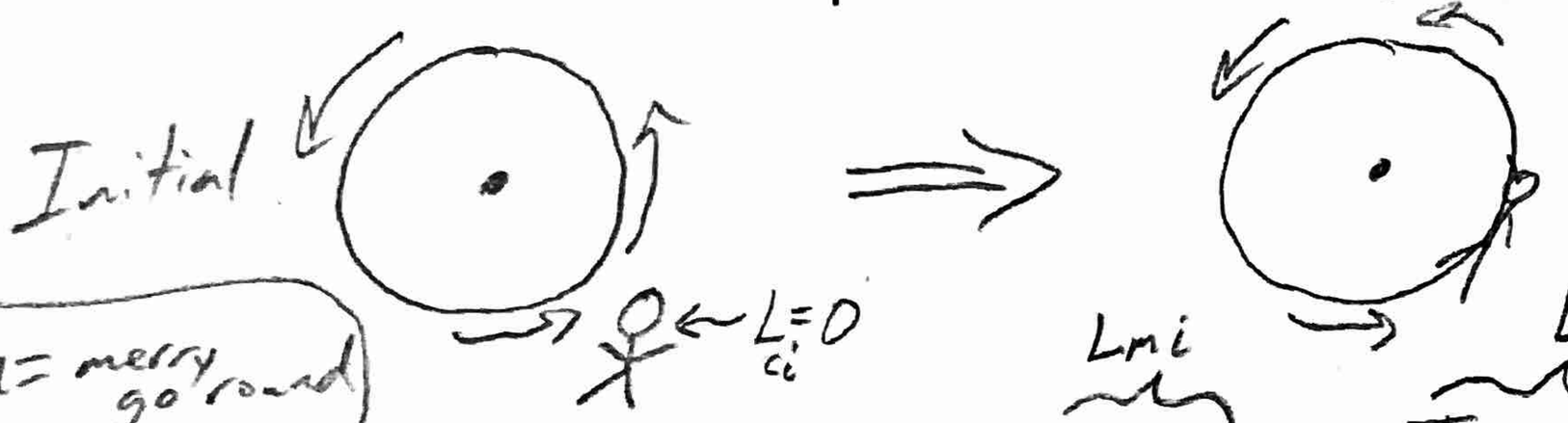
Name: Key

Practice – 10.5 Angular Momentum and Its Conservation

This is an angular unit

1. A playground merry-go-round has a mass of 120 kg and a radius of 1.80 m and it is rotating with an angular velocity of 0.500 rev/s. What is its angular velocity after an initially motionless 22.0-kg child gets onto it by grabbing its outer edge? This might be easier to visualize if you picture the merry-go-round snagging the child and yanking him/her into motion. [You may assume that the merry-go-round is a uniform disc with $I=1/2\ mr^2$ and that the child is a point source with $I=mr^2$.]



$$L_i = L_f \Rightarrow \underbrace{I_{mi}\omega_{mi}}_{L_{mi}} + \underbrace{I_{ci}\omega_{ci}}_{L_{ci}} = I_{mf}\omega_{mf} + I_{cf}\omega_{cf}$$

$$\frac{1}{2}(120\,kg)(1.8\,m)^2(0.5\,rev/s) + 0 = \omega_f(I_M + I_C)$$

I_{mi}, L_{mi}, ω_{mi}, L_{ci}

$$97.2\,kg\,m^2\frac{rev}{s} + 0 = \omega_f\left(\underbrace{\tfrac{1}{2}(120\,kg)(1.8\,m)^2}_{I_M} + \underbrace{22\,kg(1.8\,m)^2}_{I_{child}}\right)$$

$$97.2\,kg\,m^2\frac{rev}{s} = \omega_f(199.4\,kg\,m^2 + 71.3\,kg\,m^2)$$

$$97.2\,kg\,m^2\frac{rev}{s} = \omega_f(265.7\,kg\,m^2)$$

$$0.365\frac{rev}{s} = \omega_f$$

$$\omega_f = 0.365\frac{rev}{s}\left(\frac{2\pi\,rad}{rev}\right) = \frac{2.3\,rad}{s}$$