**Chemistry I – Dimensional Analysis**

**Dimensional Analysis:**

 - Dimensional Analysis—provides a mathematical way of converting

 between one unit and another

 - also called the “Factor-Label” Method or “Unit-Factor” Method

 - Dimensional Analysis is based on EQUALITIES between units

 - uses a CONVERSION FACTOR (based on the equality of the 2 units)

 to convert from one unit to another

 - *How many eggs in 3.25 dozen??*

 **Given: 3.25 doz**

 **Answer: ?? eggs**

 **So we have to convert between DOZ and EGGS**

 **We need an EQUALITY between those 2 different units**

 **Equality: 1 doz = 12 eggs**

 **Now to set up Dimensional Analysis:**

 **1) start with the Given information as a FRACTION**

 **(over 1)**

**2) multiply by the CONVERSION FACTOR (written as a**

 **FRACTION so the GIVEN UNITS are in the**

 **DENOMINATOR!!)**

 **- you may need to use MORE THAN ONE factor**

**3) solve the problem to get the ANSWER in the units**

 **you are looking for**

NOTICE that the units of DOZ cancel out since DOZ/DOZ = 1 !!! The only units left are EGGS and that is what you are looking for so solve the problem (MULTIPLY any factors in the NUMERATOR and DIVIDE by any factors in the DENOMINATOR)

 *3.25 ~~doz~~ 12 eggs*

 *------------------ x ----------------- = 39 eggs*

 *1 1 ~~doz~~*

 *- How many dozen is 62 eggs??*

$$\left(\frac{62 eggs}{1}\right)\left(\frac{1 doz}{12 eggs}\right)=5.17 doz$$

 - in some cases in Dimensional Analysis you may need to use MORE THAN

 ONE conversion factor

 - if this is the case, they may be grouped together until the desired units

 are obtained.

 - *How many seconds are in 1.00 years??*

 **Given: 1.00 years**

 **Answer: ?? seconds**

 **Since if I knew the equality it would already answer the**

 **question, we need to build up to it**

 **Equality: 1.00 years = 365.25 days**

 **1.00 days = 24 hours**

 **1.00 hours = 60 minutes**

 **1.00 min = 60 seconds**

 **We will need to use ALL of these conversion factors as we**

 **solve this problem**

*1.00 ~~yrs~~ 365.25 ~~days~~ 24 ~~hrs.~~ 60 ~~min~~ 60 sec*

*----------- x ---------------- x -------------- x ---------- x ------------ = 31, 557, 600 sec*

 *1 1.00 ~~yrs~~ 1.00 ~~days~~ 1.00 ~~hrs~~  1.00 ~~min~~*

NOTICE that ALL of the units cancel out EXCEPT seconds (which is the unit that we want for the answer!!)

 - *How many minutes in 16.00 years??*

$$\left(\frac{16.00 yrs}{1}\right)\left(\frac{365.25 days}{1 yrs}\right)\left(\frac{24 hrs}{1 days}\right)\left(\frac{60 min}{1 hrs}\right)=8,415,360 min$$

 - *How many years in 1.00 minute??*

$$\left(\frac{1.00 min}{1}\right)\left(\frac{1 hrs}{60 min}\right)\left(\frac{1 days }{24 hrs}\right)\left(\frac{1 yrs}{365.25 days}\right)=1.9 x 10^{-6} yrs.$$

- Sometimes you may be given or need to work with derived units (units that are

 a result of a particular equation involving more than one variable)

- In this case, treat the factor as a RATIO (fraction) of the units with the proper

 numbers going with the units

- **Ex. A low flow shower head is rated as 1.5 gallons per minute. How many L of**

 **water to take a 15 min shower??**

 **- HINT: 1 gal = 3.79 Liters**

 **- since a 1 min shower takes 1.5 gallons (according to given info) then the**

 **ratio could be written as (depending on what units need to cancel):**

 ***1.5 gallons 1 min***

 ***------------------- OR -----------------***

 ***1 min 1.5 gallons***

 - SOLVE:

 15 ~~min~~ 1.5 ~~gallons~~ 3.79 L

 -------------- x -------------------- x -------------- = 85.3 L of water!!

 1 1 ~~min~~ 1 ~~gallon~~

 - *A car is going 65 miles per hour. How many meters per second is it going?*

 *- HINT : 1 mile = 5280 ft*

 *1 meter = 39.37 inches*

$$\left(\frac{65 miles}{1 hr}\right)\left(\frac{5280 ft}{1 miles}\right)\left(\frac{12 in}{1 ft}\right)\left(\frac{1 m}{39.37 in}\right)\left(\frac{1 hr}{60 min}\right)\left(\frac{1 min}{60 sec}\right)=29 m/sec$$

- Sometimes factors must be SQUARED or CUBED during a calculation.

- If this is the case, YOU DO WITH THE UNITS THE SAME THING YOU DO WITH THE

 NUMBERS!!! (if you square the numbers, then SQUARE the units too!!)

- A *box has a volume of 3.25 cubic feet. What would the volume be in cubic*

 *centimeters???*

 - HINT : 1 inch = 2.54 cm

$$\left(\frac{3.25 ft^{3}}{1}\right)\left(\frac{12 in}{1 ft}\right)^{3}\left(\frac{2.54 cm}{1 in}\right)^{3}=9.20 x 10^{4} cm^{3}$$

$$\left(\frac{3.25 ft^{3}}{1}\right)\left(\frac{12 in}{1 ft}\right)\left(\frac{12 in }{1 ft}\right)\left(\frac{12 in}{1 ft}\right)\left(\frac{2.54 cm}{1 in}\right)\left(\frac{2.54 cm}{1 in}\right)\left(\frac{2.54 cm}{1 in}\right)$$