

**Lesson 00-A6-Percent Error and Percent Difference**

One of the common themes of our laboratory exercises is the comparison between theory and measurement. You will be comparing your measurements with theoretical predictions. This type of exercise is a test of the theory and at the same time a test of your ability to make careful measurements.

Since all measurements have some degree of error associated with them, we need a way to quantify the difference between your results and the predictions. There are many sophisticated ways of reporting experimental error, but we are going to use one simple one. This is the percent error between the measured results and the correct or predicted or reference value.

The equation to use is simple enough

$$\%Error = 100\% \times |\text{measured} - \text{reference}| / \text{reference} = 100\% \times |\text{error}| / \text{reference}$$

The vertical bars indicate absolute value of the difference. It does not matter which is larger and which is smaller. All we care about is the difference between them.

In one of our experiments we will determine the acceleration due to gravity of objects near the surface of the Earth. The correct value at the latitude of Fort Worth is

$$g = 9.795 \text{ m/s}^2$$

This known value will serve as the theoretical or reference value in our %Error calculation. Suppose that your measurement is  $10.06 \text{ m/s}^2$ . Your %Error is then

$$\%Error = 100\% \times |10.06 - 9.795| / 9.795 = 100\% \times |0.265| / 9.795 = 2.705\%$$

An identical equation is used to calculate the percent difference. The difference between percent error and percent difference is philosophical rather than mathematical. We call it a percent difference when we are comparing results that should be the same. The equation is

$$\%Error = 100\% \times |\text{measured} - \text{reference}| / \text{reference} = 100\% \times |\text{difference}| / \text{reference}$$

We will need to decide in such a case which of the measurements is to serve as the reference value. If you have many results from many measurements, one possibility is to use the average value as the reference value. For example,

Measurement	%Difference from the average
18.3	2.27%
17.9	4.41%
17.7	5.47%
21.0	12.1%
Average = 18.725	