CHEM 141 Handout
SIGNIFICANT FIGURES

The term ***significant figures*** in a measurement refers to the number of digits needed to express the measured value in scientific notation.

> *Example:* The scientific form of 0.000578 is 5.78×10^{-4}. There are 3 significant figures corresponding to the three digits 5, 7 & 8 in the scientific notation)

Rules in determining the number of significant figures:
Since nonzero digits are always significant, we only have to worry about zeros.

The following summarizes the rules on significant figures, in terms of zeros:

1. ***Leading zeros*** - zeros before the first nonzero digit are not significant

   Example: 0.00034 has 2 SF ($= 3.4 \times 10^{-4}$); 0.0105 has 3 SF ($= 1.05 \times 10^{-2}$)

2. ***Trailing zeros*** = final zeros
   (a) In whole numbers - zeros are not significant unless specified as significant by placing a bar or a decimal point

   Example: There are 3 SF in 560. ($= 5.60 \times 10^{2}$); 2 in 1200 ($= 1.2 \times 10^{3}$); 2 in $1\bar{0}$ ($= 1.0 \times 10^{1}$); 3 in 300**.** (*Notice the decimal point in the end* $=3.00 \times 10^{3}$)

   (b) Decimals - zeros to the right of a decimal point are always significant, except for leading zeros discussed in 1.

   Example: 12.00 has 4 SF; 0.00500 has 3 SF; 0.000709100 has 6 SF; 1.060×10^{-5} has 4 SF

Mathematical Operations Involving Significant Figures

1. Addition and subtraction
   The final answer should have the same number of decimal places as the least precise measurement (i.e. the measurement with the least no. of decimal places)

Example:

12	No decimal place	56.75	2 decimal places
+ 2.4	One decimal place	- 1.2	1 decimal place
14	(No decimal place)	55.6	(55.55 rounded off to 1 decimal place)

2. Multiplication and division
   The final answer must have the *same number of SF as the measurement with the least number of SF*, i.e. the least precise measurement

Example: ***6.7*** x 2.56 x 3.333 = 57.167616 or **57** (Final answer can only have 2 SF)

↗ This term only has 2 SF (the least SF)

$(16.75 \times 1.4 \times 10^{-4}) \div 2.15 = 1.09069... \times 10^{-3}$ or $\mathbf{1.1 \times 10^{-3}}$

↗ 4 SF ↖ 2 SF (least) ↖ 3 SF (Final answer must have 2 SF)

Mathematical Operations ... (Cont.)

3. Logarithms and antilogarithms

Given the logarithm of n equal to a:

$$\log n = a \qquad \text{or } n = 10^{a}$$

The number n is the *antilogarithm* of a. There are two components of a logarithm: a *characteristic* and *mantissa*. The ***characteristic*** is the integer part while the ***mantissa*** is the decimal part. In the example below, these two components are indicated by arrows.

$$\log \mathbf{25} = 1.3979$$

Characteristic = 1 **Mantissa = 0.3979**

The *number of digits in the mantissa should equal the number of significant figures in the logarithm.* Thus, in the example above, since the logarithm (25) has 2 significant figures, the mantissa should be rounded off to 2 digits. Therefore, the equation should be written as:

$$\log \mathbf{25} = 1.\mathbf{40}$$

This *logarithm* has *2 SF* The *mantissa* (right of decimal point) must have *2 digits*