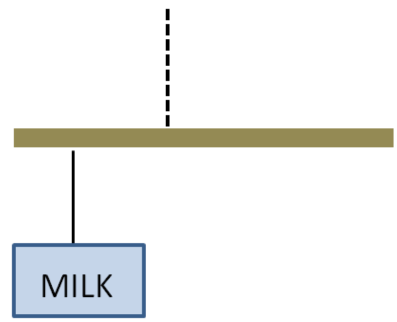
Exam 3 Review Problems

Name: ___________________________

1. Angular acceleration (α) and centripetal acceleration (a_c)
    a. A. Compare and contrast angular acceleration (α) and centripetal acceleration (a_c).
    b. Provide an example where only one of these quantities non-zero
    c. Provide an example where an object has a non-zero value for both of these.

2. List all the linear quantities that we are able to determine mathematically after this semester's studies. Now consider all the angular quantities we are able to determine and match them up with their linear analog.

3. A store owner wants to hang two signs in a window and decides to use a long wooden dowel that he has handy and a chain. He only has enough chain to attach the dowel in one spot. He screws in a hook and hangs the dowel from the ceiling. He immediately realizes that he's attached the chain off center but figures it'll be easy enough to fix by attaching the signs in spots that balance the whole thing out.



The dowel is 2.0 meters long, has a mass of 1.0 kg and has been suspended at a point located 0.75 meters from the left end. He then attaches the first sign, which is 5.0 kg, 0.30 meters from the left end. The second sign has a mass of 4.0 kg?

    a. Using **center of gravity** find the distance from the right end that the second sign has to be hung for the dowel to hang exactly level.
    b. Using **Torque** find the distance from the right end that the second sign has to be hung for the dowel to hang exactly level.

4. A boy is sitting on the edge of a merry-go-round 2 m from the center, while his sister pushes it. The sister applies a Force of 250N for 1.5 seconds. If the merry-go-round started at rest, has no friction, and accelerates with an angular acceleration of 1.1 rad/s^2 .
    a. Find the final angular velocity.
    b. After 1 minute from the start of the push, what is the boy's angular displacement?

5. Two vehicles collide head on. Initially the first vehicle is traveling at 10.0 m/s due North and the second vehicle, which is twice the mass of the first, is traveling due South at 20.0 m/s. After the collision, the first vehicle is traveling at 17.0 m/s due South.
    a. Determine the final velocity of the second vehicle?
    b. What is the impulse delivered to each vehicle?

$\theta_f = \theta_i + \omega_i \Delta t + ½\, \alpha(\Delta t)^2$ $\qquad \omega_f = \omega_i + \alpha \Delta t$ $\qquad \omega_f^2 = \omega_i^2 + 2\alpha (\Delta\theta)$

$\tau = F_\perp r$ $\qquad v = \omega r$ $\qquad a_c = \frac{v^2}{r} = \omega^2 r$

$a_t = \alpha r$

$x_{cg} = \frac{x_1 m_1 + x_2 m_2 + x_3 m_3 + \dots}{m_1 + m_2 + m_3 + \cdots}$ $\qquad F_{sp} = -k\,\Delta x$ $\qquad \frac{F}{A} = Y\,\frac{\Delta L}{L}$

$\vec{\boldsymbol{p}} = m\vec{\boldsymbol{v}}$ $\qquad \vec{\boldsymbol{J}} = \vec{\boldsymbol{F}}\,\Delta t = \Delta \vec{\boldsymbol{p}}$ $\qquad \vec{\boldsymbol{p}}_i = \overrightarrow{\boldsymbol{p_f}}$

$\Sigma\vec{\boldsymbol{F}} = m\vec{\boldsymbol{a}}$ $\qquad m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$ $\qquad \vec{\boldsymbol{L}} = I\vec{\boldsymbol{\omega}}$

$g = 9.8 m/s^2$

$v_x = \frac{\Delta x}{\Delta t} = \frac{x_f - x_i}{\Delta t}$ $\qquad a_x = \frac{\Delta v_x}{\Delta t} = \frac{v_{xf} - v_{xi}}{\Delta t}$

$x_f = x_i + v_{xi}\Delta t + ½\, a_x(\Delta t)^2$ $\qquad v_{xf} = v_{xi} + a_x \Delta t$ $\qquad v_{xf}^2 = v_{xi}^2 + 2a_x(\Delta x)$

$\sin\theta$ = opp/hyp $\qquad \cos\theta$ = adj/hyp $\qquad \tan\theta$ = opp/adj

$a^2 + b^2 = c^2$