SIGNIFICANT FIGURES

The concept of significant figures (SF, sig figs) is based upon the degree of uncertainty that exists in any measurement and the error introduced into any calculation using that measurement. As a chain is no stronger than its weakest link, a calculation can be no more accurate that the least accurate number used in the calculation. The application of this concept can produce results that can be very confusing to students familiar with the precise requirements of classical mathematics. For example, you learned in grade school that 100 plus 1 will equal 101. Assuming that these to numbers represent the results of measurements and reflect their accuracy, with the application of significant figure rules, the answer will be 100, not 101. Your instructor and text will explain why this rather strange phenomenon occurs. The purpose of this handout is to summarize the rules for using significant figures that you will have to apply in all calculations in chemistry class and lab.

Before you can apply significant figure rules, you must be able to determine how many sig figs there are in any given number. The rules are:

1. All non-zero digits are significant in any number.
2. Zeroes between non-zero digits ARE always significant.
3. Trailing zeroes in non-decimal numbers ARE NOT significant.
4. Trailing zeroes in decimal numbers ARE significant.
5. Leading zeroes in decimal numbers less than one ARE NOT significant.
6. In decimal numbers greater than one, ALL digits are significant.
7. Exact numbers* have an infinite number of sig figs.
8. All digits in a number written in scientific notation are significant.
9. A line over a zero** indicates that that zero and all digits to the left are significant.

Examples:

Number	Number of Sig Figs	Rule(s)
36,892	5	1
2,004	4	2
340,000	2	3
3.45000	6	4, 6
0.000456	3	5
80.41	4	6
7 days/week	∞	7
3.4050×10^{10}	5	8
34,000,$\overline{0}$00	6	9

*Exact numbers are used in the calculation but their effect on the number of sig figs in the answer is ignored.

**If you need to write 3000 to 3 sig figs, put a line over the middle zero (30$\overline{0}$0).

The rules for determining the number of sig figs in the answer to a calculation are different depending upon which mathematical operation you are performing.

For multiplication, division, and exponentiation the answer can have no more sig figs than the LEAST number of sig figs in any number used in the calculation. For example:

459 X 32 X .003512 = 52 (51.584256 rounded to 2 sig figs)

Because 32 only has 2 SF the answer must be rounded off to 2 SF.

$\frac{3000 \text{ X } 3.2222 \text{ X } 652}{3.589002}$ = 2,000,000 (1756093.532 rounded to 1 SF)

Because 3000 has only 1 SF, the answer must be rounded off to 2 million.

A note on rounding, digits to the right of the decimal are dropped when rounding, digits to the left of the decimal are replaced with zeroes, NEVER DROPPED!

34.5677 equals 34.6 when rounded to 3 sig figs.
45089.000 equals 45,000 when rounded to 2 sig figs (not 45).

For addition and subtraction, the rule is a little confusing. The answer can have no more significant PLACES than the least significant place in any number used in the calculation.

For Example (Least significant place underlined):

$1\underline{2},000$	Good to the 1,000's place
$34\underline{5}$	Good to the 1's place
$+ \quad 0.003\underline{4}$	Good to the 10,000th place
$1\underline{2},000$	Answer good to the 1,000's place

Notice the 345 and 0.0034 were essentially discarded. This is because the first number was inaccurately measured and was only good to the thousand's place.

$3405.003\underline{4}$	Good to the 10,000th place
$- \quad 1.\underline{0}$	Good to the 10th place
$3404.\underline{0}$	Answer good to the 10th place

Totally weird dude!

Have fun with those sig figs!