CHEM 450 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:

1. Exact numbers (Ex. 12 or a dozen) have *infinite number of significant figures* and therefore do not influence the number of significant figures in your measurement or calculation.

2. Since nonzero digits are always significant, we only have to worry about zeros.

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

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

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

   b. ***Trailing zeros*** = final zeros
   (i) 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 $56\bar{0}$. (= 5.60×10^{2}); 2 in 1200 (= 1.2×10^{3}) ; 2 in $1\bar{0}$ (= 1.0×10^{1}); 3 in 300**.** (*Notice the decimal point in the end* =3.00×10^{3})

   (ii) 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

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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 x 1.4 x 10^{-4}) ÷ 2.15 = 1.09069... x 10^{-3} or **1.1 x 10^{-3}**

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

3. Logarithms and antilogarithms

Given the logarithm of n equal to a:

$\log n = a$ 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 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 **25** = 1.**40**

This *logarithm* has *2 SF*

The *mantissa* (right of decimal point) must have *2 digits*