Physics Reference #05

- *Angular Velocity*
  ω
- *Angular Acceleration*
  α
- *Radial Velocity*
  v_r
- *Radial Acceleration*
  a_r
- *Tangental Velocity*
  $r\omega$
- *Tangental Acceleration*
  $r\alpha$
- *Torque*
  $\tau = rF\sin(\varphi) = mr^2\alpha = I\alpha$

- *Moment of Inertia (rod)*
  $I = \frac{1}{3}m_\Sigma L^2$
- *Moment of Inertia (ring)*
  $I = m_\Sigma R^2$
- *Moment of Inertia (disk)*
  $I = \frac{1}{2}m_\Sigma R^2$
- *Moment of Inertia (sphere)*
  $I = \frac{2}{5}m_\Sigma R^2$
- *Moment of Inertia (sph. shell)*
  $I = \frac{2}{3}m_\Sigma R^2$
- *Moment of Inertia (round)*
  $I = \beta m_\Sigma R^2$
- *Rolling constraints*
  $x = r\theta$
  $v = r\omega$
  $a = r\alpha$

- *Min. Static Friction (to roll)*
  $\mu s \geq \frac{1}{3}\tan(\varphi)$
- *Work*
  $W_\Sigma = \Delta K_{cm} + \Delta K_\theta$
- *Kinetic Energy (rotational)*
  $K = \frac{1}{2}m_\Sigma v_{cm}^2 + \frac{1}{2}I\omega^2$
- *Atwood's Machine*
  $a = g(m_2 - m_1)/(m_1 + m_2 + \beta m_\Sigma)$
- *Atwood's Machine*
  $v = \sqrt{(2gH(m_2 - m_1)/(m_1 + m_2 + \beta m_\Sigma))}$
- *Parallel Axis Theorem*
  $I = I_{cm} + m_\Sigma r_{cm}^2$
- *Parallel Axis Theorem*
  $K = \frac{1}{2}I_{cm}\omega^2 + \frac{1}{2}(m_\Sigma r_{cm}^2)\omega^2$

- *Unrolling Spool*
  $v = \sqrt{(\frac{4}{3}gH)}$
- *Rolling Ball (loop-the-loop)*
  $H_{min} = 2.7R$
- *Perpendicular Axis Theorem*
  $I_z = I_x + I_y$

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