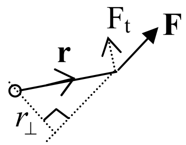
Chapter 11 – Summary

Definitions

<table>
<tr><td>$\theta = \frac{s}{r}$</td><td>Angular position – θ in rad</td><td>$K = \frac{1}{2} I\omega^2$</td><td colspan="4">Rotational Kinetic Energy</td></tr>
<tr><td>$\Delta\theta = \theta_2 - \theta_1$</td><td>Angular displacement</td><td>$I = \sum m_i r_i^2$ or $\int r^2 dm$</td><td colspan="4">Rotational Inertia or Moment of Inertia
r_i (r) is the perpendicular distance to the axis of rotation</td></tr>
<tr><td rowspan="2">$\omega_{avg} = \frac{\Delta\theta}{\Delta t}$; $\omega = \frac{d\theta}{dt}$</td><td rowspan="2">Angular velocity</td><td rowspan="2">Some useful results for I_{com}</td><td>object</td><td>thin hoop (ring)</td><td>disk</td><td>sphere</td></tr>
<tr><td>I_{com}/mR^2</td><td>1</td><td>1/2</td><td>2/5</td></tr>
<tr><td>$\alpha_{avg} = \frac{\Delta\omega}{\Delta t}$; $\alpha = \frac{d\omega}{dt}$</td><td>Angular acceleration</td><td>$\tau = rF\sin\phi = r_{\perp}F = rF_t$</td><td colspan="4">rotational axis out of the paper</td></tr>
<tr><td colspan="2">ω and α are vectors: +ve - counterclockwise
-ve - clockwise</td><td>$W = \int_{\theta_i}^{\theta_f} \tau d\theta$</td><td colspan="4">Work done by a torque as the object is rotating from θ_1 to θ_2</td></tr>
<tr><td colspan="2">$P = \frac{dW}{dt} = \tau\omega$ Power delivered by the torque</td><td>$W = \tau\Delta\theta$</td><td colspan="4">For constant torque</td></tr>
</table>

Theorems/Laws/Equations

Kinematic Equation for constant α	Linear ←→ Angular relationship	Parallel Axis Theorem
$\omega = \omega_o + \alpha t$ $\theta - \theta_o = \omega_o t + \frac{1}{2}\alpha t^2$ $\omega^2 = \omega_o^2 + 2\alpha(\theta - \theta_o)$ $\theta - \theta_o = \frac{1}{2}(\omega + \omega_o)t$ $\theta - \theta_o = \omega t - \frac{1}{2}\alpha t^2$	$s = \theta r$ $v = \omega r$ $a_t = \alpha r \cdots\cdots$(tangential acceleration) $a_r = \frac{v^2}{r} = \omega^2 r \cdots\cdots$(radial acceleration) $T = \frac{2\pi r}{v} = \frac{2\pi}{\omega}$	$I = I_{com} + Mh^2$ Newton's 2nd Law for rotational motion $\sum \tau_{ext} = I\alpha$ Work-Kinetic Energy theorem for rotational motion $\Delta K = K_f - K_i = \frac{1}{2} I(\omega_f^2 - \omega_i^2) = W$