* = those problems covered in class.

Metric Conversions!
Practice Using the Factor-label Method

If a car is going down the highway at a rate of 95 km/h, how fast is this in m/s?

\[
\left(\frac{95 \text{ km}}{\text{h}}\right) \left(\frac{1 \text{ h}}{3600 \text{ s}}\right) \left(\frac{1000 \text{ m}}{1 \text{ km}}\right) = 26 \text{ m/s}^{-1}
\]

Factor-Label Method for Conversions

- When converting from one unit to another (i.e., kg \(\rightarrow\) g, or feet \(\rightarrow\) meters), we use **Conversion Factors**.
- Conversion factors tell us the equivalent magnitude in the new unit.
  - For example:
    - 1 in. = 2.54 cm
    - 1 lb = 454 g
    - 1 kg = 2.2 lb
Factor-Label Method for Conversions

- When converting, we make fractions (ratios) out of the conversion factors so that the original unit divides out (cancels out) and the new unit remains:

  - Example:
    - 2.75 pounds is equal to how many kilograms?

\[
\left( \frac{2.75 \text{ lb}}{2.2 \text{ lb}} \right) \left( \frac{1 \text{ kg}}{1 \text{ lb}} \right) = 1.25 \text{ kg}
\]

Common Conversion Factors
(You will NOT need to memorize these!)

- 1 mile (mi) = 1609 m
- 1 inch (in) = 2.54 cm
- 2.2 pounds (lb) = 1 kg
- 1 lb = 454 g
- 1 mL = 1 cm³
- 1 gallon (gal) = 3.785 L
- 1 gal = 8 pints

The Space Needle is 605.0 ft tall (base to top of the antenna).

- How many meters is this?
  - ft → in → cm → m

\[
\left( \frac{605.0 \text{ ft}}{1 \text{ ft}} \right) \left( \frac{12 \text{ in}}{1 \text{ ft}} \right) \left( \frac{2.54 \text{ cm}}{1 \text{ in}} \right) \left( \frac{1 \text{ m}}{100 \text{ cm}} \right) = 184.4 \text{ m}
\]
According to the Guinness Book of World Records (GWR, 2008), a man from London balanced a 352 lb car (a Mini) on his head for 33 seconds.

What is the mass of this car in kilograms?

\[
\text{(352 lb)} \times \left( \frac{1 \text{ kg}}{2.2 \text{ lb}} \right) = \left( 160 \right) \text{ kg}
\]

A cheetah can run at speeds up to 70.0 miles per hour. How fast is this in meters per second?

\[
\left( \frac{70 \text{ mi}}{h} \right) \times \left( \frac{1609 \text{ m}}{1 \text{ mi}} \right) \times \left( \frac{1 \text{ h}}{3600 \text{ s}} \right) = \left( 31.3 \right) \text{ m/s}
\]

Michael Phelps holds the Olympic Record for the 200m butterfly from his race at the Beijing Olympics with a time of 1 min, 50.53 s. His average speed was 1.81 meters/second.

How fast was he swimming in miles per hour?

\[
\left( \frac{1.81 \text{ m}}{s} \right) \times \left( \frac{3600 \text{ s}}{1 \text{ h}} \right) \times \left( \frac{1 \text{ mi}}{1609 \text{ m}} \right) = \left( 4.05 \right) \text{ mi/h}
\]
The world record for the Men's 100m sprint, 9.58 seconds, was set by Usain Bolt of Jamaica in 2009. This means he was running at an average speed of 10.44 m/s.

https://www.youtube.com/watch?v=3mblhpC29_g

a) How fast was Usain Bolt running in km/hr?

b) How fast was he running in mi/hr?

\[
\left( \frac{10.44 \text{ m}}{5 \text{ s}} \right) \left( \frac{1 \text{ km}}{1000 \text{ m}} \right) \left( \frac{3600 \text{ s}}{1 \text{ h}} \right) = 37.58 \text{ km/h}
\]

\[
\left( \frac{10.44 \text{ m}}{5 \text{ s}} \right) \left( \frac{1 \text{ mi}}{1609 \text{ m}} \right) \left( \frac{3600 \text{ s}}{1 \text{ h}} \right) = 23.36 \text{ mi/h}
\]

A Lotus Elise reportedly can accelerate from 0 → 60 mi/h in under 5 seconds! Assume its acceleration is 43,200 mi/hr² (miles per hour squared).

