**Chemistry** **Concepts** Name:

**Chapter 2**: Measurements and Calculations

2-1: Scientific Method

**Scientific method** - logical approach to solving problems …

1. Observation - use of the senses to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   1. data may be:
2. *\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (*descriptive)
3. *\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_* (numerical)
   1. **System** - specific portion of matter in a given region of space that has been \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
4. **Hypothesis** - generalizations about \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, must be \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
5. Experiment - must be conducted to test the hypothesis.
   1. *\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_* -experimental conditions that remain constant.
   2. *\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_* - experimental conditions that change.
      1. *\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ variable* – manipulated by scientist
      2. *\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ variable* – changes in response to independent variable
   3. **Model** - more than just a physical object; it is often …
6. visual, verbal, or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_l
7. example: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
8. **Theory** - broad generalization that \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ or phenomena.

2-2: Units of Measurement

Measurements represent quantities.

* **Quantity** - has \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* measurement ≠ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + the teaspoon is a unit of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + volume is a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

SI has seven (7) base units - most other units are derived from these seven

3.

4.

5.

6.

7.

Mass vs. weight

* **Mass** - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* **Weight** - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Combinations of SI base units form **derived units.**

pressure is measured in kg/m•s2, or *\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*

* **Volume** - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + The derived SI unit is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + The cubic centimeter, cm3, is often used
  + The liter, L, is a non-SI unit
    - 1 L = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
    - 1 mL = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* **Density** - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + The derived SI unit is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ per cubic meter, kg/m3
  + g/cm3 or g/mL are also used

**Sample Problem A:** A sample of aluminum metal has a mass of 8.4 g. The volume of the sample is 3.1 cm3. Calculate the density of aluminum.

* **Conversion factor** - ratio derived from the equality between two different units that can be used \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* **Dimensional analysis** - mathematical technique that allows you to use units to solve \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* Ex: how many seconds are in 2.3 years?

**Sample Problem B:**  Express a mass of 5.712 grams in milligrams and in kilograms.

2-3: Using Scientific Measurements

* **Accuracy** - closeness of measurements to the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the quantity measured.
* **Precision** - closeness of a set of measurements of the same quantity \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* **Percentage error** – percentage a measurement is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Sample Problem C:** A student measures the mass and volume of a substance and calculates its density as 1.40 g/mL. The correct, or accepted, value of the density is 1.30 g/mL. What is the percentage error of the student’s measurement?

* **Error in Measurement** - some error or uncertainty always exists in any measurement.
  1. skill \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  2. conditions \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  3. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* **Significant figures** - consist of all the digits known with certainty plus \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + The term significant **does not** mean \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Sample Problem D:**  How many significant figures are in each of the following measurements?

a. 28.6 g

b. 3440. cm

c. 910 m

d. 0.046 04 L

e. 0.006 700 0 kg

**15.78 g**

**+ 3.1 g**

**Addition or Subtraction with Significant Figures**

* Least precise place value
* Answer will go by lowest placeholder.

**Multiplication or Division with Significant Figures**

**15.78 g x 3.1 g**

* Least total significant figures
* Answer will have the same as the least total significant figures.

**Sample Problem E:** Carry out the following calculations. Express each answer to the correct number of significant figures.

a. 5.44 m - 2.6103 m

b. 2.4 g/mL × 15.82 mL

* Disregard \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ when determining significant figures.

**Scientific notation** -numbers are written in the form M × 10n, where the factor M is \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and n is a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

* example: 0.000 12 mm = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ mm

**Sample Problem:** Convert into scientific notation:

1. 47,532 g
2. 0.0029 m
3. 583.4 s

**Mathematical Operations Using Scientific Notation**

**1.** Addition and subtraction —These operations can be performed only if the values have \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (n factor).

example: (4.2 × 104 kg) + (7.9 × 103 kg)

**2.**  Multiplication —The M factors are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, and the exponents are \_\_\_\_\_\_\_\_\_\_\_\_\_ algebraically.

example: (5.23 × 106 µm)(7.1 × 10−2 µm)

**3.** Division — The M factors are \_\_\_\_\_\_\_\_\_\_\_\_\_\_, and the exponent of the denominator is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

example:

**Sample Problem F:**  Calculate the volume of a sample of aluminum that has a mass of 3.057 kg. The density of aluminum is 2.70 g/cm3.

Direct vs. Inverse Proportions

1. Two quantities are **directly proportional** to each other if \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
2. Two quantities are **inversely proportional** to each other if \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.