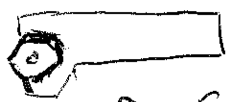
35 cm



$F = 65\ N$ | $\tau = ?$

$\tau = F \cdot \sin\theta \cdot r$

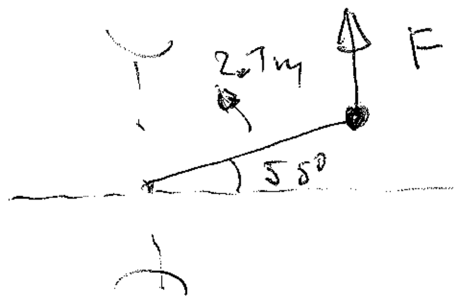
75. ORGANIZE AND PLAN Since the force and the radius are specified, the only variable in the torque equation. $\tau = rF\sin\theta$, is the angle. The sin function has a maximum value of 1 when this angle is 90° (or equivalently when the force is applied in the same direction as the rotational motion).

Known: $r = 35$ cm, $F = 65$ N, $\theta = 90°$.

SOLVE Using 90° as the angle of application, the torque is:

$$\tau = (0.35\ \text{cm})(65\ \text{N})\sin 90° = 23\ \text{N}\cdot\text{m}$$

A force is applied at a point 2.7 m away from the axis of rotation gives rise to a torque of 71 N· m. Find the magnitude of the force if it makes an angle of 55° with a line from the axis of rotation to the application point.



$F = ?$ if $\tau = 71\ N.m$

$$\tau = F \cdot \sin\theta \cdot r$$

$$= F \cdot (\sin 55^\circ) \cdot (2.7m)$$

$$71\ (N.m) = F \cdot (\sin 55^\circ) \cdot (2.7m)$$

$$\boxed{\frac{71\ (N.m)}{(\sin 55^\circ) \cdot (2.7m)} = F = 32\ N}$$

A torque of 18 N · m is applied to a solid, uniform disk of radius 0.75 m. If the disk accelerates at 4.7 rad/s^2, what is the mass of the disk ? Rotational inertia of a disk is I= ½ M. r^2, where M is the mass of the disk and r – its radius.

$$\tau = I \cdot \alpha$$

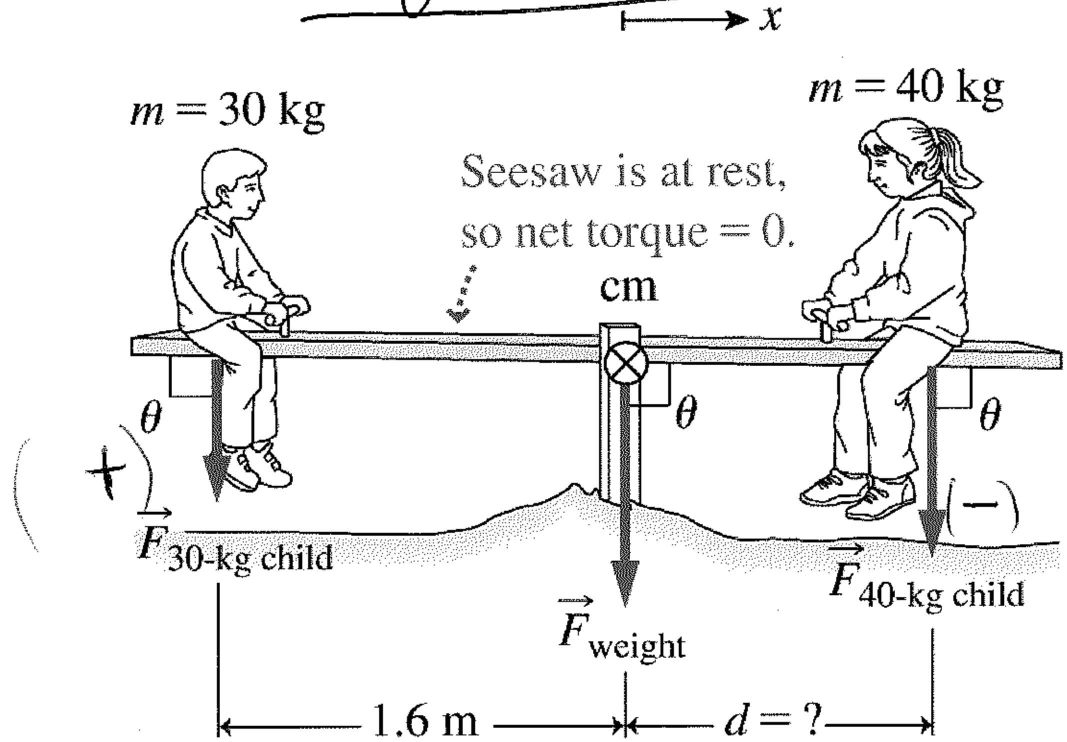
$$3.83\,kg.m^2 = \frac{\tau}{\alpha} = I = \frac{1}{2} M r^2$$

$$3.83\,kg.m^2 = \frac{1}{2} M . (0.75m)^2$$

$$\frac{(3.83) . 2}{(0.75)^2} = M = 13.6\,kg$$

Figure 8.19

Equilibrium



To find distance d, use fact that net torque = 0:

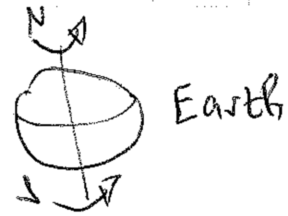
$$\tau_{\text{net}} = \tau_{\text{30-kg child}} + \tau_{\text{40-kg child}} + \tau_{\text{weight}} = 0$$

Each torque = $rF\sin\theta$. Torque τ_{weight} exerted on board by gravity = 0 because $r = 0$. Factor out the equation and solve for d:

$$\tau_{\text{net}} = (1.6\text{ m})(30\text{ kg})(9.8\text{ m/s}^2)(\sin 90°) - d\underbrace{(40\text{ kg})(9.8\text{ m/s}^2)}_{F_g}(\sin 90°) = 0$$

$$d = 1.2\text{ m}$$

$L_{Earth} = ?$



86. **Organize and Plan** From Equation 8.19, the angular momentum is related to the angular velocity: $L = I\omega$. We need to calculate the rotational inertia of Earth (assuming it is a uniform solid sphere, so $I = \frac{2}{5}MR^2$) and convert its once-a-day rotation into rad/s.

Known: $M = 5.97\times10^{24}$ kg, $R = 6.38\times10^{6}$ m, $\omega = 1$ rev/day.

Solve Plugging in the given values, the Earth's rotational inertia and angular velocity are:

$$I = \tfrac{2}{5}(5.97\times10^{24}\text{ kg})(6.38\times10^{6}\text{ m})^2 = 9.72\times10^{37}\text{ kg m}^2$$

$$\omega = \frac{1\text{ rev}}{24\text{ h}}\left[\frac{2\pi\text{ rad}}{1\text{ rev}}\right]\left[\frac{1\text{ h}}{60\text{ min}}\right]\left[\frac{1\text{ min}}{60\text{ sec}}\right] = 7.27\times10^{-5}\text{rad/s}$$

Combining these values:

$$L = I\omega = (9.72\times10^{37}\text{ kg m}^2)(7.27\times10^{-5}\text{ rad/s}) = 7.07\times10^{33}\text{ J s}$$

Reflect Notice that we have put the answer in the conventional units for angular momentum: Joule seconds.