Derived units

e.g. Pascal = $1\ \frac{N}{m^2} = 1\left(\frac{kg\,m}{s^2}\right)\left(\frac{1}{m^2}\right)$

$= 1\ \frac{kg}{m\,s^2}$

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Unit Conversions

Example 75 $\frac{miles}{hour}$ = how many $\frac{m}{s}$?

1 mile = 5,280 feet, so $\frac{5,280\,ft}{1\,mile} = 1$

1 m = 3.28 feet, so $\frac{1\,m}{3.28\,ft} = 1$

1 hr = 3,600 s so $\frac{1\,hr}{3,600\,s} = 1$

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So, $75\ \frac{miles}{hr}\left(\frac{5,280\,ft}{1\,mile}\right)\left(\frac{1\,m}{3.28\,ft}\right)\left(\frac{1\,hr}{3,600\,s}\right)$

0.447

$= 33.5\ m/s$

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We may need to convert prefixes between SI units.

Suppose we measure a length 546 nm. But we need to convert to meters

$546\ nm\left(\frac{10^{-9}\,m}{1\,nm}\right) = 546 \times 10^{-9}\ m$

$= 5.46 \times 10^{-7}\ m$

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Scale analysis can be useful!

~~What are the units for acceleration?~~

~~Suppose we know~~ We know the units for acceleration are m/s^2

We know that force is $\frac{kg\ m}{s^2}$

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Symbolic representation

$\frac{ML}{T^2}$ force = F

M mass = m

$F = m(?)$ acceleration

$f = ma$?

$F = ma^2$?

$F = \frac{m}{a}$?

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$\frac{ML}{T^2} = M\left(\frac{L}{T^2}\right)$

$\uparrow a$

Kinetic energy (destructive force) carried by hurricane-force winds

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We know units for energy are $\frac{ML^2}{T^2}$

$E \approx m(\ )$

$\uparrow$ velocity squared because we know velocity units are $\frac{L}{T}$

We might say $E = mv^2$ (wrong. Off by a factor of 1/2)

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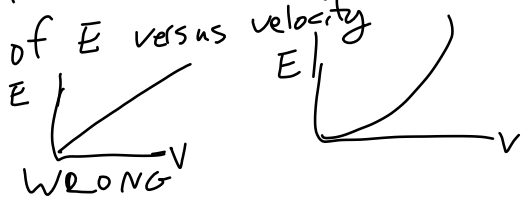
So we can't guess the ½ factor. But, if we wanted a general plot of E versus velocity



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From last time, mass of mosquitoes $\sim 10^9$ kg (corrected)

Mass of humans?

10^9 humans $\left(\frac{10^2 \text{ kg}}{\text{human}}\right) \rightarrow 10^{11}$ kg

Aug 24-10:36 AM