **(30 x time in seconds)**

Record this value in the margin to the left of Table 1.1 and alongside *Experiment 3.*

Accuracy marks for reactions where the [BrO_3^-] is changed

Calculate the difference between the (V x t) values for *Experiments 1 and 2.*

Calculate $\dfrac{\textbf{difference in Vt values}}{\textbf{larger Vt used in calculating difference}}$ **x 100**

Record both Vt and % difference below Table 1.1

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Assign accuracy marks as follows:

Difference	Mark
Up to 4%	5
4+% to 5%	4
5+% to 6%	3
6+% to 8%	2
8+% to 10%	1
Greater than 10%	0

IT IS RECOMMENDED THAT EXAMINERS RECORD THE EXPRESSION FOR EACH % DIFFERENCE ON THE SCRIPT **5**

Accuracy marks for reactions where the [Br^-] is changed

Calculate the difference between the (V x t) values for *Experiments 1 and 3* **and** for *Experiments 2 and 3.*

For each pair of experiments – calculate

$$\frac{\textbf{difference in Vt values}}{\textbf{larger Vt used in calculating difference}} \times \textbf{100}$$

Record Vt and % difference for each pair below Table 1.1

Assign accuracy marks as follows for the **smaller of the two** % **differences:**

Difference	Mark
Up to 5%	5
5+% to 7%	4
7+% to 10%	3
10+% to 15%	2
15+% to 20%	1
Greater than 20%	0

5

IF A SPREADSHEET IS USED TO GENERATE Vt VALUES, Vt DIFFERENCES, % DIFFERENCES AND MARKS, DOUBLE CHECK THE EXPERIMENT TIMES ENTERED FOR EACH CANDIDATE

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(b) Give **one mark** for one of the following ideas:

Total volume is constant so that reagent volume is $\propto$ concentration of reagent

Total volume is constant so that (individual) volumes represent **or** are a measure of concentration

Total volume is constant so that in any pair of experiments only one concentration is varied

The concentration of phenol remains constant **1**

In (c) to (e) when calculating the appropriate order of reaction from the candidate's results, allow fractional/decimal orders or the calculated order rounded to the nearest whole number.

(c) The effect on the rate of reaction when [BrO_3^-] is changed

Give **one mark** for a comparison of the volumes of $BrO3^-$ used for Experiments 1 and 2.

Give **one mark** for a comparison of the calculated rates of reaction for Experiments 1 and 2.

Give **one mark** for linking the volume ratio to rate ratio to suggest an appropriate order of reaction.

N.B. There must be use of experimental values and calculation to gain these marks. **3**

(d) The effect on the rate of reaction when [Br^-] is changed

Give **one mark** for a comparison of the volumes of Br^- used for Experiments 1 and 3.

Give **one mark** for a comparison of the calculated rates of reaction for Experiments 1 and 3.

Give **one mark** for linking the volume ratio to rate ratio to suggest an appropriate order of reaction.

N.B. There must be use of experimental values and calculation to gain these marks. **3**

Where candidates use compare Vt values to establish order, give 1 mark for each Vt value, correctly calculated for the appropriate experiment and 1 mark for order statement from the Vt values.

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(e) The effect on the rate of reaction when $[H^+]$ is changed

Give **one mark** for selection of experiment 3 and experiment 4.

Providing experiments 3 and 4 have been selected

Give **one further mark** for a calculation that compares the volumes of acid used and also compares the calculated rates.

(Most text-books give the reaction as 2nd order with respect to acid - expect to see rate increasing x 3 when the concentration of acid is doubled.) **2**

Total for Question 1 = 20

2 Three basic plan methods have been identified.

METHOD A - Preparing a solution by dissolving solid in hot water and cooling to saturate

METHOD B - Preparing a solution at room temperature

METHOD C - Preparing a solution from weighed solid and weighed/measured water

and

Three additional methods for determining the solubility

METHOD D - Titration method

METHOD E - Cooling curve

METHOD F - Filtrate method when a fixed mass of water is used in the experiment

IN EACH METHOD:

Record the letter of the marking point in the script at the point where it is given and place a tick in the grid in the margin.

Each point scores one mark — count the ticks and record the total below the grid.

Candidates employing different methods for making the saturated solution and for determining the solubility will be seen frequently. Mark each using the appropriate section of the mark scheme.

In all calculation sections, allow answers that are in g/100g water, g/g water, g/100 cm^3 water or g/cm^3 of water.

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If the preparation of the saturated solution can be marked using different methods, award the marks for the method that benefits the candidate.

