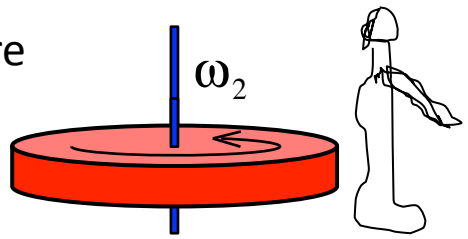
Problem 11.31

What is the disk's new *angular momentum* after the girl sits?

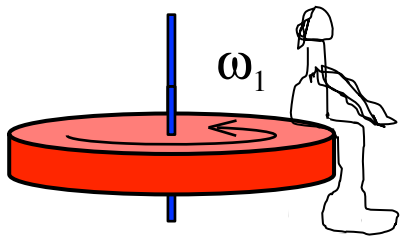
The girl provides a torque to the merry-go-round that motivates it to angularly slow down, and the merry-go-round providing an equal and opposite torque on the girl motivating her to angularly speed up. These torques are internal with no external torques acting, so of *angular momentum* is conserved.

before



Treating the girl like a point mass with *moment of inertia* of m_1R^2, we an write:

after



$$\sum L_1 + \sum \cancel{\tau}^{0}_{\text{external}} \Delta t = \sum L_2$$

$$\Rightarrow \quad I_{mgr}\omega_1 = \left(I_{mgr} + I_{girl}\right)\omega_2$$

$$\Rightarrow \quad \omega_2 = \frac{I_{mgr}}{\left(I_{mgr} + m_{girl}R^2\right)}\omega_1$$

$$= \frac{\left(250.\ \text{kg}\cdot\text{m}^2\right)}{\left(\left(250.\ \text{kg}\cdot\text{m}^2\right) + \left(25.0\ \text{kg}\right)\left(2.00\ \text{m}\right)^2\right)}\left[\left(10.0\frac{\text{rev}}{\text{min}}\right)\left(\frac{2\pi\ \text{rad}}{\text{rev}}\right)\left(\frac{1\ \text{min}}{60\ \text{s}}\right)\right]$$

$$= .748\ \text{rad/s} \qquad \left(= 7.14\ \text{rev/min}\right)$$