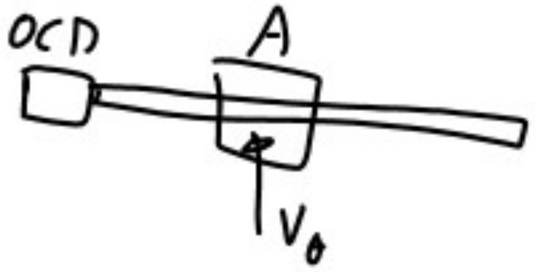
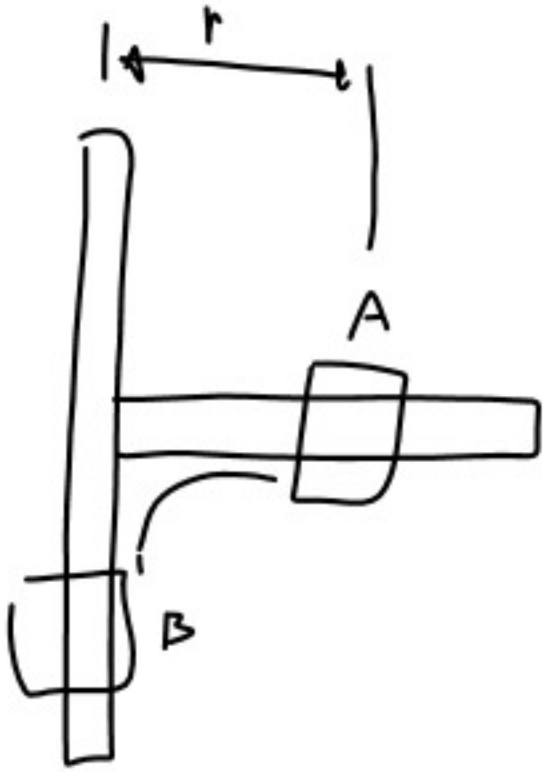
12.92

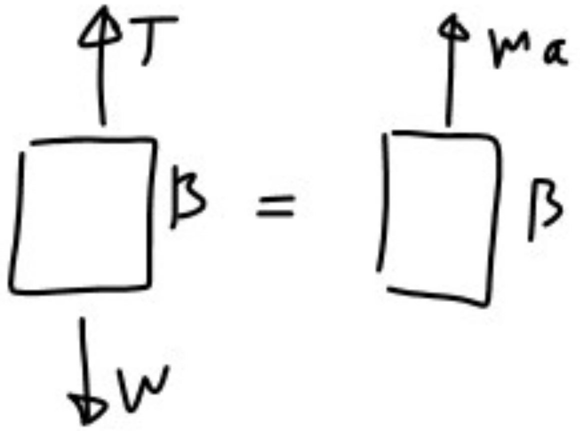
$V_\theta = R\dot{\theta}$

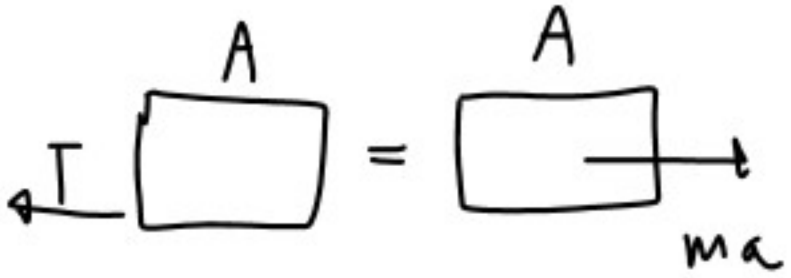




$T - W = ma$

$= m\ddot{r}$





$-T = ma$

$= m(\ddot{r} - r\dot{\theta}^2)$

Impulse and Momentum

$$\vec{L} = m\vec{v}$$

$$\vec{F} = \frac{d}{dt} m\vec{v}$$

$$\overrightarrow{Imp}_{1\to 2} = F_{avg}\,\Delta t$$

$$\int_{t_1}^{t_2} \vec{F}\,dt = m\vec{v}_2 - m\vec{v}_1$$

$$\overrightarrow{Imp}_{1\to 2} = \vec{L}_2 - \vec{L}_1$$

$$\vec{L}_1 + \overrightarrow{Imp}_{1\to} = \vec{L}_2$$

$$\vec{L}_1 + \Sigma\,\overrightarrow{Imp}_{1\to 2} = \vec{L}_2$$

$$\Sigma\vec{L}_1 + \overrightarrow{Imp}_{1\to 2} = \Sigma\vec{L}_2$$

$$\Sigma\vec{L}_1 = \Sigma\vec{L}_2$$

A 2500-lb automobile is moving at a speed of 60 mi/h when the brakes are fully applied, causing all four wheels to skid. Determine the time required to stop the automobile (*a*) on dry pavement ($\mu_k = 0.75$), (*b*) on an icy road ($\mu_k = 0.10$).

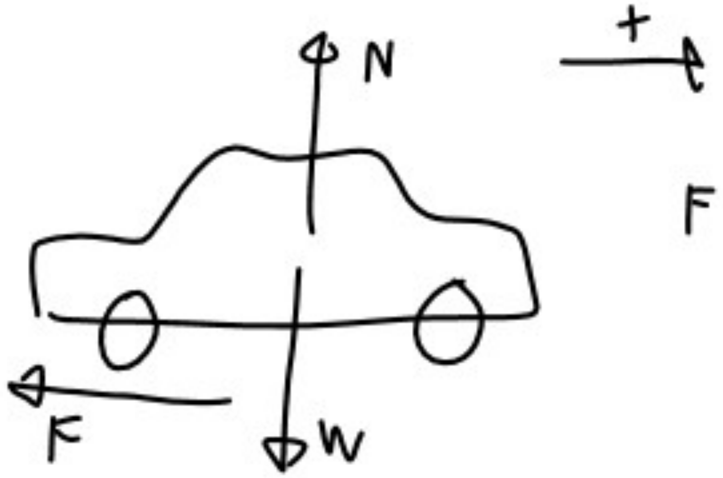
$$60\ \frac{\text{mi}}{\text{h}} \cdot \frac{1\ \text{h}}{3600\ \text{s}} \cdot \frac{5280\ \text{ft}}{1\ \text{mi}} = 88\ \text{ft/s}$$

$$\vec{L}_2 - \vec{L}_1 = \vec{Imp}_{1\to2} \qquad (\vec{L}_2 = 0)$$

$$m = \frac{W}{g} = \frac{2500\ \text{lb}}{32.2\ \text{ft/s}^2} = 77.6\ \frac{\text{lb s}^2}{\text{ft}}$$

$$N = \frac{\text{kg m}}{\text{s}^2} \qquad \frac{N\,\text{s}^2}{\text{m}} = \text{kg}$$

$$\vec{L}_1 = m\vec{v}_1 = 77.6 \cdot 88 = 6832\ \text{lb s}$$



$$F = -\mu_K N = -\mu_K W = 0.75(2500) = 1875\ \text{lb}$$

$$\vec{Imp}_{1\to2} = -6832\ \text{lb s} = F\Delta t$$

$$\frac{-6832\ \text{lb s}}{-1875\ \text{lb}} = \boxed{3.64\ \text{s}}$$

A sailboat weighing 980 lb with its occupants is running downwind at 8 mi/h when its spinnaker is raised to increase its speed. Determine the net force provided by the spinnaker over the 10-s interval that it takes for the boat to reach a speed of 12 mi/h.