Significant Figures

In the Mass and Density Experiment in CHEM 117 we are able to estimate the uncertainties in the volume and mass of the spheres and propagate these uncertainties to estimate the uncertainty in the density, as described above. However, an easier and more common way, although less exact, to present the precision in a calculated result is to follow the rules for significant figure rules. These are the rules that will be applied to all data obtained through calculations in both the laboratory and lecture courses. The significant figure rules are outlined below. We will apply these significant figure rules in all subsequent lab reports, in General Chemistry lecture courses on exams and homework and in all subsequent problems in your chemistry courses in both laboratory and lecture.

There are three different sets of rules you will encounter in this course; one for addition and subtraction, one for multiplication and division, and one for logarithms. It is important to keep in mind that following the significant rules generally tend to overestimate the uncertainties, which is why we follow the rules of propagation of error when we want to be more exact. But following these rules is are only option when we are not given uncertainties that were estimated from repeat measurements

Significant figure rules for addition and subtraction

$a + b = c$ or $a - b = c$

The decimal place to which c should be reported to depends on the decimal place of least significance in a and b.

For instance,

12.3 -10.34 = 1.96 = 2.0

The decimal place of least significance is controlled by 12.3, so the answer should be reported to the tenths place as 2.0.

Significant figure rules for multiplication and division

(a)(b) = c or a/b = c

The correct total number of significant figures reported in the answer is equal to the number of significant figures in the factor, a or b, that contains the lowest number of significant figures.

For instance,

12.3 /10.34 = 1.189555 (result from calculator) = 1.19

12.3 contains only three significant figures (10.34 contains four) so the answer should be reported with three significant figures.

Significant figure Rules for Logarithms

A = logB

The correct total number of significant figures reported in A after the decimal place is equal to the total number of significant figures in the B.

-log(0.0000016) = 5.92

0.0000016 contains only two significant figures so the answer should be reported with two significant figures after the decimal place.

$A = 10^B$

The correct total number of significant figures reported in A is equal to the number of significant figures in B after the decimal place is.

$10^{-3.4} = 0.0004$

-3.4 contains only one significant figure after the decimal place, so the answer should be reported to only one significant figure.

Often there will be more than one type of operation in the problem, such as addition and multiplication. You need to do the operation in parenthesis first, apply the significant figure rules, keep all figures for subsequent calculation but make note of the significant figures in the intermediate operation. Then apply the other significant figure rule as you work your way to the next operation.

Example:

(A+B)/C

(2.3 + 0.356) / (0.121) =

Operation inside parenthesis
$2.3 + 0.356 = 2.656 = 2.6_{56}$ (precision is limited by to tenths place by 2.3)

The division
$2.6_{56}/0.121 = 21._{95041322} = 22.$ (precision is limited by the two significant figures in $2.6_{56)}$.