Units

Units ⇒ very important in describing objects or phenomena

Ex.) My house is 15 away.

⇒15 m?, 15 miles?, 15 blocks?, 15 min?

→ All numbers will need to have units associated with it.

- measured values
- in equations
- final results

We'll be using standard dimensions ⇒ System of Units

2 systems that we are familiar with:

1) British system
2) Metric system (SI)

Metric system $\Rightarrow$ 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 $\neq$ mass (weight is related to mass)

mass $\Rightarrow$ same everywhere (Earth, Moon, space)

weight $\Rightarrow$ depends on where you are

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

$\Rightarrow W = 30$ lbs on Moon surface (133 N)

Careful: Don't confuse symbols used for quantities or in equations with symbols used for units.

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

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

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

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, $\omega = \dfrac{\Delta\theta}{\Delta t} = \dfrac{3.14\text{ rad}}{4.0\text{ s}} = 0.79\dfrac{\text{rad}}{\text{s}}$

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

We really like the metric system

⇒ Base 10 system

⇒ Larger/smaller units found by multiplying/dividing by powers of 10

⇒ Larger/smaller units in British system inconsistent (a pain).

eg. in → ft : divide by 12

ft → 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 ⇒ 180×10^{-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.) $A = w\ l$

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

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

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

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