

# Notation (Instructors may request alternate notation)

Symbol	Meaning
$t, \rho, \pi, e, i$ $g, G$ $\mu_s, \mu_k, e_r$ $\frac{\partial y}{\partial x}, \frac{\partial^2 y}{\partial x^2}$ $\frac{dy}{dt}, \dot{y}$ $\frac{d^2 y}{dt^2}, \ddot{y}$ $\int_{t=0}^{\bar{t}} y(t) dt$	$t$ time, $\rho$ density, $\pi \approx 3.14159265358979323$ $e \approx 2.718281828459045$ $i \triangleq \sqrt{-1}$ Gravitational constants: Earth $g \approx 9.80665 \frac{m}{s^2}$ Universal $G \approx 6.673 \times 10^{-11} \frac{m^3}{kg s^2}$ Coefficient of static and kinetic friction. Coefficient of restitution. First or second partial derivative of the scalar $y$ with respect to the scalar $x$ . Ordinary time derivative of $y$ . Second ordinary time derivative of $y$ . Definite integral of $y(t)$ from $t = 0$ to $t = \bar{t}$ .
Vectors and dyadics	
$\vec{v}$ $\vec{0}$ $ \vec{v} $ $\vec{v}^n$ $\vec{a} \times \vec{b}$ $\vec{a} \cdot \vec{b}$ $[\vec{v}]_b$ $\vec{0}, \vec{1}, \vec{d}$ $[\vec{d}]_b$ $\frac{N \partial \vec{v}}{\partial x}$ $\frac{N d \vec{v}}{dt}$ $[\frac{N d \vec{v}}{dt}]_b$	Vector $\vec{v}$ . Zero vector. Magnitude of vector $\vec{v}$ . $ \vec{v}  = (\vec{v} \cdot \vec{v})^{1/2} = \sqrt{\vec{v} \cdot \vec{v}}$ Vector $\vec{v}$ raised to the $n$ power. $\vec{v}^n \triangleq  \vec{v} ^n = (\vec{v} \cdot \vec{v})^{n/2}$ , e.g., $\vec{v}^2 \triangleq  \vec{v} ^2 = \vec{v} \cdot \vec{v}$ Cross product of vector $\vec{a}$ with vector $\vec{b}$ . Dot product of vector $\vec{a}$ with vector $\vec{b}$ . $3 \times 1$ matrix representation of the vector $\vec{v}$ expressed in the $b$ basis. Example: $\begin{bmatrix} 2 \\ 3 \\ 4 \end{bmatrix}_b$ represents the vector $2\hat{b}_x + 3\hat{b}_y + 4\hat{b}_z$ Zero dyadic, unit dyadic, dyadic $\vec{d}$ . $3 \times 3$ matrix representation of the dyadic $\vec{d}$ expressed in the $b$ basis. Example: $\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}_b$ represents the dyadic $1\hat{b}_x\hat{b}_x + 2\hat{b}_x\hat{b}_y + 3\hat{b}_x\hat{b}_z + 4\hat{b}_y\hat{b}_x + 5\hat{b}_y\hat{b}_y \dots$ Partial derivative in reference frame $N$ of the vector $\vec{v}$ with respect to $x$ . Ordinary time derivative in reference frame $N$ of the vector $\vec{v}$ . $3 \times 1$ matrix representation of $\frac{N d \vec{v}}{dt}$ , expressed in the $b$ basis.
Mass, center of mass, inertia	
$S_{cm}$ $m^S$ $\vec{I}^{S/O}$ $[I^{S/O}]_b$ $I_{\hat{u}\hat{v}}^{S/O}$	The subscript cm denotes the mass center of a body or system $S$ . Mass of $S$ ( $S$ is a particle, body, or system of particles and bodies). $S$ 's inertia dyadic about point $O$ ( $S$ is a particle, body, or system of particles and bodies). $S$ 's inertia matrix about $O$ for basis $b$ ( $\hat{b}_x, \hat{b}_y, \hat{b}_z$ ). $S$ 's inertia scalar (moment or product) about point $O$ for the unit vectors $\hat{u}$ and $\hat{v}$ .
Rotational kinematics	
${}^a R^b$ ${}^N \vec{\omega}^B$ ${}^N \vec{\alpha}^B$	Rotation matrix relating the right-handed orthogonal unit vectors $\hat{a}_x, \hat{a}_y, \hat{a}_z$ to the right-handed orthogonal unit vectors $\hat{b}_x, \hat{b}_y, \hat{b}_z$ . Reference frame $B$ 's angular velocity in reference frame $N$ . Reference frame $B$ 's angular acceleration in reference frame $N$ .
Translational kinematics	

$\vec{r}^{Q/O}$	Point $Q$ 's position vector from point $O$ (sometimes denoted ${}^O\vec{r}^Q$ ).
${}^N\vec{v}^Q$	Point $Q$ 's velocity in reference frame $N$ .
${}^N\vec{v}^{Q/R}$	Point $Q$ 's velocity relative to point $R$ in reference frame $N$ ( ${}^N\vec{v}^{Q/R} = {}^N\vec{v}^Q - {}^N\vec{v}^R$ ).
${}^N\vec{a}^Q$	Point $Q$ 's acceleration in reference frame $N$ .
<b>Momentum, inertia force, kinetic energy in a reference frame <math>N</math></b>	
${}^N\vec{L}^S$	$S$ 's translational momentum in reference frame $N$ ( $S$ is a particle, body, or massive system).
${}^N\vec{H}^{S/O}$	$S$ 's angular momentum about point $O$ in reference frame $N$ ( $S$ is a massive system).
${}^N\vec{L}_{u_r}^S$	$S$ 's generalized momentum in reference frame $N$ for the generalized speed $u_r$ .
${}^N\vec{F}^S$	$S$ 's effective force ( $m\vec{a}$ ) in $N$ ( $S$ is a particle, body, or system of particles and bodies).
${}^N\vec{M}^{S/O}$	$S$ 's moment of effective forces ( $\vec{r} \times m\vec{a}$ ) about point $O$ in reference frame $N$ .
${}^N\mathcal{F}_r^S$	$S$ 's generalized effective force in reference frame $N$ for the generalized speed $u_r$ .
${}^N K^S$	$S$ 's kinetic energy of $S$ in reference frame $N$ ( $S$ is a particle, body, or massive system).
${}^N \mathcal{L}^S$	$S$ 's Lagrangian in reference frame $N$ .
<b>Forces, moments, torque</b>	
$\vec{F}^{Q/R}$	Force on point $Q$ by point $R$ .
$\vec{F}^S$	Resultant of forces on the point, particle, body, or system $S$ .
$\vec{M}^{S/O}$	Moment of the set $S$ of bound vectors about point $O$ .
$\vec{T}^A$	Torque of the couple associated with the replacement of forces on rigid object $A$ .
$\vec{T}^{A/B}$	Torque of the couple associated with forces on rigid object $A$ by rigid object $B$ .
<b>Power, work, potential energy, and generalized force in a reference frame <math>N</math></b>	
${}^N P^S$	Power due to all the forces on point, body, or system $S$ and $S$ 's motion in $N$ .
${}^N W^S$	Work due to all forces on point, body, or system $S$ and $S$ 's motion in $N$ .
${}^N U^S$	Potential energy due to all forces on system $S$ and $S$ 's configuration in $N$ .
<b>Current, voltage, electrical elements</b>	
$i, v$	current, voltage      Note: $j \triangleq \sqrt{-1}$ when $i$ is electrical current.
$R, C, L$	resistance, capacitance, inductance