Many of the methods of determining solubility contain small errors that are not penalised (e.g. water that is lost in filter papers or on wet, filtered solid)

METHOD A

(a) PREPARATION OF THE SATURATED SOLUTION

Marking point

(a) Heating water above room temperature

(b) Dissolving (enough) solid (so that)

(c) Solid forms on cooling **3**

DETERMINATION OF THE 'SOLUBILITY'

(d) Weighing a sample of the saturated solution

(e) Evaporating all of the water

(f) Weighing the solid remaining

(g) Using specimen results (numerical or algebraic) to calculate the solubility **4**

METHOD B

(a) PREPARATION OF THE SATURATED SOLUTION

Marking point

(a) Add solid to water (until)

(b) Solid remains undissolved/no more dissolves (Implied by filtering)

(c) Allow to stand/leave for a long time (to establish equilibrium) **3**

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DETERMINATION OF THE 'SOLUBILITY'

	METHOD B1	**METHOD B2 (for a known mass of water when making saturated solution)**
(d)	Weighing a sample of the saturated solution	*Weighing an empty container (and adding the filtrate)*
(e)	Evaporating all of the water	Evaporating all of the water
(f)	Weighing the solid remaining	Weighing the solid remaining
(g)	Using specimen results (numerical or algebraic) to calculate the solubility	Using specimen results (numerical or algebraic) to calculate the solubility

4

METHOD C

(b) PREPARATION OF THE SATURATED SOLUTION

Marking point

(a) Weigh or state mass of solid **and** measure or state mass/volume of water

(b) Dissolve solid until undissolved solid remains (Implied by filtering) *(If heated during preparation, solid forms on cooling)*

(c) Allow to stand/leave for a long time (to establish equilibrium) **3**

DETERMINATION OF THE 'SOLUBILITY'

	METHOD C1	**METHOD C2 (where solid is added in small weighed quantities)**
(d)	Filter the solution/separate solid from solution (e.g. decant)	The mass of each small sample has been measured
(e)	Dry the residue	Number of samples dissolved is recorded
(f)	Weigh the residual solid	Weighs solid from the final sample that is not added to the solution (as solution becomes saturated)
(g)	Using specimen results (numerical or algebraic) to calculate the solubility.	Using specimen results (numerical or algebraic) to calculate the solubility.

4

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METHOD D - TITRATION METHOD FOR DETERMINATION OF THE 'SOLUBILITY'

Only (d) may be awarded for a straight titration of $KClO_3$ with HCl

(d) Accurately measure a volume (pipette/burette) of **and** weigh the measured volume of the saturated solution

(e) (i) React with (excess) KI and acid

or

(ii) *(React with (excess) hydrochloric acid)*

(f) (i) Titrate iodine formed with thiosulphate

or

(ii) *(Titrate excess acid with sodium hydroxide)*

(g) Using specimen results (numerical or algebraic) to calculate the solubility. **4**

METHOD E - COOLING CURVE METHOD FOR DETERMINATION OF SOLUBILITY

(d) (i) weighing samples of solid with a different mass for each experiment

or

(ii) *(Maintaining a fixed mass of solid in each experiment)*

(e) (i) Having a fixed mass/volume of water in each experiment

or

(ii) *(Varying the mass/volume of water in each experiment)*

(f) Noting the temperature at which crystals form from hot solution for at least 5 variables

(g) Showing an appropriate calculation to obtain solubility data for one of the experiments,

and

Indicating that a solubility temperature graph would be drawn,

and

The solubility at room temperature to be read from the graph **4**

METHOD F - METHOD FOR DETERMINATION OF SOLUBILITY WHERE CANDIDATES START WITH A KNOWN MASS OF WATER

(d) Weigh container, e.g. a beaker

(e) Filter the saturated solution into the weighed beaker

(f) Weigh the beaker + saturated solution

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(g) Calculate the mass of solute in the known mass of water and hence determine the solubility **4**

(b) Variation of sodium bromide 'Solubility' with temperature

Give **one mark** if both axes have linear numerical scales **and** points are plotted in at least 5 "large" squares in either direction.

Give **one mark** if two appropriate lines (straight lines or curves - but no s shaped curves) have been drawn through the plotted points.

The two lines do not have to intersect.

Do **not** give this mark if there is an obvious error in the plotting of any point **or** there is a "rounding" of any line to connect the two or to force a fit to the plotted point at 50°C

Give **one mark** for an appropriate transition temperature, read from the graph to within ½ small square.

This mark is independent of the previous mark.

To award this mark there must be an intersection of two lines and not a rounded point of inflexion.

Do **not** give this mark if additional graph lines have been drawn.

[The published transition temperature is 50.7°C]

Total for Question 2 = **10**

Total for Paper = **30**

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