

Lecture 1 - 5th September 2024

density: $\rho = \frac{m}{V} \rightarrow$ water density: 997 kg/m^3

Significant Digits

- all nonzero digits are significant!
- for quantities less than one, any zero preceding the first non-zero digit is not significant.
↳ eg: 0.00237 has 3 sig figs.
- in quantities greater than one, any zero following the last non-zero digit is not significant, unless there is a decimal point.
↳ eg: 200 has only one sig fig, while 200.00 has four.

Stoichiometry:

Example: what is $7.2 \frac{\text{Btu}}{\text{lbm}^\circ\text{F}}$ expressed in units of $\text{Jg}^{-1}\text{K}^{-1}$?

↳ given: $1 \text{ J} = 9.4782 \cdot 10^{-4} \text{ Btu}$, $1 \text{ kg} = 2.20462 \text{ lbm}$, $1 \text{ K} = 1.8^\circ\text{F}$

$$\begin{aligned} &\rightarrow 7.2 \frac{\text{Btu}}{\text{lbm}^\circ\text{F}} \cdot \frac{1 \text{ J}}{9.4782 \cdot 10^{-4} \text{ Btu}} \cdot \frac{2.20462 \text{ lbm}}{1 \text{ kg}} \cdot \frac{1 \text{ kg}}{1000 \text{ g}} \cdot \frac{1.8^\circ\text{F}}{1 \text{ K}} \\ &= 30.1 \frac{\text{J}}{\text{gK}} \end{aligned}$$

Example: you are interested in calculating the annual reduction in CO_2 emissions by replacing your car with an all-electric vehicle. Assume that you drive an annual distance 14000 km. Your car has a fuel efficiency 28 miles

per gallon. The electric car has an average energy consumption of 157 Wh/km.

↳ Data for CO₂ emission: 25g CO₂/kWh, 2.3 kg CO₂/L

$$\begin{aligned} \text{Gas: } 14000 \frac{\text{km}}{\text{year}} &\cdot \frac{6.21371 \cdot 10^{-4} \text{ mi}}{1 \text{ m}} \cdot \frac{1000 \text{ m}}{1 \text{ Km}} \cdot \frac{1 \text{ gal}}{28 \text{ mi}} \\ &\cdot \frac{1000 \text{ L}}{264.172 \text{ gal}} \cdot \frac{2.3 \text{ kg CO}_2}{1 \text{ L}} = 2705 \frac{\text{kg CO}_2}{\text{year}} \end{aligned}$$

$$\begin{aligned} \text{Electric: } 14000 \frac{\text{km}}{\text{year}} &\cdot \frac{157 \text{ Wh}}{1 \text{ Km}} \cdot \frac{25 \text{ g CO}_2}{1 \text{ kWh}} \cdot \frac{1 \text{ kWh}}{1000 \text{ Wh}} \cdot \frac{1 \text{ kg}}{1000 \text{ g}} \\ &= 55 \frac{\text{kg CO}_2}{\text{year}} \end{aligned}$$

$$\text{reductions: gas - electric} = 2705 - 55 = 2650 \frac{\text{kg CO}_2}{\text{year}}$$