Lesson 1

1 Prerequisite Knowledge

1.1 Units & Dim

$[\cdots]$ = "Units of"

[mass] = kg

[length] = m

[time] = s

Physics 1A has 3 unit systems

Sys	$[L]$	$[T]$	$[M]$
Mks	m	s	kg
CGS	cm	s	g
US Customary	ft	s	slug

$$[v] = \frac{\text{length}}{\text{time}}$$

$$[v]_{\text{CGS}} = \frac{\text{cm}}{\text{s}}$$

$$[v]_{\text{MKS}} = \frac{\text{m}}{\text{s}}$$

$$[v]_{\text{US}} = \frac{\text{ft}}{\text{s}}$$

$$[F] = [m][a]$$

$$[F] = [m]\frac{[v]}{[T]}$$

$$[F] = [m]\frac{[L]}{[T]^2}$$

$$[F]_{\text{MKS}} = \text{kg}\frac{\text{m}}{\text{s}^2} = \text{N}$$

$$[F]_{\text{CGS}} = \text{g}\frac{\text{cm}}{\text{s}^2} = \text{dyne}$$

$$[F]_{\text{US}} = (\text{sl})\frac{\text{ft}}{\text{s}^2} = \text{lb}$$

$[C] = 1$

$[p] = \dfrac{\text{kg}}{\text{m}^3}$

$[A] = \text{m}^2$

$[v] = \dfrac{\text{m}}{\text{s}}$

1.2 SI Units

Prefix	Symbol	Power	Amount
giga	G	10^9	$1,000,000,000$
mega	M	10^6	$1,000,000$
kilo	k	10^3	$1,000$
base	-	10^0	1
centi	c	10^{-2}	$\frac{1}{100}$
milli	m	10^{-3}	$\frac{1}{1,000}$
micro	μ	10^{-6}	$\frac{1}{1,000,000}$
nano	n	10^{-9}	$\frac{1}{1,000,000,000}$
pico	p	10^{-12}	-

1.3 Unit Conversion

Given: $mi = 1609\text{m}$ $hr = 3600\text{s}$

$$\left(\frac{60\text{mi}}{1\text{hr}}\right)\left(\frac{1609\text{m}}{1\text{mi}}\right)\left(\frac{1\text{hr}}{3600\text{s}}\right) = 27\,{}^{\text{m}}\!/_{\text{s}}$$

Find $9.8\ {}^{\text{m}}\!/_{\text{s}^2}$ in ${}^{\text{mph}}\!/_{\text{s}}$

$$\left(\frac{9.8\text{m}}{\text{s}^2}\right)\left(\frac{1\text{mi}}{1609\text{m}}\right)\left(\frac{3,600\text{s}}{1\text{hr}}\right) = 22\,{}^{\text{mph}}\!/_{\text{s}}$$

1.4 Notable Derivatives

$$\frac{\text{d}\left(x^n\right)}{\text{d}x} = nx^{n-1}$$

$$\frac{\text{d}\left(\frac{1}{x^n}\right)}{\text{d}x} = \frac{\text{d}\left(x^{-n}\right)}{\text{d}x} = -nx^{-n-1}$$

$$\frac{\text{d}\left(Ae^{kx}\right)}{\text{d}x} = Ake^{kx}$$

1.5 Notable Integrals

$$\int (x^n) \mathrm{d}x = \frac{1}{n+1} x^{n+1} + C$$

$$\int (x^{-n}) \mathrm{d}x = \frac{1}{-n+1} x^{1-n} + C \implies (n \neq 1)$$

$$\int \left(\frac{1}{x}\right) \mathrm{d}x = \ln |x| + C$$