Uncertainty
(tells how estimated and range)

Uncertainty of a Measurement

measurement always listed one place beyond smallest increment of instrument

Using a meter stick the Smallest increment is the mm, therefore you would estimate one place further list how you estimated

Uncertainty of an Operation

smallest/largest an operation could be using measurements

Add/or subtract the uncertainty to the measurement and recalculate operation. When operation is division add unc. to top and subtract from bottom.

$$\Delta O = |O_2 - O_1|$$

smallest increment

27.3 mm ± .1 mm

estimated value

how estimated

Percentage of Uncertainty of a measurement

unc/measurement x 100

Percentage of Uncertainty of an Operation

$\Delta O/O_1 \times 100$

Accuracy
(closeness to accepted)

Absolute Error (E_a)

actually difference between measured and accepted value

$$E_a = |O - A|$$

Relative Error (E_r)

difference expressed as a percentage

$$E_r = E_a / A \times 100$$

Precision
(agreement among many)

Absolute Deviation (D_a)

difference of one measurement to groups

$$D_a = |O - M|$$

Relative Deviation (D_r)

difference expressed as a percentage

$$D_r = D_a\ (ave)/M$$

D_a *(ave)* is the average of the D_a's of each group
M is the average of the Observed values of the group