

# Introduction to Measurement & Motion

## English vs. Metric System of Measurement

Science uses the metric system.

- English is base (2, 4, 12, 3, 2000...)
- Metric is base 10

### Prefixes

Prefix	Variable	Scientific Notation	Number
giga	G	$10^9$	1,000,000,000
mega	M	$10^6$	1,000,000
kilo	k	$10^3$	1,000
centi	c	$10^{-2}$	.01
milli	m	$10^{-3}$	.001
micro	$\mu$	$10^{-6}$	.000001
nano	n	$10^{-9}$	.000000001

$\mu$

$$1 \text{ M}_m = 1,000,000 \text{ m}$$

## International System of Units (SI units) - *Système Internationale*

A set of standard **base units** that are used to measure physical principles.

MKS

meters → distance

kilograms → mass

seconds → time

### Conversions

- When you convert a value, you change the number and the units, but not the physical quantity
- Conversions are really multiplying by a fraction that equals 1

$$\begin{array}{l} S = S \\ \frac{m}{m} = 1 \end{array} \left\{ \begin{array}{l} \sqrt{24} \cdot 7! = \sqrt{24} \cdot 7! \\ \frac{\sqrt{24} \cdot 7!}{\sqrt{24} \cdot 7!} = 1 \end{array} \right.$$

$$12 \text{ in} = 1 \text{ ft} \rightarrow \frac{12 \text{ in}}{1 \text{ ft}} = 1$$

Example → Length of a football field in meters

1.094 yards = 1 meter

Tip: Always start with what you already know.

$$100 \text{ yds} \times \left( \frac{1 \text{ m}}{1.094 \text{ yds}} \right) = \boxed{91.4 \text{ m}}$$

**Velocity** (or speed)

A measurement of how quickly or slowly something is traveling.

Formula

$$\text{velocity} = \frac{\text{distance}}{\text{time}} \rightarrow \boxed{v = \frac{d}{t}}$$

Units

$$\left( \frac{\text{m}}{\text{s}} \right)$$

*The peregrine falcon is the world's fastest known bird and has been clocked diving downward toward its prey at a constant vertical velocity of 97.2 m/s. If the falcon dives straight down from a height of 102 m, how much time does this give a rabbit below to consider its next move as the falcon begins its descent?*



Average walking speed in m/s:

$$v = \frac{d}{t} = \frac{10 \text{ m}}{6.45 \text{ s}} = \underline{1.55 \text{ m/s}}$$

Mph:

$$1,604 \text{ m} = 1 \text{ mile}$$

$$3600 \text{ s} = 1 \text{ hr}$$

$$\frac{1.55 \text{ m/s}}{5} \times \left( \frac{1 \text{ mile}}{1,604 \text{ m}} \right) \times \left( \frac{3600 \text{ s}}{1 \text{ hr}} \right) =$$

$$\boxed{3.47 \text{ mph}}$$