1.)

2.) If \( I = 10 \text{ kg m}^2 \), \( \alpha = ? \)
2) If \( I = 10 \text{ kg}m^2 \), what is \( \alpha = ? \)

\[ F_g d_i = +T \]

\[ 3k_g (d_1)(a_y) \sin (90° - 30°) = +T \]

\[ -T = F_g d_2 (60°)(a_y) + F_{\text{static}} (d_2)(a_x) \]

\[ 3k_g (d_1) = 8k_g (d_2) + 1k_g (2d_2 + d_2) \]

\[ d_1 + d_2 = 8 \text{ m} \]

\[ d_1 = 8 \text{ m} - d_2 \]

\[ 2d_2 = 8d_2 + 2 + d_2 \]

\[ \frac{22}{d_2} = d_2 = \frac{11}{6} \text{ m} \]
1) A diagram shows forces and moments with labels 3kg, 1kg, and 43N. The question asks where the fulcrum goes.

2) If $I = 10 \text{ kgm}^2$, $\alpha = ?$

$T = I \alpha$

$-800 \text{ Nm} = (10 \text{ kgm}^2) \alpha$

$\alpha = 80 \text{ rad/s}^2$

$+T + -T$

$(10)(5)(4) + (-5)(20)(10) = T_{\text{net}}$

$2 \theta_0 - 100 \theta_0 = T_{\text{net}}$

$T_{\text{net}} = -800 \text{ Nm}$

$d = \Delta r$

$n = \omega r$

$a_t = \alpha r$
\[ p = m \nu \]

**Momentum**

\[ \Delta p = m(\Delta \nu) = J = F \cdot t \]

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**Inertia in motion**

**Resistance to change in velocity**

**Impulse** (change in momentum)

**Force applied over a period of time**
Collisions (Two Types)

Kinetic - Sticking Together

Inelastic - Bouncing Off One Another

Kinetic Energy Is Conserved

\[ K.E. \_o = K.E. \_f \]

\[ \frac{1}{2} m v_o^2 = \frac{1}{2} m v_f^2 \]

Momentum Conservation

Kinetic Energy Is Not Conserved, Some Lost To Deformation Of Object(s) ≠ \( W_f \) (Heat).
Example 1a:

\[ \text{t}_{\text{explosion}} = 0.2 \text{sec.} \]

\[ m_{\text{TOTAL}} = 3 \text{kg.} \]

\[ 200 \text{m/sec} = \vec{v} \]

\[ 2 \text{kg.} \quad 1 \text{kg.} \]

\[ \vec{v} = ? \]

\[ P_{\text{total}_0} = P_{\text{total}_f} \]

\[ P_0 = P_{1_f} + P_{2_f} \]

\[ m_0 \cdot v_0 = m_1 \cdot v_{1_f} + m_2 \cdot v_{2_f} \]

\[ 3 \text{kg.} \cdot (0 \text{m/sec}) = (2 \text{kg.}) \cdot (200 \text{m/sec}) + (1 \text{kg.}) \cdot v_{2_f} \]

\[ v_{2_f} = -400 \text{m/sec.} \]
Example 1b: If $t_{\text{explosion}} = 0.2 \text{ sec}$, what is the force of the explosion?

\[ \Delta p_2 = m_2 \Delta V_2 \]

\[ J = \Delta p = (2 \text{ kg})(200 \text{ km/hr} - 0 \text{ km/hr}) \]

\[ J = F \cdot t \]

\[ \frac{400 \text{ kg km/hr}}{6 \text{ sec}} = F \cdot (0.2 \text{ sec}) \]

\[ 2000 \text{ N} = F \]

\[ J_1 = \Delta p_1 = m_1 \Delta V_1 = F \cdot t = F \cdot (0.2 \text{ sec}) \]

\[ F = -2000 \text{ N} \]

Opposite direction for piece 1
\[ F \cdot t = \int - \Delta p = m \cdot a \cdot v \]

\[ 1N \ (6000 \text{ sec.}) = 6000N \ (1 \text{ sec.}) \]
\[ l = I \omega \]

- Angular momentum
- Rotational Inertia (based on shape)
- Angular velocity

\[ l_{\text{TOTAL}} = l_{\text{TOTAL}_f} \]
What is the velocity (speed and direction) of ball #1 after the collision?
\[ P_{\text{total } x} = 30 \text{ kg m/sec} \]
\[ P_{\text{total } y} = 0 \text{ kg m/sec} \]

\[ m, V_{f y} = P_{f y} = 5 \text{ kg m/sec} \]

\[ \frac{5 \text{ kg m/sec}}{(3 \text{ kg})} = V_{f y} \]

\[ P_{\text{total } x} = 30 \text{ kg m/sec} = P_{f1x} + P_{f2x} \]
\[ m, V_{i0} = 30 = m, V_{f1x} + m_2 V_{f2x} \]

\[ 30 \text{ kg m/sec} = 3 \text{ kg} \left( V_{f1x} \right) + (2 \text{ kg}) (4.5 \text{ m/sec}) \]

\[ V_{f1x} = 7.11 \text{ m/sec} \]
**m** and **r** are not factors in determining the order of objects finishing down the incline.

\[ m \cdot \text{P.E.} \]

Based on shape:

\[ 0.5 \cdot \frac{1}{2} mr^2 = I \]

\[ 0.4 \cdot \frac{2}{3} mr^2 = I \]

\[ 1 \cdot 1 mr^2 = I \]

KE + KE rot.

\[ \frac{1}{2} mv^2 + \frac{1}{2} I \omega^2 \]

\[ mgh = \frac{1}{2} mv^2 + \frac{1}{2} \left( \frac{2}{5} mr^2 \right) \omega^2 \]

\[ gh = \frac{1}{2} v^2 + \frac{1}{2} \left( \frac{2}{5} r^2 \right) \left( \frac{v}{r} \right)^2 \]

\[ gh = \frac{1}{2} v^2 + \frac{1}{2} \left( \frac{2}{5} r^2 \right) \frac{v^2}{r} \]
\[ v = 5 \text{ m/s}. \]
\[ m = 5 \text{ kg}. \]

\[ m = 80 \text{ kg}. \]
\[ v = 0.3 \text{ m/s}. \]

\[ W_f = ? \]
\[ p_0 + I \omega_0 = \frac{L_{f \text{ total}}}{I_{\text{ total}}} + p_f \]

\[ m_0 v_0 + I \omega_0 = I \omega_f + m_f v_f \]

\[ v = 5 \text{ m/s} \]
\[ m = 5 \text{ kg} \]
\[ m = 80 \text{ kg} \]
\[ v = 0.3 \text{ m} \]
\[ w_0 = \text{ constant} \]

Assume that Abraham Lincoln is pretty much a solid cylinder and go from there...
\[ n = 10 \text{ rpm} \]
\[ m = 80 \text{ kg} \]
\[ l_{\text{total}_o} = l_{\text{total}_f} \]
\[ p = m v \]
\[ I = I_o \]
\[ I_{\text{cylinder}} = \frac{1}{2} m r^2 \]

\[ 50 \text{ kg} \times \omega_o = \frac{1}{2} m r^2 \omega \]
\[ 50 \text{ kg} \times \omega_i = \frac{1}{2} \left( 80 \text{ kg} + 5 \text{ kg} \right) (0.5 \text{ m})^2 \omega \]
\[ d = cr \]
\[ n = wr \]
\[ a_t = \omega r \]

Fraken-Devil Cat vs Crayfish Zilla

Joe Koh
3/3/15