

DIMENSIONAL ANALYSIS AND UNIT CONVERSIONS

Dimensional analysis is a useful problem strategy for dealing with problems involving measurements. Measurements must have both a value and a unit, which must also be accounted for in any mathematical manipulation of the measurement. Dimensional analysis can be summarized in five simple steps, as shown below:

1. Write the value and unit of the known quantity
2. Draw a bracket (or a new fraction)
3. Place the known's unit on BOTTOM of the bracket/fraction
4. Place the desired unit on TOP of the bracket/fraction
5. Fill in the conversion factor and calculate!

TIP: it is easier if the bigger unit always receives the value "1" in the conversion factor

EXAMPLE: If the earth has a diameter of 12756 km, then how many miles is the diameter of the earth? (1km=1.6miles)

$$12756 \text{ km} \times \frac{1 \text{ mile}}{1.6 \text{ km}} = 7973 \text{ miles}$$

Complete the following conversions, showing ALL work.

1. A bullet has a mass of 452.2g. Express this in kilograms.

$$\frac{452.2g}{1000g} \times \frac{1kg}{1000g} = 452.2kg$$

2. The distance from the earth to the sun is approximately 9.6×10^8 miles. How many kilometers is this? (1 mile = 1.6 km)

$$\frac{9.6 \times 10^8 \text{ miles}}{1 \text{ mile}} \times \frac{1.6 \text{ km}}{1 \text{ mile}} = 1.5 \times 10^9 \text{ miles}$$

3. A block of wood has a volume of 455 mL. How many nanoliters does it occupy?

$$\frac{455 \text{ mL}}{1000 \text{ mL}} \times \frac{1 \text{ L}}{1 \text{ L}} \times \frac{10^9 \text{ nL}}{1 \text{ L}} = 4.55 \times 10^8 \text{ nL}$$

4. An arrow is travelling with a velocity of 357 ft/s. How many meters per second is this? (2.54cm = 1in)

$$\frac{357 \text{ ft}}{1 \text{ sec}} \times \frac{12 \text{ in.}}{1 \text{ ft}} \times \frac{2.54 \text{ cm}}{1 \text{ in}} \times \frac{1 \text{ m}}{100 \text{ cm}} = 109 \text{ m}$$

5. A candy bar can supply 325000 calories when burned. How many joules of energy is this? (1cal = 4.184J)

$$\frac{325000 \text{ cal}}{1 \text{ cal}} \times 4.184 \text{ J} = 1.36 \times 10^6 \text{ J}$$

6. A car engine is making 3600 rotations per second. How many rotations is the car making per day?

$$\frac{3600 \text{ r}}{1 \text{ sec}} \times \frac{60 \text{ sec}}{1 \text{ min}} \times \frac{60 \text{ min}}{1 \text{ hr}} \times \frac{24 \text{ hr}}{1 \text{ day}} = 3.1 \times 10^8 \text{ rotations/day}$$

7. A certain book measures 25.25cm on one side. Express this value in micrometers.

$$\frac{25.25 \text{ cm}}{100 \text{ cm}} \times \frac{1 \text{ m}}{1 \text{ m}} \times \frac{10^6 \text{ } \mu\text{m}}{1 \text{ m}} = 2.525 \times 10^5 \text{ } \mu\text{m}$$

8. Calculate the number of kilomoles of lead present in 452 centimoles of lead.

$$\frac{452 \text{ cmoles}}{100 \text{ cmoles}} \times \frac{1 \text{ mole}}{1 \text{ mole}} \times \frac{1 \text{ kmole}}{1000 \text{ mole}} = 4.52 \times 10^{-3} \text{ kmoles}$$

9. 400K is equivalent to what temperature in degrees Celsius?

$$400 \text{ K} - 273 = 127^\circ \text{C}$$

10. If you are travelling down the interstate and the speed limit is 70 miles per hour, are you speeding if you are travelling 0.022 kilometers per second?

$$\frac{70 \text{ mile}}{1 \text{ hr}} \times \frac{1.6 \text{ km}}{1 \text{ mile}} \times \frac{1 \text{ hr}}{60 \text{ min}} \times \frac{1 \text{ min}}{60 \text{ sec}} = 3.1 \times 10^{-2} \text{ km/s}$$

$$\frac{0.022 \text{ km}}{1 \text{ sec}} \times \frac{1 \text{ mile}}{1.6 \text{ km}} \times \frac{60 \text{ sec}}{1 \text{ min}} \times \frac{60 \text{ min}}{1 \text{ hr}} = 49.5 \text{ mph}$$