1. UNITS AND PRECISION

1.1 Units
1.2 Unit Conversion
   Ex 1.1: Velocity
   Ex 1.2: Convert Pow
1.3 Units in Problems
1.4 Precision
1. Units:
SI : International System of Units

Length : meter   [ m ]
Time    : second  [ s ]
Mass    : kilogram [ kg ] = 1000 [ g ]

This semester : except for treatment of heat all SI units are combinations of [ m, s, kg ]
1.2. Unit Conversion

Watch Out !!

Everyday use: often not SI!

i.e., length = inch, yard, mile
time = minute, hour
mass = ounce (oz), pound (lb)
volume = pint, gallon

Convert all units to SI before calculation

Results of a calculation is in SI units if all input quantities are in SI
1.2. Unit Conversion: Example 1.1

\[
60 \text{ miles/hour} \times \frac{1600 \text{ m}}{3600 \text{ s/hour}} = 26.7 \text{ m/s}
\]  

1 mile = 1600 m → \( \frac{1600 \text{ m}}{1 \text{ mile}} = 1 \) → \( \frac{1 \text{ mile}}{1600 \text{ m}} = 1 \)

1 hour = 3600 s → \( \frac{3600 \text{ s}}{1 \text{ hour}} = 1 \) → \( \frac{1 \text{ hour}}{3600 \text{ s}} = 1 \)

multiply with conversion ratio such that unwanted units cancel
1.2. Unit Conversion: Example 1.1

often: prefix - powers of 10 (table in text)

\[ 1 \text{ kg} = 1000 \text{ g} = 10^3 \text{ g} \]
\[ 1 \text{ cm} = 0.01 \text{ m} = 10^{-2} \text{ m} \]

Remove prefix! **Must** be included in "converting to SI Units"!
1.2. Unit Conversion: Example 1.2

Conversion of powers:

\[ 1 \, cm^2 = 1 \left( \frac{cm \cdot 10^{-2} \, m}{cm} \right)^2 = 10^{-4} \, m^2 \]

want \( m^2 \)

convert inside the power!

Watch out for powers!

Quiz 1.1: convert power

How many \( m^3 \) are in a \( cm^3 \)?
1.2. Unit Conversion: Quiz 1.1
Conversion of powers:

solution: \[ 1 \, cm^3 = 1 \left( \frac{10^{-2} m}{cm} \right)^3 = 10^{-6} m^3 \]
1.3. Units in Problems:

Problem solving:
in text units always carried along - units are a useful aid in problem solving
in the Text: insert numerical values

and their units

in lecture usually proceed as follows:
- insert numerical values only
- convert to SI
- results are in SI

Watch Out! Eliminate crosscheck with units
1.4. Precision - in laboratory

each measured quantity \( x \) has a quoted precision \( \Delta x \)

\[ x - \Delta x \quad \rightarrow \quad x \quad \rightarrow \quad x + \Delta x \]

\( x \) can lie anywhere in the "range"
\[ [x - \Delta x, x + \Delta x] \]

we quote \( (x \pm \Delta x) \) as a result

"error"
1.4. Precision - in problem solving work with very accurately measured quantities, for "CAPA" computer use a minimum of 3 significant figures!!

e.g. \[ \pi = 3.14 \]
\[ g = 9.81 \text{ (acceleration of gravity)} \]

0.0135759 m = 1.36 \times 10^{-2} \text{ m, not 0.01 m!!}