HONORS CHEMISTRY: UNCERTAINTY OF INSTRUMENT READINGS AND OTHER RAW DATA

1. Data in the lab is measured by including all of the KNOWN digits plus one estimated digit. For example in the thermometer below, the gradations each represent 2°F. The measurement is “known” to the tens place. We need to include an “estimated” digit as well so the correct data measurement would be to the tenths place.

 Correct Measurement: 76.0°F



1. Every measurement in the lab has uncertainty associated with it – this is written as:

MEASUREMENT ± UNCERTAINTY

There are three types of uncertainty:

1. Absolute uncertainty – this is what we will use in lab this year. This is the actual uncertainty in a quantity relative to the instrument being used. In the thermometer example above, the last digit represents the estimated or “uncertain” digit. We always place a “1” in the uncertain place. The uncertainty would be ±0.1.
2. Relative uncertainty – expresses the uncertainty as a fraction of the quantity of interest. The relative uncertainty is calculated as: absolute uncertainty / measured quantity

For the thermometer example, the relative uncertainty would be calculated as:

 0.1 / 76.0 = **0.0013**

1. Percent uncertainty – relative uncertainty x 100

For the thermometer example, the percent uncertainty would be calculated as:

 0.0013 \* 100 = **0.13**

EXAMPLE #1: A student measures the volume of a burette below. Be sure to list the appropriate number of digits, as well as the absolute, relative, and percent uncertainty that goes along with the measurement.

Absolute: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Relative:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Percent:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

EXAMPLE #2: Convert the following to relative uncertainties:

1. 2.70± 0.05 cm b.) 12.02 ±0.08 cm

EXAMPLE #3: Convert the following to absolute uncertainty:

1. 3.5 ± 10% cm b.) 16 ± 8% s

EXAMPLE #4: Use the following scales to measure the quantities required. Be sure to list the appropriate number of digits as well as the ABSOLUTE uncertainty that goes along with each measurement.