What is its acceleration in m/s²?

\[
\frac{43200 \text{ mi}}{1 \text{ h}} \times \frac{1 \text{ h}}{3600 \text{ s}} \times \frac{3600 \text{ s}}{1 \text{ mi}}
\]

\[
= 15.36 \text{ m/s}^2
\]

The largest single ruby (GWR, 2009), has dimensions of 12.20 in. x 6.49 in. x 5.51 in.

What is the volume of this ruby in liters (L)?

How does this compare to a 2-Liter bottles of pop? (which is bigger, and how many times bigger?)

\[
(12.20 \text{ in}) (6.49 \text{ in}) (5.51 \text{ in}) \left( \frac{2.54 \text{ cm}}{1 \text{ in}} \right)^3 \left( \frac{1 \text{ mL}}{1 \text{ cm}^3} \right) \left( \frac{1 \text{ L}}{1000 \text{ mL}} \right)
\]

\[
= 9.15 \text{ L}
\]

\[
(7.15 \text{ L}) \left( \frac{1 \text{ bottle}}{2 \text{ L}} \right) = 3.57 \text{ bottles}
\]
The Georgia Aquarium in Atlanta has the largest amount of water volume of all the world's aquariums (GWR, 2007). It has a total of 63.99 million pints of water in its tanks.

How many cubic meters is this equivalent to?

\[
\left( \frac{63.99 \times 10^6 \text{ pint}}{8 \text{ pint}} \times \frac{1 \text{ gal}}{1 \text{ pint}} \times \frac{3.785 \text{ L}}{1 \text{ gal}} \times \frac{1000 \text{ cm}^3}{1 \text{ L}} \times \frac{1 \text{ m}^3}{100 \text{ cm}^3} \right) = \frac{2.42 \times 10^4}{8 \times 10^3} \times 30,280 \text{ m}^3
\]

The gas tank of a Subaru Forester can hold 15.9 gal.

How many liters of gas is this?

\[
(15.9 \text{ gal}) \times \frac{3.785 \text{ L}}{1 \text{ gal}} = 60.2 \text{ L}
\]

Gas mileage for a Toyota Corolla can be 38 mpg (miles per gallon).

What is its gas mileage in kilometers per Liter?

\[
\left( \frac{38 \text{ mi}}{1 \text{ gal}} \times \frac{1 \text{ gal}}{3.785 \text{ L}} \times \frac{1.609 \text{ km}}{1 \text{ mi}} \right) = 160.15 \times 16 \text{ km/L}
\]
Gas costs $3.60/gallon here. Gas cost $1.41/Liter in Canada this year (costs have already been converted to U$S).

Who pays more for a gallon of gas, and how much more?

\[
\frac{1.41}{1 \text{ gal}} \times \frac{3.785 \text{ L}}{1 \text{ gal}} = \frac{5.34}{\text{ gal}}
\]

Canada pays $1.74 more per gallon.

\[
\frac{5.34}{3.60} \times 100 \% = 148 \%
\]

The density of aluminum is 2.7 g/mL. What is its density in kg/m³?

\[
\frac{2.7 \text{ g}}{1 \text{ mL}} \times \frac{1 \text{ kg}}{1000 \text{ g}} \times \frac{1 \text{ mL}}{1 \text{ cm}^3} = \frac{2.7 \text{ g}}{1 \text{ cm}^3}
\]

\[
= \frac{2.7 \text{ kg}}{1 \text{ m}^3}
\]