

Significant Figures

It is necessary in physics and elsewhere to put values through mathematical calculations. Since the values going into the calculations have some level of uncertainty, it is reasonable to assume there will be some uncertainty in the values coming out (regardless of how many decimal places your calculator is happy to return to you). You should start developing good habits about reporting your results to a proper number of significant figures. There are two rules you need to know to do this, and they're quite simple:

Addition/Subtraction

When adding and subtracting, round off your result to the number of decimal places found in the least precise term.

Example: You measure the voltage across a number of resistors in series and find: 8.42 V, 3.04 V, and 8.55mV. You add these values to find the net voltage drop across the resistors; your calculator tells you it's 11.46855 V. You're tempted to copy down what the Great Calculator tells you, but first you pause to think....

Putting all values in the same units (converting millivolts) and lining up decimals, you find:

8.42 V
3.04 V
0.00855 V

The first two values tie for the least precise terms (they are only precise to the nearest 0.01 V), so you should round the result from your calculator to the nearest 0.01 V, or to **11.47 V**.

Multiplication/Division

When multiplying and dividing, round off the solution to the number of significant digits found in the least precise of the factors in the calculation.

Example: A bullet is observed to take 0.48s to hit a target that is 115 m away. You calculate it's average speed by dividing total distance traveled by the time interval. Your calculator tells you it's traveling at 239.58333333... m/s. Before writing that down, you think...

The time is precise to two digits; the distance is precise to three digits. So you round the solution to the *least* precise two digits, **240 m/s**. In this case, the "0" is not a significant figure.

Powers, Square Roots, Trig Functions, Etc....

To the degree of precision we're going to use in daily problem-solving, just use the multiplication/division rule. (PHY121 students see Appendix A-6 for a more thorough treatment.)

If not otherwise noted, assume all values in practice/project homework are precise to three digits.

<i>Examples:</i>	<u>Listed Value</u>	<u>Implied Precision</u>
	10m	10.0m
	8 s	8.00 s
	12.55 s	12.55 s (value given to more than 3 digits)
	500,000N	5.00 10 ⁵ N (three digits are precise, others are just place holders)

Known Error/Rounding

When error is given or calculated, always round the error UP to the nearest single digit, unless the first digit is a "1", then round up to the nearest two digits. Round the value (up or down as appropriate) to the same number of decimal places as the error.

Example: The lab software gives you the slope of a position-time graph as .25333 m/s and the error as 0.0211 m/s. First round the error: The first digit is a "2", so we'll only keep one, and error is rounded *up* so the error rounds to 0.03 m/s. The slope is rounded to the same number of digits (to the hundredth place) or **0.25 m/s**.

Example: If the error in the above example had been 0.0131 m/s instead, then... The first error digit is a "1", so we'll keep two digits, and the error rounds to 0.014 m/s. The slope is rounded to the same number of digits (to the hundredth place) or **0.253 m/s**.