Worksheet 1 - Calculations

Significant Figures - the number of significant figures (sig. fig.) is a measure of the degree of **uncertainty** in a measurement. There is experimental uncertainty in the last significant figure of a measurement. The rules for sig. fig. are given in Chapter 1.5. All non-zero numbers are significant. Zeros between numbers are significant. Zeros to the left of numbers are not significant. Zeros to the right of numbers may be significant (in presence of a decimal point).

1. Express each of the following numbers in **scientific notation** and decide the number of significant figures:

	Scientific notation	sig.fig.
409.10	______________	_____
4091.00	______________	_____
0.004091	______________	_____
308,000	______________	_____
30,860	______________	_____
0.00056030	______________	_____

Calculations with significant figures - In **multiplication** or **division**, the number of sig. fig. in the answer has only as many sig. fig. as the factor with the smallest number of sig. fig.

$$\frac{(0.46307)(0.0805)}{(63.54)(0.052)(2.809)} = 0.004016430$$

(0.052) ← 2 sig. fig. - limiting factor

which rounds to .0040 or 4.0×10^{-3} (2 sig. fig.)

In **addition** and **subtraction**, the answer should be reported to the same number of decimal places as the term with the least number of decimal places.

$$37.598 - 36.76 = 0.838$$

(36.76) ← 2 decimal places - limiting factor

which rounds to 0.84 or 8.4×10^{-1}

Do addition and subtraction first. When rounding, numbers ≥ 5 are rounded up. Do not round until the **end** of the calculations.

2. Do the following calculations and express the answers to the correct number of sig. fig.

$$\frac{29.837-29.241}{32.064} =$$

$$\frac{752.12 + 26.3}{1.024236842} =$$

Dimensional Analysis - This technique can be used to change units (K$\rightarrow$ ^{o}C) and also as an aid in solving problems, by carefully keeping track of units. SI Units and conversion factors are listed in Appendix 6 (A26) in the textbook. A table of metric to English conversion factors is on page 16 of the textbook. .

> *A certain process yields 4.85 x 10^{-2} g of a chemical product per second. How many kilograms will be produced in five days of continuous reaction?*

Start with what you know on the left and what you are trying to find on the right.

$$\frac{4.85 \times 10^{-2}\ \text{g}}{\text{s}} \qquad\qquad = \_\_\_ \ \text{kg}$$

Then find **conversion factors**, which allow you to change your units.

$$\frac{4.85 \times 10^{-2}\ \text{g}}{\text{s}} \left| \frac{\mathbf{60\ s}}{\mathbf{min}} \right| \frac{\mathbf{60\ min}}{\mathbf{h}} \left| \frac{\mathbf{24\ h}}{\mathbf{day}} \right| \frac{\mathbf{5\ days}}{} \left| \frac{\mathbf{1\ kg}}{\mathbf{10^3\ g}} \right. = 20.95200\ \text{kg}$$

Finally, determine the number of sig. fig. The first term has 3 sig. fig. All of the other factors are definitions, and have ∞ sig. fig. So, the answer will be limited to 3 sig. fig., *21.0 kg*.
In the **conversion factors** the value of the numerator and denominator are the same; 60 seconds = 1 minute, 24 hours = 1 day. The final conversion unit illustrates the use of **metric prefixes**; 1000 grams = 1 kilogram. It is important to know these commonly used prefixes.

3. Fill in the missing information in the following chart.

Metric prefix	Symbol	Exponent
	M	
		10^{-9}
deci		
		10^{-6}
	p	
kilo		
	m	
		10^{-2}

4. A volume of 520. cm^3 is equivalent to:

_____ mL _____ dL ______ L

5. Make the following conversions (Express your answer in ***scientific notation***.)

a. 0.0024 km to nm

b. 3.5 g/dm^3 to mg/mm^3

c. 95 yards to cm (3 feet in a yard; 2.54 cm in 1 inch)

6. You feel a bit feverish and take your temperature with a lab thermometer, marked in degrees kelvin. It reads 310 K. What is your Fahrenheit temperature?
[Remember (^oF) = 1.8 (^oC) + 32^o and K = ^oC +273]

Work on the following problems, paying attention to sig. fig.

7. Write down your height. Convert it to meters (m.)

__ft. __in. = ___ m.

8. A child's sandbox is 4.0 ft. wide, 4.0 ft. long and 9.0 in deep. If there are, on the average, 55 grains of sand per mm^3, how many grains of sand are there in the sandbox?