* = those problems covered in class.

9/9/2019

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?

$$\left(\frac{95\,km}{h}\right)\left(\frac{1\,h}{3600\,s}\right)\left(\frac{1000\,m}{1\,km}\right) = 26\,m\cdot s^{-1}$$

Factor-Label Method for Conversions

- When converting from one unit to another (i.e. kg → g, or feet → 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?

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

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 cm^3
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

$$(605.0\ \text{ft})\left(\frac{12\ \text{in}}{1\ \text{ft}}\right)\left(\frac{2.54\ \text{cm}}{1\ \text{in}}\right)\left(\frac{1\ \text{m}}{100\ \text{cm}}\right)$$

$$= 184.4\ \text{m}$$

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?

$$(352\ \text{lb})\left(\frac{1\ \text{kg}}{2.2\ \text{lb}}\right) = \boxed{160.\ \text{kg}}$$

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

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

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?

$$\left(\frac{1.81\ \text{m}}{\text{s}}\right)\left(\frac{3600\ \text{s}}{1\ \text{h}}\right)\left(\frac{1\ \text{mi}}{1609\ \text{m}}\right) = \boxed{4.05\ \text{mi}\cdot\text{h}^{-1}}$$

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=3nbJhpcZ9_g

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

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

$$\left(10.44\frac{m}{s}\right)\left(\frac{1\,km}{1000\,m}\right)\left(\frac{3600\,s}{1\,h}\right) = 37.58\frac{km}{h}$$

$$\left(10.44\frac{m}{s}\right)\left(\frac{1\,mi.}{1609\,m}\right)\left(\frac{3600\,s}{1\,h}\right) = 23.36\frac{mi}{h}$$

A Lotus Elise r reportedly can accelerate from 0 → 60 mi/h in under 5 seconds! Assume its acceleration is 43,200 mi/hr^2 (miles per hour squared).

- What is its acceleration in m/s^2?

$$43200\frac{mi}{h^2}\times\frac{1\,h}{3600\,s}\times\frac{1\,h}{3600\,s}\times\frac{1609\,m}{1\,mi}$$

$$= \boxed{5.36\ m\cdot s^{-2}}$$

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?)

$$(12.20\,in)(6.49\,in)(5.51\,in)\left(\frac{2.54\,cm}{1\,in.}\right)^3\left(\frac{1\,mL}{1\,cm^3}\right)\left(\frac{1\,L}{1000\,mL}\right)$$

$$= \boxed{7.15\ L}$$

$$(7.15\,L)\left(\frac{1\ bottle}{2L}\right) = \boxed{3.57\ bottles}$$

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?

$$(63.99\times10^6 \text{ pint})\left(\frac{1 \text{ gal}}{8 \text{ pint}}\right)\left(\frac{3.785 \text{ L}}{1 \text{ gal}}\right)\left(\frac{1000 \text{ cm}^3}{1 \text{ L}}\right)\left(\frac{1 \text{ m}}{100 \text{ cm}}\right)^3$$

$$= \frac{2.42\times10^{11}}{(8)(100^3)} = 30,275 \text{ m}^3$$

$$\approx \boxed{30,280 \text{ m}^3}$$

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

- How many Liters of gas is this?

$$(15.9 \text{ gal})\left(\frac{3.785 \text{ L}}{1 \text{ gal}}\right) = \boxed{60.2 \text{ L}}$$

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

- What is its gas mileage in kilometers per Liter?

$$\left(\frac{38 \text{ mi}}{\text{gal}}\right)\left(\frac{1 \text{ gal}}{3.785 \text{ L}}\right)\left(\frac{1.609 \text{ km}}{1 \text{ mi}}\right)$$

$$= 16.15 \approx \boxed{16 \text{ km/L}}$$

Gas costs $3.60/gallon here. Gas cost $1.41/Liter in Canada this year (costs have already been converted to US$).

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

$$\left(\frac{\$1.41}{1\,L}\right)\left(\frac{3.785\,L}{1\,gal}\right) = \frac{\$5.34}{gal}$$

Canada pays $1.74 more per gallon

$$\left(\frac{5.34}{3.60} \times 100\% = 148\%\right)$$

The density of aluminum is 2.7 g/mL. What is its density in kg/m^3?

$$\left(\frac{2.7\,g}{mL}\right)\left(\frac{1\,kg}{1000\,g}\right)\left(\frac{1\,mL}{1\,cm^3}\right)\left(\frac{100\,cm}{1\,m}\right)^3$$

$$= \boxed{2700\ kg \cdot m^{-3}}$$