Feel free to rip this equation sheet from the rest of the test. If you don't, **please write your name** and lab weekday/time here.

Potentially useful math:

sin θ = opposite/hyp cos θ = adjacent/hyp tan θ = opposite/adj $a^2 + b^2 = c^2$

for $ax^2 + bx + c = 0$ $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Kinematics

$$\Delta\vec{x} = \vec{x}_f - \vec{x}_i \qquad \vec{v}_{\text{ave}} = \frac{\Delta\vec{x}}{\Delta t} \qquad \vec{a}_{\text{ave}} = \frac{\Delta\vec{v}}{\Delta t}$$

$$\Delta\vec{x} = \vec{v}_0\, t + \frac{1}{2}\vec{a}\, t^2 \qquad \vec{v} = \vec{v}_0 + \vec{a}t \qquad v^2 = v_0^2 + 2a\Delta x$$

Forces

net **F** = m**a** W = m g $f_k = \mu_k F_N$ $f_s \leq \mu_s F_N$

Constants and Unit Conversions

$g = 9.8\ \text{m/s}^2$ 1 in = 2.54 cm 1 kg = 2.24 lb

$1\ \text{m}^3 = 1000\ \text{L}$

1 m = 3.28 ft

Prefixes:

1 m = 100 cm = 1000 mm = 1,000,000 μm = 1,000,000,000 nm

1 kg = 1000 g

Work = (component of force in the direction of displacement)(displacement) = $F_{\parallel}\,\Delta x$

Kinetic Energy: $KE = \frac{1}{2}\, m\, v^2$ $RKE = \frac{1}{2}\, I\, \omega^2$

Gravitational Potential Energy: GPE = mgy where y is change in vertical height

Momentum: momentum p = (mass)(velocity) angular momentum L = I ω

Impulse: $I = F\Delta t = \Delta p$ Elastic collisions only: $\mathbf{v}_{1i} - \mathbf{v}_{2i} = -(\mathbf{v}_{1f} - \mathbf{v}_{2f})$ This is a vector equation.

Torque = $F_{\perp}\, r$ $\Sigma\tau = I\,\alpha$ Moment of inertia definition: $I = \Sigma\, m\, R^2$ $I_{disk} = \frac{1}{2}\, M\, R^2$

Centripetal acceleration $a_c = v^2/r$ $\Delta x = r\Delta\theta$ $v = r\omega$ $a_{tan} = r\alpha$

$\omega = \omega_o + \alpha t$ $\Delta\theta = \omega_o t + \frac{1}{2}\alpha t^2$ $\omega^2 = \omega_o^2 + 2\alpha(\theta - \theta_o)$

Newton's Universal Law of Gravity: $F = G\dfrac{m_1 m_2}{r^2}$ where r is center-to-center and $G = 6.67 \times 10^{-11}\ \text{Nm}^2/\text{kg}^2$