

# **N2 – Dimensional Analysis**

Also known as “Unit Conversion”

# Remember - Canceling Units

One on top cancels with one on the bottom

$$\frac{\cancel{xy}}{\cancel{x}} = y$$

$$\frac{15 \cancel{\text{cm}^3}}{5 \cancel{\text{cm}}} = 3 \text{ cm}^2$$

# Conversion Factors

*A relationship between how many of one thing equals how many of another thing*

$$12\text{in} = 1\text{ft}$$

$$24\text{hrs} = 1,440\text{min}$$

$$1000\text{m} = 1\text{km}$$

*You can rewrite as fractions:*

$$\frac{12\text{in}}{1\text{ft}} = 1$$

$$\frac{24\text{hr}}{1,440\text{min}} = 1$$

$$\frac{1\text{km}}{1000\text{m}} = 1$$

# Conversion Factors

*You can flip conversion factors too*

$$12\text{in} = 1\text{ft} \quad 24\text{hrs} = 1,440\text{min}$$

*Just depends on what you are doing*

$$\frac{12\text{in}}{1\text{ft}} = 1 \quad \frac{1\text{ft}}{12\text{in}} = 1$$

$$\frac{24\text{hr}}{1,440\text{min}} = 1 \quad \frac{1,440\text{min}}{24\text{hr}} = 1$$

# Using Conversion Factors

*If you multiply by a conversion factor, you are just multiplying by 1...your answer LOOKS DIFFERENT because of the unit but is the same SIZE MEASUREMENT. (12in/1ft or 1ft/12in)*

$$85 \text{ inches} \times \frac{1 \text{ ft}}{12 \text{ in}} = 7.1 \text{ ft}$$

# Using Conversion Factors

*You can use multiple conversion factors –  
“a frog hopping across a pond on lily pads”*

**Convert 3.6mi into cm.**

*(1cm=0.3937in, 12in=1ft, 1mi=5,280ft)*

$$3.6\cancel{mi} \times \frac{5280\cancel{ft}}{1\cancel{mi}} \times \frac{12\cancel{in}}{1\cancel{ft}} \times \frac{1\text{cm}}{0.3937\cancel{in}} = 5.8 \times 10^5 \text{cm}$$

# You try one...

Convert 15 years into minutes

$$15 \text{ yrs} \times \frac{365 \text{ days}}{1 \text{ yr}} \times \frac{24 \text{ hrs}}{1 \text{ day}} \times \frac{60 \text{ min}}{1 \text{ hr}} = 7.9 \times 10^6 \text{ min}$$

# Dimensional Analysis with “Derived/Double Units”

*Some units are combinations of two or more other units. Like miles per hour (mi/hr). Fix the top unit, then go back and fix the bottom unit*

**Convert 20mi/hr into in/sec.**

$$\frac{20\cancel{\text{mi}}}{1\cancel{\text{hr}}} \times \frac{5280\cancel{\text{ft}}}{1\cancel{\text{mi}}} \times \frac{12\text{in}}{1\cancel{\text{ft}}} \times \frac{1\cancel{\text{hr}}}{60\cancel{\text{min}}} \times \frac{1\cancel{\text{min}}}{60\text{sec}} = 352 \frac{\text{in}}{\text{sec}}$$



# You try one...

Convert 30km/day into ft/min (1m=39.37in)

$$\frac{30\text{km}}{1\text{day}} \times \frac{1000\text{m}}{1\text{km}} \times \frac{39.37\text{in}}{1\text{m}} \times \frac{1\text{day}}{24\text{hr}} \times \frac{1\text{hr}}{60\text{min}} = 820 \frac{ft}{min}$$

# Dimensional Analysis - Squared, Cubed (etc) Units

*If you have a unit that is raised to a power, then the conversion factors used will also need to be raised to that power.*

$$1 \text{ in} = 2.54\text{cm} \quad \text{but} \quad 1\text{in}^2 = (2.54\text{cm})^2$$

$$1 \text{ ft} = 12\text{in} \quad \text{but} \quad 1\text{ft}^3 = (12\text{in})^3$$

$$\frac{5\cancel{\text{in}}^2}{1\cancel{\text{in}}^2} \left| \frac{(2.54\text{cm})^2}{1} \right. = 32.258 \text{ cm}^2$$