University Physics I - Basics (partial)

§Measurements

Table 1: There are seven fundamental SI units.

symbol	name	measures
m	meter	length
kg	kilogram	mass
s	second	time
K	kelvin	temperature
mol	mole	amount of substance
A	ampere	electric current
cd	candela	luminous intensity

Table 2: Introductory mechanics and waves utilize several derived units.

combination	symbol	measures
rad		angular position
m^2		area
m^3		volume
$\mathrm{m\,s^{-1}}$		velocity
$\mathrm{rad\,s^{-1}}$		angular velocity
$\mathrm{m\,s^{-2}}$		acceleration
$\mathrm{rad\,s^{-2}}$		angular acceleration
$\mathrm{kg\,m\,s^{-2}}$	N	force
$\mathrm{kg\,m^2\,s^{-2}}$	$\mathrm{N\,m}$	torque
$\mathrm{kg\,m^2\,s^{-2}}$	J, $\mathrm{N\,m}$	energy
$\mathrm{kg\,m^2\,s^{-3}}$	W, $\mathrm{J\,s^{-1}}$	power
$\mathrm{kg\,m\,s^{-1}}$		linear momentum
$\mathrm{kg\,m^2\,rad\,s^{-1}}$		angular momentum
$\mathrm{kg\,m^{-1}\,s^{-2}}$	Pa, $\mathrm{N\,m^{-2}}$	pressure
$\mathrm{kg\,s^{-2}}$	$\mathrm{N\,m^{-1}}$	spring constant
$\mathrm{s^{-1}}$	Hz	frequency
$\mathrm{rad\,s^{-1}}$		angular frequency
$\mathrm{rad\,m^{-1}}$		angular wavenumber
$\mathrm{m^{-1}}$		linear density
$\mathrm{m^{-2}}$		areal density
$\mathrm{m^{-3}}$		volumetric density

Table 3: Prefixes and their powers make number representations compact and consistent.

name	sym.	power	decimal
yocto	y	10^{-24}	0.000 000 000 000 000 000 000 001
zepto	z	10^{-21}	0.000 000 000 000 000 000 001
atto	a	10^{-18}	0.000 000 000 000 000 001
femto	f	10^{-15}	0.000 000 000 000 001
pico	p	10^{-12}	0.000 000 000 001
nano	n	10^{-9}	0.000 000 001
micro	µ	10^{-6}	0.000 001
milli	m	10^{-3}	0.001
centi	c	10^{-2}	0.01
deci	d	10^{-1}	0.1
		10^{0}	1
deca	da	10^{1}	10
hecto	h	10^{2}	100
kilo	k	10^{3}	1000
mega	M	10^{6}	1 000 000
giga	G	10^{9}	1 000 000 000
tera	T	10^{12}	1 000 000 000 000
peta	P	10^{15}	1 000 000 000 000 000
exa	E	10^{18}	1 000 000 000 000 000 000
zetta	Z	10^{21}	1 000 000 000 000 000 000 000
yotta	Y	10^{24}	1 000 000 000 000 000 000 000 000

§Math

$$\vec{A} \cdot \vec{B} = |\vec{A}||\vec{B}| \cos \phi_{\text{AB}} = A_x B_x + A_y B_y + A_x B_z$$

$$\begin{aligned} \vec{A} \times \vec{B} &= |\vec{A}||\vec{B}| \sin \phi_{\text{AB}} \hat{n} \\ &= \quad (A_y B_z - A_z B_y)\hat{x} \\ &\quad - (A_x B_z - A_z B_x)\hat{y} \\ &\quad + (A_x B_y - A_y B_x)\hat{z} \end{aligned}$$

The cross product can be represented as a determinant

$$\vec{A} \times \vec{B} = \begin{vmatrix} \hat{x} & \hat{y} & \hat{z} \\ A_x & A_y & A_z \\ B_x & B_y & B_z \end{vmatrix}$$

If $ax^2 + bx + c = 0, x = \frac{-b \pm \sqrt{b^2 = 4ac}}{2a}$

$\frac{dx^m}{dx} = mx^{m-1}$

$\int x^m \, dx = \frac{x^{m+1}}{m+1} + C$

§Concept symbols

A wave amplitude, area
$\vec{a}$ acceleration
c speed of light
D distance, diameter
d distance, diameter, depth, differential (e.g. dx)
E energy
$\vec{F}$ force
f (linear) frequency, factor
G gravitational constant
g accleration due to gravity
H height
h height
I moment of inertia
i index counter
$\hat{i}$ unit vector for x
$\vec{J}$ impulse
j index counter
$\hat{j}$ unit vector for y
K kinetic energy
k spring constant, restoring force constant, angular wavenumber, index counter
$\hat{k}$ unit vector for z
L length
$\vec{L}$ angular momentum, length
l length
ℓ length
M mass
m mass
$\vec{N}$ normal force
n antinode number
$\vec{n}$ unit normal
P power
p pressure
$\vec{p}$ linear momentum
q generic variable
$\vec{q}$ generic multi-variable
R radius
r radius, radial position
$\vec{r}$ position
s arc length
$\vec{s}$ displacement
T period
$\vec{T}$ tension
t time
U potential energy
V volume
$\vec{v}$ velocity
W work
w weight, width
x position coordinate 1
y position coordinate 2
z position coordinate 3
α angular acceleration, generic angle
β generic angle
Δ coarse change (e.g. Δx)
δ uncertainty, small change
ϵ strain, small value
θ generic angle
κ restoring torque constant
λ wavelength, linear mass density
μ coefficient of friction, linear mass density
ρ volumetric mass density
σ areal mass density
$\vec{\tau}$ torque
ϕ phase angle, generic angle
ω angular frequency
$\vec{\Omega}$ precession velocity
$\vec{\omega}$ angular velocity