Units

Units $\Rightarrow$ very important in describing objects or phenomena

Ex.) My house is 15 away.

$\Rightarrow$15 m?, 15 miles?, 15 blocks?, 15 min?

$\rightarrow$ All numbers will need to have units associated with it.

– measured values

– in equations

– final results

We'll be using standard dimensions $\Rightarrow$ System of Units

2 systems that we are familiar with:

1) British system

2) Metric system (SI)

Metric system ⇒ 7 base dimensions
– all other quantities made up from these base dimensions

Base Dimension	SI	also	British
Length, [L]	meter, m	cm, km, mm	in, ft, yd
Time, [T]	second, s	min, hr, yr	
Mass, [M]	kilogram, kg	g	slug, (lb)

Careful: Weight ≠ mass (weight is related to mass)

mass ⇒ same everywhere (Earth, Moon, space)

weight ⇒ depends on where you are

Ex.) m = 75 kg ⇒ W = 165 lbs on Earth surface (734 N)

⇒ W = 30 lbs on Moon surface (133 N)

Careful: Don't confuse symbols used for quantities or in equations (*italicized*) with symbols used for units (not italicized).

$F = ma$ m = 15 g l = 30 m

All other quantities in a system are made up of the base dimensions or units

Quantity	Dimensions	SI units
velocity, v	$\frac{[L]}{[T]}$	$\frac{\mathrm{m}}{\mathrm{s}}$
acceleration, a	$\frac{[L]}{[T^2]}$	$\frac{\mathrm{m}}{\mathrm{s}^2}$
Force, F	$\frac{[M][L]}{[T^2]}$	$\frac{\mathrm{kg}\cdot\mathrm{m}}{\mathrm{s}^2}=\mathrm{N}$
Work, W Energy, E_k, E_p	$\frac{[M][L^2]}{[T^2]}$	$\frac{\mathrm{kg}\cdot\mathrm{m}^2}{\mathrm{s}^2}=\mathrm{J}$

Other base units that you will use in Physics 152 are:

Base Dimension	SI	also	British
Electric Current	Ampere, A		
Temperature	Kelvin, K	°C	°F

One supplementary base unit is:

Base Dimension	SI	also
angle	radian (rad)	deg, grads

"Pseudo" unit: unit sometimes drops out of equation.

Ex.) Arc length, $s = r\theta = (2\text{ m})\,(\pi/4\text{ rad}) = 1.57\text{ m}$

Ex.) angular speed, $\omega = \frac{\Delta\theta}{\Delta t} = \frac{3.14\text{ rad}}{4.0\text{ s}} = 0.79\frac{\text{rad}}{\text{s}}$

Ex.) tangential speed, $v = r\omega = (2\text{m})\left(0.79\frac{\text{rad}}{\text{s}}\right) = \left(1.57\frac{\text{m}}{\text{s}}\right)$

We really like the metric system

$\Rightarrow$ Base 10 system

$\Rightarrow$ Larger/smaller units found by multiplying/dividing by powers of 10

$\Rightarrow$ Larger/smaller units in British system inconsistent (a pain).

eg. in $\rightarrow$ ft : divide by 12

ft $\rightarrow$ yd : divide by 3

Each multiple of metric base unit has a prefix associated with it.

Prefix	Multiplier	Example units
k, kilo	1000 (10^3)	kg, km
M, mega	1000000 (10^6)	MJ
c, centi	1/100 = 0.01 (10^{-2})	cm, cs
m, milli	1/1000 = 0.001 (10^{-3})	mm, mL
μ, micro	1/1000000 = 0.000001 (10^{-6})	μs, μm, μN

eg. 180 cm $\Rightarrow 180 \times 10^{-2}$ m

Measurements have dimensions and units

$\Rightarrow$ equations using these measurements have dimensions and units also.

units on left side of equation = units on right side of equation

(match)

Ex.) $A = w \quad l$

$[L^2] = [L][L]$

$[L^2] = [L^2]$ √ $\{m^2 = (m)(m),\ ft^2 = (ft)(ft)\}$

We can use this dimensional equality to:

1) find units or dimensions of a new quantity

2) help remember an equation

Ex.) $F = ma$

$[?] = [M]\frac{[L]}{[T^2]}$ $\Rightarrow F$ has units of $[M]\frac{[L]}{[T^2]}$

Ex.) Does $V = \frac{4}{3}\pi R^2$ or $V = \frac{4}{3}\pi R^3$

$[L^3] \neq [L^2]$ $[L^3] = [L^3]$ √

Conversions

We'll need to convert between the British and SI system.

– conversion factors given in book (front cover)

Ex.) $$\left(6.0\,\text{ft}\right)\left(\frac{0.3048\,\text{m}}{1.0\,\text{ft}}\right)=1.8\,\text{m}$$

$$\left(4.0\,\text{m}^3\right)\left(\frac{3.281\,\text{ft}}{1.0\,\text{m}}\right)^3=141\,\text{ft}^3$$