Significant Figures

Rules for Assigning Significance to a Digit

1. Exact numbers can be considered as having an unlimited number of significant figures. For example: 1 inch is defined as 2.54 cm, therefore it this is an exact conversion factor.

2. Digits other than zero are always significant.

3. Rules about zeros:
   Final zeros after a decimal point are always significant.
   Zeros between two other significant digits are always significant.
   Zeros used only to space the decimal are never significant.

Number	Number of Significant Digits
12.560	5
9.023	4
0.0**923**	3
1900	Could be 2, 3, 4*

   * Convention is to draw a line above the last significant zero in this type of case.

   190$\overline{0}$ contains 4 significant figures

   The use of exponential notation eliminates the need for this convention
   1.90×10^3 has 3 significant figures

4. For multiplication/division:
   The answer is rounded off to the same number of SF as possessed by the least precise term in the calculation.

SF	5		2			2
	153.06	X	0.24	=	36.734	= 37

5. For addition/subtraction:
   The digits reported are determined by the uncertainty in the least precise measurement (not by the number of significant figures). Sometimes this is considered to be the least number of digits after the decimal point.

	142.032		142.03	
	7.6		7.6	
+	32.4524	+	32.45	
			182.08	= 182.**1**

   In this case, the answer is reported to the "**tenth's**" decimal place.

Significant Figures With Both Addition And Multiplication Operations

Example: Convert 73˚F to K (Kelvin)

STEP 1: Convert 73°F to °C. $°C = \dfrac{5 \times (°F - 32)}{9}$

In this equation, 32, 9 and 5 are "exact" numbers (see rule 1).

$$°C = \dfrac{5 \times (73 - 32)}{9} = \dfrac{5 \times (41)}{9} = 22.8 = 23°C$$

> Note that in this equation, 73 contains 2 significant figures and the numbers 9, 5, and 32 are "exact". Multiplication or subtraction by "exact" numbers does not affect the number of significant figures reported.
>
> The subtraction of (73 – 32) yields 41, which contains 2 significant figures. *Remember, for addition or subtraction, report to the same number of decimal places as the term with the least amount of decimal places (see rule 5).*   In this case, it the "ones" place.
>
> Therefore, the answer should contain only 2 significant figures (23°C).

STEP 2: Convert 23°C (2 significant figures) to K (Kelvin)   K = 273.15 + ° C

$$
\begin{array}{r}
273.15 \\
+\,23. \\
\hline
296.15 = 296\ K
\end{array}
$$

> Because in addition, you report to the same number of decimal places as the term with the least amount of decimal places (rule 5), the answer (296 K) has 3 significant digits, even though 23°C only has 2 significant digits.

Significant Figures With Conversion Factors Using "Inexact" Numbers

When doing a calculation using an "inexact" conversion factors or numbers (such as pounds to grams), always use a conversion factor with at least the same number significant figures as the data being converted.

For example: Convert 3.450 lb to grams.

Note that 3.450 lb contains 4 significant figures. The conversion factor for pounds to grams is "inexact" and is given by:

$$1 \text{ pound} = 453.59 \text{ grams*}$$

This conversion factor contains 5 significant figures, so it is acceptable to use. You would not want to use a conversion factor with only 2 or 3 significant figures.

*Table 1-8 and Appendix C, *General Chemistry*, Whitten, Davis, and Peck, 9th Edition.

SF	4		5				4
	$\dfrac{3.450 \text{ lb} \quad \text{x} \quad 453.59 \text{ g}}{1 \text{ lb}}$			=	1564.9 g	=	1565 g