NOTES ON UNCERTAINTY

There is uncertainty in every measurement due to limitation of accuracy and precision.
Accuracy-how close the instrument measures to an accepted standard.
Precision-how closely two or more measurement of the same thing agree when measured with equal care by the same instrument.

Each instrument has its own actual uncertainty that can only be obtained by experiment (i.e. finding the variation in values from repeated measurements). Uncertainty is not necessarily determined by the size of the markings on the instrument.
Typical uncertainty values for the apparatus used in this course are given below. It takes practise to make a measurement with only the uncertainty that is listed.

TYPICAL UNCERTAINTY VALUES

Platform balance	$\pm$ 0.5g
Centigram balance	$\pm$ 0.01g
Thermometer -10°C -110°C	$\pm$0.2°C
Graduated cylinder 50ml	$\pm$0.2ml
Graduated cylinder 10ml	$\pm$0.2ml
50ml Burette	$\pm$0.02ml
50ml Gas Measuring Tube	$\pm$0.02ml

How to record a measurement

Record all digits that are certain plus one uncertain digit (i.e. all the significant figures). Then express the uncertainty as a number occupying the same decimal place as the estimated figure. Leading zeros are not significant figures - they only mark the decimal place.

Rules for calculating with uncertainties

1) When adding or subtracting uncertain quantities the uncertainty in the result is the sum of the individual uncertainties.

2) When multiplying or dividing uncertain quantities the uncertainty in the result can be calculated as the sum of the percentage of uncertainty in the factors. Note that the final answer should always be rounded to the same number of significant digits as are found in the least precise number used in the calculation.

MANUFACTURERS' TOLERANCES FOR SOME VOLUMETRIC GLASSWARE.

Beakers. All beakers are graduated to within ± 5%.
(Sometimes the graduations are stamped slightly crooked !).
Beakers should be used for estimating very approx. amounts and are really considered as reaction vessels.
E.g. "Add about 50mls....."

3075 Cylinder
PYREX® brand, Student, Plastic Hexagonal Base, Graduated

Calibrated "to contain." These cylinders were designed initially for school laboratories. However, low cost and design advantages have made them attractive to other users. They are supplied in two parts—a strong, accurate glass graduate and a detachable, sturdy plastic base which absorbs impacts and reduces breakage.

By removing the base, the graduate can be conveniently stacked. Replacement graduates can be purchased separately.

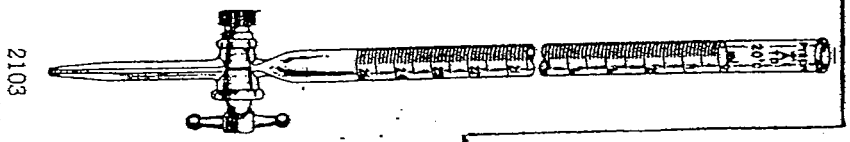
Bumper guards are supplied with 25 through 100 ml. sizes inclusive. Graduation marks are in durable white enamel.

3075

CGW Cat. No.	Capacity ml.	Grad. Interval ml.	Tolerance ± ml.	Approx. Height mm.
3075-10	10	0.1	0.1	160
3075-25	25	0.2	0.3	188
3075-50	50	1.0	0.4	218
3075-100	100	1.0	0.6	248

Graduated cylinders.
Read from the bottom up. They can be calibrated 'to deliver' TD, or 'to contain' TC 'TD' cylinders are used to dispense measured volumes, whereas 'TC' cylinders are used to collect the desired amount of liquid.
Both types are calibrated at 20°C.
E.g. "Add 12mls...."

2103 Buret
PYREX® brand, Accu-Red™, Class A, & Teflon® Stopcock Plug

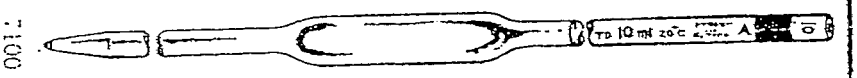


2103

CGW Cat. No.	Capacity ml.	Grad. Interval ml.	Tolerance ± ml.	Approx. Height mm.
2103-10	10	.05	.02	560
2103-25	25	.10	03	560
2103-50	50	.10	05	750
2103-100	100	.20	.10	752

Burette. Read from the top down. They are calibrated 'TD' at 20° An initial and a final reading are required to measure a volume. Measurements should be made to 2 decimal place
E.g. "Add 31.50mls....."

7100 Pipet PYREX® brand, Accu-Red™, Transfer, Class A, Color-Coded,



7100

CGW Cat. No.	Capacity ml.	Tolerance ± ml.	Color Code
7100-1	1.00	.0060	Blue
7100-2	2.00	.0060	Orange
7100-3	3.00	.0100	Black
7100-4	4.00	.0100	2-Red
7100-5	5.00	.0100	White
7100-10	10.00	.0200	Red
7100-15	15.00	.0300	Green
7100-20	20.00	.0300	Yellow
7100-25	25.00	.0300	Blue
7100-50	50.00	.0500	
7100-100	100.00	.0800	

Pipette. Volumetric transfer pipettes are calibrated "TD" at 20°C Each pipette delivers only the volume marked on the stem. There is also, a coloured band for quick identification, e.g. blue is 25.00ml.
E.g. "Add 10.00mls...."