Common Metric Prefixes:

Giga (G) = 1,000,000,000 = 1 \cdot 10^9

Kilo (k) = 1,000 = 1 \cdot 10^3

Deci (d) = .1 = 1 \cdot 10^{-1}

Centi (c) = .01 = 1 \cdot 10^{-2}

Milli (m) = .001 = 1 \cdot 10^{-3}

Micro (\mu) = .000001 = 1 \cdot 10^{-6}

Nano (n) = .000000001 = 1 \cdot 10^{-9}

Common Metric-English Approximate Equivalents:

Length: 1 inch (in) = 2.54 centimeters (cm)

Mass: 1 pound (lb) = 454 grams (g)

Volume: 1 quart (qt) = 946 milliliters (mL)

Time: 1 second (sec) = 1.00 second (s)

Metric System Exact Equivalents:

Length: 1 meter (m) = 100 centimeters (cm)

1 meter (m) = 1000 millimeters (mm)

1 kilometer (km) = 1000 meters (m)

Volume: 1 Liter (L) = 1000 milliliters (mL)

1 Liter (L) = 10 deciliters (dL)

1 milliliter (mL) = 1 cubic centimeter (cm^3)

English System Exact Equivalents

Length: 1 foot (ft) = 12 inches (in)

1 mile (mi) = 1760 yards (yd)

1 mile (mi) = 5280 feet (ft)

Mass: 1 pound (lb) = 16 ounces (oz)

1 ton = 2000 pounds (lb)

Volume: 1 quart (qt) = 32 fluid ounces (fl oz)

1 quart (qt) = 2 pints (pt)

1 gallon (gal) = 4 quarts (qt)
**Significant Figures in Chemistry**

Exact Values = Unlimited Significant Figures (SF's apply only to measurements)

Measurements (Count the number of digits from left to right):

A) Start with the first non-zero digit.
B) Do not count place holder zeros (0.011, 0.00011, and 11,000 each have only two significant digits)

**Significant Figures in Calculations in Chemistry**

Addition/ Subtraction: The answer is limited to the least certain measurement in a set of data.

Multiplication/ Division: The answer is limited to the least number of significant digits in the given data.

**Temperature Equivalents**

\[
\frac{9}{5} (\, ^\circ C) + 32 = (\, ^\circ F)
\]

\[
\frac{5}{9} (\, ^\circ F - 32) = (\, ^\circ C)
\]

\[
(\, ^\circ C) + 273 = K
\]

**Energy Equalities**

1 calorie (cal) = 4.184 joules (J)

1 kilocalorie (kcal) = 1000 calories (cal) = 1 food Calorie (Cal)

1 kilocalorie (kcal) = 4.184 kilojoules (kJ)

**Specific Heat Equation**

\[ q = mc\Delta T \]

q=heat in calories

m=mass in grams

\[ c=\text{specific heat in } \frac{\text{cal}}{\text{grams} \cdot \text{degrees Celsius}} \]

\[ \Delta T = \text{change in temperature in degrees Celsius} \]

**Weighted Percentage Calculations**

Atomic Mass = (Mass of Isotope#1 X Abundance Percentage) + (Mass of Isotope#2 X Abundance Percentage)

**Calculation of Number of Protons and Neutrons for an Element**

Atomic Mass = total protons + total neutrons  \( \text{(Total Protons} = \text{Atomic Number}) \)
1 Mol = molar mass of a substance = $6.02 \times 10^{23}$ atoms = 22.4L at STP

Molarity = moles/Liter of solution.

**Stoichiometry Analysis Strategy**

$2C(s) + O_2(g) \overset{\Delta}{\rightarrow} 2CO(g)$

**Conversion Factors:**

$$\frac{2molC}{1molO_2} = \frac{2molC}{2molCO} = \frac{1molO_2}{2molCO}$$

**Boyles Law:**

$$P_1V_1 = P_2V_2$$

**Charles’ Law:**

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$ where $T$ needs to be represented in Degrees Kelvin

**Combined Gas Law:**

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

**Standard Conditions of Temperature and Pressure for gasses:**

Temp. = 0 °C = 273 K

Press. = 1 atmosphere = 760 mm Hg = 760 torr = 76 cm Hg

**Direct Proportions:**

Values on one side of the equals sign increases causes the other side of the equals sign to increase.

Values on one side of the equals sign decreases causes the other side of the equals sign to decrease.

**Indirect Proportions:**

Values on one side of the equals sign increases causes the other side of the equals sign to decrease.

**Concentration Formula:**

$$M_1V_1 = M_2V_2$$ where $M_1V_1$ are the Molarity and Volume of the initial concentrated solution and $M_2V_2$ are the Molarity and Volume of the final diluted solution.
**Stock Solution Formula:**

\[ C_1V_1 = C_2V_2 \]

where \( C_1V_1 \) are the Concentration and Volume of the initial concentrated solution and \( C_2V_2 \) are the Concentration and Volume of the final diluted solution. (Initial concentration would also be known as the Stock Solution.)

Using The \( C_1V_1 = C_2V_2 \) Equation:

Step 1) Determine the initial concentration of stock solution. This is C1.

Step 2) Determine the volume of stock solution required. This is usually the unknown.

Step 3) Determine the final concentration required. This is C2.

Step 4) Determine the final volume required. This is V2.

Step 5) Insert the values determined in steps 1-4 into the formula and solve for the unknown.

Note: This equation is only used when calculating how to prepare a less concentrated solution from a more concentrated solution. Do not use this equation in other situations.

**Equilibrium Constant (K):**

\[ K = \frac{[C]^a[D]^d}{[A]^b[B]^c} \]

where C and D are the concentrations of the products, A and B are the concentrations of the reactants, a and b are the stoichiometric coefficients of the products, and c and d are the stoichiometric coefficients of the reactants.

**pH Calculations:**

\[ pH = -\log[H_3O^+] \]

where a pH<7 is acidic, a pH>7 is basic, and a pH=7 is neutral.

**Graphing Bacterial Growth:**

When graphing using semilog paper, use the y-axis to represent the log of the number of cells present and the x-axis as the time elapsed. (Make sure that the scale is consistent between each of the divisions on each of the axes)

**Rules For Manipulating Percents:**

1. To convert a percent to its decimal equivalent move the decimal point two places to the left.

2. To change a decimal to a percent, move the decimal point two places to the right and add a % sign.
3. To change a percent to a fraction, write the percent as a fraction with a denominator of 100.

4. To convert a fraction to a percent, convert the fraction to its decimal equivalent and then move the decimal two places to the right and add a % sign.

5. To find a percentage of a particular number convert the percent to its decimal equivalent and multiply the decimal times the number of interest.

**Percent Error:**

Percent Error = \[
\frac{(\text{True Value} - \text{Average Measured Value}) \times 100}{\text{True Value}}\]

**Concentration:**

The amount of a particular substance (solute) in a stated volume (or mass) of a solution or mixture. (Concentration is the ratio where the numerator is the amount of the material of interest and the denominator is usually the volume or sometimes mass of the entire mixture.)

**Calculating the Concentration of Solute After Diluting a Stock Solution:**

**Rule 1:** To calculate the concentration of a substance in a diluted sample, multiply the original concentration of the substance times the dilution.

**Rule 2:** To calculate the concentration of a substance in an original stock solution, multiply the concentration of the substance in a diluted sample times the inverse of the dilution (expressed as a fraction).