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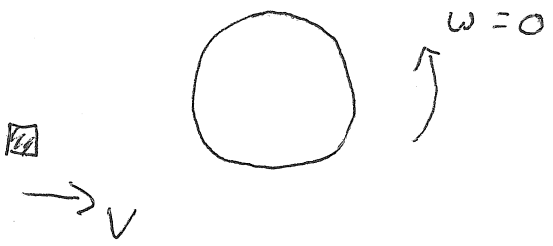
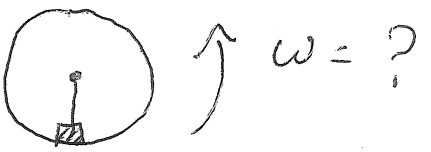
A student sits at rest on a piano stool that can rotate without friction. The moment of inertia of the student-stool system is $4.1\ kg\,m^2$. A second student tosses a $1.5\ kg$ mass with speed $2.7\ m/s$ to the student on the stool, who catches it at a distance of $0.40\ m$ from the axis of rotation. What is the resulting angular speed of the wheel?

before



after



inelastic collision $\Rightarrow \Delta L = 0$

before

$p = mv$

$L = I\omega$

$v = r\omega$

$I = mr^2$

after

$L = I_{stool}\omega + I_{mass}\omega$

before

after

$L = mr^2\omega_i$

$= mr^2\left(\frac{v}{r}\right)$

$= mrv$

$L = I_{stool}\omega + mr^2\omega$

$$0 = \left(I_{stool}\omega + mr^2\omega\right) - mrv$$

$$0 = \left(I_{stool} + mr^2\right)\omega - mrv$$

$$\frac{mrv}{I_{stool} + mr^2} = \omega$$

$$\frac{1.5\,kg\,(0.40\,m)\;2.3\,m/s}{4.1\,kg\,m^2 + 1.5\,kg\,(0.40\,m)^2} = 0.373\,\frac{rad}{s}$$

$$\boxed{0.37\,\frac{rad}{s}}$$