Day 1 (class 2): units, dimensions

Wednesday, October 2, 2013  8:51 AM

General Review

Significant figures

ex. 37.12 m if measured at cm scale then 4 sig-figs

our class (rule of thumb)
- Keep 4 (or 5 if powers or exponentials) throughout calc.
- Answer w/ 3 sig figs. (technically only valid lowest # of
  sig figs from input)

Scientific Notation

ex. Speed of light

\[ c = 297,792,458 \text{ m/s} = (2.97792458) \times 10^8 \text{ m/s} \]

\[ \approx 3.00 \times 10^8 \text{ m/s} \]

3 sig figs

Multiplication/Division: Use the commutative property of Multiplication

ex. Distance light travels in 1.2 pico seconds

\[ |\Delta \vec{r}| = |\vec{V}| \Delta t = (3.0 \times 10^8 \text{ m/s})(1.2 \times 10^{-12} \text{ s}) = (3.0)(1.2)(10^8)(10^{-12}) \text{ m} \]

\[ \approx (3.4)(10^{-4}) \text{ m} \]

\[ = 3.4 \times 10^{-4} \text{ m} \]

Dimensions & Dimensional Analysis (more fundamental than units)

Notation: time [T], length [L], mass [M]

ex. Speed = \frac{\text{distance}}{\text{time}} or [\text{L}] \approx \text{the dimensions [L]}
ex. Speed = \( \frac{\text{distance}}{\text{time}} \) or \( \frac{[L]}{[T]} \leftarrow \text{the dimensions}[D]\)

**Rules:**
- Can't set apples = oranges, \([D]\)_{\text{LHS}} = [D]_{\text{RHS}}
- Can't add/sub apple to oranges, if \([D_1] + [D_2] \) then \([D_3] = [D_2]\)

\[\Delta x = V_{ix} \Delta t + \frac{1}{2} a_x \Delta t^2\] ... dimensions of \(a?\)

\([L] = \frac{[L]}{[T]} \cdot [T] + [?] \cdot [T]^2\]

\(\uparrow \text{must be } \frac{[L]}{[T]^2}\) so overall \(\frac{1}{2} a_x \Delta t^2\) has dimension of \([L]\)

**Units** (default)
- S I - System Internation also called MKS
- Derived units are from fundamental units
  ex. Newton measure of force, 2nd law \(\Sigma F = MA\) "Newton"

\(\text{dimensions } [D]_{\text{force}} = \frac{[M]}{[T]^2}\) In SI. \(N = \frac{[k g \cdot m]}{[s^2]}\)

**Conversions**

Easy (No powers) ex. 100 ft/s \(\rightarrow\) km/day

Google tells you 1 ft = 1.894 \(\times\) 10^{-4} m, 1609 m = 1 mi

\[
\begin{array}{c|c|c|c|c|c|c|c|c}
100 \text{ ft/s} & 1.894 \times 10^{-4} \text{ m/s} & 60 \text{ s} & 1 \text{ hr} & 1609 \text{ m} & 24 \text{ hr} & 1 \text{ km} & 1000 \text{ m} \\
1 \text{ ft} & 1 \text{ ft} & 1 \text{ min} & 1 \text{ hr} & 1 \text{ yr} & 1 \text{ day} & 1000 \text{ m} & 2030 \text{ km/day}
\end{array}
\]
\[
\frac{1000 \text{ m}}{1 \text{ yr}} \times \frac{1 \text{ yr}}{1 \text{ day}} \times \frac{1 \text{ day}}{1000 \text{ m}} \approx 26.3 \frac{\text{km}}{\text{day}}
\]