Reference Sheet

Centripetal acceleration of an object in uniform circular motion: $a_c = \frac{v_T^2}{r}$ or $\omega^2 r$

Tangential velocity $v_T = \omega r$
Tangential acceleration $a_T = \alpha r$

Newton's second law: $\vec{F} = m\vec{a}$
Newton's third law: $\vec{F}_{\text{A on B}} = -\vec{F}_{\text{B on A}}$

Momentum $\vec{p} = m\vec{v}$

Maximum force of static friction: $\mu_s F_N$
Force of kinetic friction: $\mu_s F_N$

Translation	Rotation
Position x	Angle θ
Velocity v	Angular velocity ω
Acceleration a	Angular acceleration α
$v(t) = v_0 + at$	$\omega(t) = \omega_0 + \alpha t$
$x(t) = x_0 + v_0 t + \frac{1}{2}at^2$	$\theta(t) = \theta_0 + \omega_0 t + \frac{1}{2}\alpha t^2$
$v_f^2 - v_0^2 = 2a\Delta x$	$\omega_f^2 - \omega_0^2 = 2\alpha\Delta\theta$
Force $\vec{F}$	Torque: $\tau = F_\perp r$ or $Fr_\perp$
Mass m	Moment of Inertia: $I = \lambda MR^2$
Newton's second law $\vec{F} = m\vec{a}$	Newton's second law for rotation $\tau = I\alpha$
Work $= \vec{F} \cdot \Delta\vec{s}$	Work $= \tau\Delta\theta$
Kinetic energy $\frac{1}{2}mv^2$	Kinetic energy $\frac{1}{2}I\omega^2$
Power ($\vec{F}$ constant) $= \vec{F} \cdot \vec{v}$	Power (τ constant) $= \tau\omega$
Momentum $\vec{p} = m\vec{v}$	Angular momentum $L = I\omega$

Moment of inertia of...

- Any object: $I = m\langle r^2 \rangle$, where $\langle r^2 \rangle$ is the average squared radius
- A hollow cylinder or single mass a distance r from the pivot: $I = mr^2$
- A solid sphere: $I = \frac{2}{5}mr^2$
- A cylinder or disk: $I = \frac{1}{2}mr^2$

Angular momentum of a single object about a pivot: $L = mvr_\perp = mv_\perp r$