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

\[ V = \frac{4}{3} \pi r^3 \]

\[ V = \frac{4}{3} \times 3.1416 \times (1/2 \times 8.59 \text{ in})^3 = \]

\[ = 331.9 \text{ in}^3 \]

Unity Factor: 2.54 cm = 1 in

\[ 331.9 \text{ in}^3 \times (2.54 \text{ cm} / 1 \text{ in})^3 \text{ Note!!!} \]

\[ = 5439 \text{ cm}^3 \]

Densities

Will the bowling ball float in water? Demo

\[ D = \frac{5443 \text{ g}}{5439 \text{ cm}^3} \text{ Too close to call. See } \text{Errors in Measurement Lecture Demonstrations} \]

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?

\[ 1 \text{ cm}^3 = 1 \text{ mL} = 10^{-3} \text{L} \text{ (Note: 1 mL = 1 cm}^3 \text{ = “1 cc”) } \]

\[ V (\text{L}) = 5500 \text{ cm}^3 \times (1 \text{ L} / 1000 \text{ cm}^3) \]
\[ m \text{ (g)} = V \text{ (L)} \times D \text{ (g/L)} = 5.500 \text{ L} \times 0.082 \text{ g/cm}^3 = 0.451 \text{ g} \]

Why does the Hydrogen balloon float? \( F = W = m \text{ g} \)

\[ F = W = (0.451 \text{ g} \times 1 \text{ kg} /1000\text{g}) \times 9.8 \text{ m/s}^{-2} = \]

= 0.0044 N

Force Upward: (Archimedes)

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

\[ F = m \text{ g} \]

\[ F = (6.6 \text{ g} \times 1 \text{ kg}/1000\text{g}) \times 9.8 \text{ m/s}^{-2} = \]

= 0.065 N

Net force = 0.065 N - 0.044 N upwards.

References

Contributors and Attributions
- Ed Vitz (Kutztown University), John W. Moore (UW-Madison), Justin Shorb (Hope College), Xavier Prat-Resina (University of Minnesota Rochester), Tim Wendorff, and Adam Hahn.