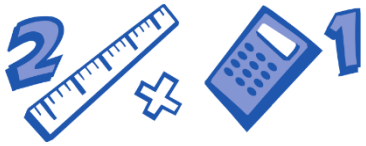
Measurement and the Metric System **Name**_____

Significant Digits and Uncertainty in Measurements

Read from **Lesson 3 Measurements in Chemistry** in the **Chemistry Tutorial Section, Chapter 1** of **The Physics Classroom**:
Part 3a: Precision and Uncertainty **Part 3b:** Significant Digits **Part 3c:** Evaluating Results

Significant Digits

Significant digits in a measurement are all of the certain digits in that measurement, plus the first estimated digit.



1. How many significant digits are in each of the following measurements?

a. 7.14 _____	b. 71.4 _____	c. 7140 _____
d. 7140.0_____	e. 0.0714 _____	f. 0.0710_____
g. 7.14×10^{-5}_____	h. 7.14×10^{11}_____	i. 71.40714 _____

2. Carry out the following calculations and show the correct number of significant digits in your answer.
   a. 60.2 + 31.4 _____
   b. 60.2 - 31.4_____
   c. 60.2 x 31.4_____
   d. 60.2 / 31.4_____
   e. 60.2^4_____
   f. 60.2 x 0.031_____
   g. (60.2 x 31.4) / 0.07_____
   h. $\sqrt{60.2}$_____

Uncertainty In Measurements

When you are working in a chemistry lab, your measurements should be both **accurate** and **precise**.
Percent error is the difference between an **experimental value** and a **theoretical value,** calculated as a percentage of the theoretical value.

3. Three measurements of volume, mass, and length were made. Are these measurements accurate, precise, both, or neither?
   a. Volume measurements: 16.1 mL, 15.9 mL, 16.0 mL.
   If the actual volume is 12.1 mL, are the volume measurements accurate, precise, both, or neither? _____

   b. Mass measurements: 848 g, 678 g, 1002 g
   If the actual mass is 535 g, are the mass measurements accurate, precise, both, or neither? _____

   c. Length measurements: 5.2 cm. 5.4 cm, 5.5 cm
   If the actual length is 5.3 cm, are the length measurements accurate, precise, both, or neither?_____

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4. The density of mercury is 13.8 g/mL. In lab, Molly Cule measures the density to be 13.4 g/mL. What is the percent error of her result?

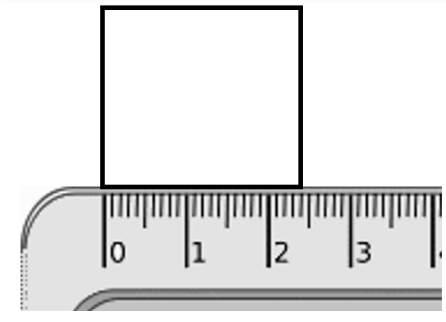
5. A rectangular cube has a volume of 777 cm^3. Mark Kury makes measurements of its length, width, and height and measures them to be 9.29 cm, 7.81 cm, and 11.2 cm, respectively.
   a. What is the calculated volume?
   b. What is the percent error of the calculated volume?

6. Flo Wrene receives a gold medal in a trivia contest. She is not certain that it is real gold. The density of gold is 19.3 g/cm^3. If Flo's medal has a mass of 125.0 g and a volume of 8.46 cm^3, is the medal made from gold? If it is not real gold, calculate the medal's density and the percent error of this density compared to the density of gold.

7. a. A cube of copper has a mass of 188.9 g. What is its volume in cm^3? (Density of copper is 8.96 g/cm^3)

   b. What is the length of one side of this cube of copper?

   c. If the cube is measured by this ruler, what is the length of one side of this cube of copper? Use the correct number of significant digits in your answer.



   d. If your answer to part b is considered to be the theoretical value and your answer to part c is considered to be the experimental value, what is the percent error of your measured length?