1.6.1: Measurements, Quantities, and Unity Factors Lecture Demonstrations

Convert Mass

Convert 12 lb weight of bowling ball to g, showing unity factors

12.00 lb x 453.59237 g/lb = 5443 g

Calculate and convert volumes

$V=4/3\ \pi\ r^3$

$V = 4/3 * 3.1416 * (1/2 * 8.59\ in)^3 =$

$4/3 * 3.1416 * 79.23\ in^3$

$=331.9\ in^3$

Unity Factor: 2.54 cm = 1 in

$331.9\ in^3$ x $(2.54\ cm / 1\ in)^3$ Note!!!

$331.9\ in^3$ x $16.39 cm^3/in^3$

$= 5439\ cm^3$

Densities

Will the bowling ball float in water? Demo [1]

D = 5443 g / 5439 cm^3 Too close to call. See Errors in Measurement Lecture Demonstrations

Mass vs. Weight

What is the mass of hydrogen?

Density of hydrogen at room temperature and 1 Atm = 0.082 g/L

What is the volume in L, assuming same size as bowling ball? Unity Factors?

1 cm^3 = 1 mL = 10^{-3}L (Note: 1 mL = 1 cm^3 = "1 cc")

V (L) = 5500 cm^3 x (1 L / 1000 cm^3)

m (g) = V (L) * D (g/L) = 5.500 L x 0.082 g/cm^3

= 0.451 g

Why does the Hydrogen balloon float? F = W = m g

F = W = (0.451 g x 1 kg /1000g) * 9.8 $m*s^{-2}$ =

= 0. 0044 N

Force Upward: (Archimedes)

D of air = 1.2 g /L; Archimedes Principle: buoyancy = mass of air displaced (6.6 g)

F = m g

F = (6.6 g x 1 kg /1000g) * 9.8 $m*s^{-2}$ =

= 0. 065 N

Net force = 0.065 N - 0.044 N upwards.

References

1. J. Chem. Educ., 2004, 81 (9), p 1309