Honors Chemistry- Uncertainties and Significant Figures (sig. figs.)

All measurements always have some uncertainty. We refer to the uncertainty as the error in the measurement. Errors fall into two categories:

1. **Systematic Error** - errors resulting from measuring devices being out of calibration. Such measurements will be consistently too small or too large. These errors can be eliminated by pre-calibrating against a known, trusted standard.

2. **Random Errors** - errors resulting in the fluctuation of measurements of the same quantity about the average. The measurements are equally probable of being too large or too small. These errors generally result from the fineness of scale division of a measuring device.

Physics and chemistry are a quantitative sciences and that means a lot of measurements and calculations. These calculations involve measurements with uncertainties and thus it is essential for the students to learn how to analyze these uncertainties (errors) in any calculation. Systematic errors are generally "simple" to analyze but random errors require a more careful analysis and thus it will be our focus. There is a statistical method for calculating random uncertainties in measurements. This requires taking at least 10 measurements of a quantity.

1. Uncertainty in a scale measuring device is equal to the smallest increment divided by 2.
2. Uncertainty in a digital measuring device is equal to the smallest increment.

Significant Figures are a necessary part of any math based science. Significant Figures are the digits in your number that were actually measured plus one estimated digit.

Significant Figures Rules:

1) All nonzero digits are significant.
2) Zeros between significant digits are significant.
3) Zeros to the left of nonzero digits are not significant.
4) Zeroes at the end of a number are significant only if they are to the right of the decimal point.

Significant Figures Examples

Number	Significant Figures
70.2	3
0.045	2
70.0	3
4.7	2
100	1
706	3
400.0	4
0.002	1
0.0020	2
0.002047	4
1.0	2
104,020	5
1.20×10^3 (illustrating 1200 with 3 sig figs)	3
2.00×10^{-3} (illustrating 0.002 with 3 sig figs)	3