Things you must know:

Definition of average velocity
Definition of momentum — The Momentum Principle
Definitions of particle energy, kinetic energy, and work — The Energy Principle

Other fundamental principles:

$$\Delta\vec{L}_A = \vec{\tau}_{net,A}\Delta t \qquad \text{or} \qquad \frac{dL_A}{dt} = \vec{\tau}_{net,A}$$

$\vec{L}_{trans,A} = \vec{r}_A \times \vec{p}$ (point particle) $\qquad \vec{\tau}_A = \vec{r}_A \times \vec{F}$

Multiparticle systems:

$\vec{r}_{cm} = \dfrac{m_1\vec{r}_1 + m_2\vec{r}_2 + \ldots}{m_1 + m_2 + \ldots}$ $\qquad \vec{P}_{tot} \approx M_{tot}\vec{v}_{cm}$ $(v << c)$ $\qquad K_{tot} = K_{trans} + K_{rel}$

$K_{rel} = K_{rot} + K_{vib}$ $\qquad K_{trans} \approx \dfrac{1}{2}M_{tot}v_{cm}^2$ $(v << c)$ $\qquad I = m_1 r_{1\perp}^2 + m_2 r_{2\perp}^2 + \ldots$

$K_{rot} = \dfrac{L_{rot}^2}{2I} = \dfrac{1}{2}I\omega^2$

$\vec{L}_{trans,A} = \vec{r}_{cm,A} \times \vec{P}_{tot}$ $\qquad \vec{L}_{rot} = I\vec{\omega}$ $\qquad \vec{L}_A = \vec{L}_{trans,A} + \vec{L}_{rot}$

Other physical quantities:

$\gamma \equiv \dfrac{1}{\sqrt{1 - \left(\dfrac{|\vec{v}|}{c}\right)^2}}$ $\qquad E^2 - (pc)^2 = \left(mc^2\right)^2$

$\vec{F}_{grav} = -G\dfrac{m_1 m_2}{|\vec{r}|^2}\hat{r}$ $\qquad U_{grav} = -G\dfrac{m_1 m_2}{|\vec{r}|}$

$\left|\vec{F}_{grav}\right| \approx mg$ near Earth's surface $\qquad \Delta U_{grav} \approx mg\Delta y$ near Earth's surface

$\vec{F}_{elec} = \dfrac{1}{4\pi\epsilon_0}\dfrac{q_1 q_2}{|\vec{r}|^2}\hat{r}$ $\qquad U_{elec} = \dfrac{1}{4\pi\epsilon_0}\dfrac{q_1 q_2}{|\vec{r}|}$

$\left|\vec{F}_{spring}\right| = k_s s$ opposite to the stretch $\qquad U_{spring} = \dfrac{1}{2}k_s s^2$ for ideal spring

$U_i \approx \dfrac{1}{2}k_{si}s^2 - E_M$ approx. interatomic pot. energy $\qquad \Delta E_{thermal} = mC\Delta T$

$E_N = -\dfrac{13.6\text{eV}}{N^2}$ where $N = 1, 2, 3\ldots$ (Hydrogen atom energy levels)

$E_N = N\hbar\omega_0 + E_0$ where $N = 0, 1, 2\ldots$ and $\omega_0 = \sqrt{\dfrac{k_{si}}{m_a}}$ (Quantized oscillator energy levels)

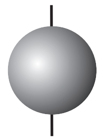
$\left|\left(\dfrac{d\vec{p}}{dt}\right)_\perp\right| = \dfrac{pv}{R} \approx \dfrac{mv^2}{R}$ (if $v << c$) where R = radius of kissing circle

$\omega = \dfrac{2\pi}{T}$ $\qquad x = A\cos\omega t$ $\qquad \omega = \sqrt{\dfrac{k_s}{m}}$

$Y = \dfrac{F/A}{\Delta L/L}$ (macro) $\qquad Y = \dfrac{k_{si}}{d}$ (micro) $\qquad$ speed of sound $v = d\sqrt{\dfrac{k_{si}}{m_a}}$

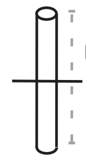
$\hat{f} = \langle \cos\theta_x, \cos\theta_y, \cos\theta_z \rangle$ unit vector from angles

Moment of intertia for rotation about indicated axis

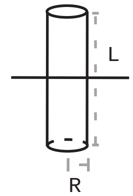


$I = \frac{2}{5}MR^2$

$I = \frac{1}{2}MR^2$



$I = \frac{1}{12}ML^2$



$I = \frac{1}{12}ML^2 + \frac{1}{4}MR^2$

$$\Omega = \frac{(q+N-1)!}{q!\,(N-1)!} \qquad S \equiv k \ln \Omega \qquad \frac{1}{T} \equiv \frac{\partial S}{\partial E}$$

$$\Delta S = \frac{Q}{T} \text{ (small } Q\text{)} \qquad \text{prob}(E) \propto \Omega\,(E)\, e^{-\frac{E}{kT}}$$

Constant	Symbol	Approximate Value
Speed of light	c	3×10^8 m/s
Gravitational constant	G	6.7×10^{-11} N · m^2/kg^2
Approx. grav field near Earth's surface	g	9.8 N/kg
Electron mass	m_e	9×10^{-31} kg
Proton mass	m_p	1.7×10^{-27} kg
Neutron mass	m_n	1.7×10^{-27} kg
Electric constant	$\frac{1}{4\pi\epsilon_0}$	9×10^9 N · m^2/C^2
Proton charge	e	1.6×10^{-19} C
Electron volt	1 eV	1.6×10^{-19} J
Avogadro's number	N_A	6.02×10^{23} atoms/mol
Plank's constant	h	6.6×10^{-34} joule · second
hbar $= \frac{h}{2\pi}$	$\hbar$	1.05×10^{-34} joule · second
specific heat capacity of water	C	4.2 J/kg
Boltzmann constant	k	1.38×10^{-23} J/K

milli	m	1×10^{-3}	kilo	K	1×10^3
micro	μ	1×10^{-6}	mega	M	1×10^6
nano	n	1×10^{-9}	giga	G	1×10^9
pico	p	1×10^{-12}	tera	T	1×10^{12}