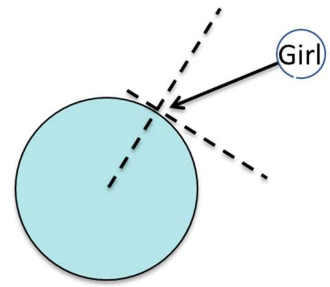
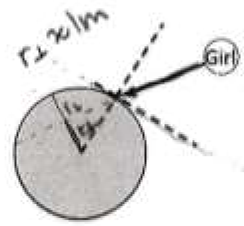
1) A girl of mass 40 kg runs as fast as she can (5 m/s) and jumps onto a the edge of a carousel… a uniform disk of mass 40 kg (same as the girl) and radius 2 m… as shown in the diagram at right (view from above). She holds onto the very edge of the carousel.



a) If the carousel was motionless before, please find the angular velocity of the carousel afterwards.

b) After a bit, the girl runs to the center of the carousel and stands tall and straight. Does the angular velocity of the carousel change? If so, find the factor by which it changes. If not, explain how you know.

1) A girl of mass 40 kg runs as fast as she can (5 m/s) and jumps onto a the edge of a carousel… a uniform disk of mass 40 kg (same as the girl) and radius 2 m… as shown in the diagram at right (view from above). She holds onto the very edge of the carousel.
a) If the carousel was motionless before, please find the angular velocity of the carousel afterwards.
b) After a bit, the girl runs to the center of the carousel and stands tall and straight. Does the angular velocity of the carousel change? If so, find the factor by which it changes. If not, explain how you know.



a) Using a momentum lens because angular momentum is conserved when there are no outside torques

$l_D + l_g = l_{D+g}$

$0 + mvr_\perp = \frac{1}{2}m_D r^2 \omega + m_g r^2 \omega$

$40kg \cdot 5m/s \cdot 1m = \frac{1}{2} 40kg\, 2m^2 \omega + 40kg\, 2m^2 \omega$

$200 \frac{kgm^2}{s} = 80 kgm^2 \omega + 160 kgm^2 \omega$

$200 \frac{kgm^2}{s} = 240 kgm^2 \omega$

$\frac{5}{6} /s = \omega$

b) $\frac{1}{2}m_D r^2 \omega + m_g r^2 \omega = \frac{1}{2} m_D r^2 \omega_F + m_g r_g^2 \omega_F$

$240kgm^2 \cdot 5/6 /s = 80 kgm^2 \omega_F + 40kg \cdot 0^2 \omega_F$

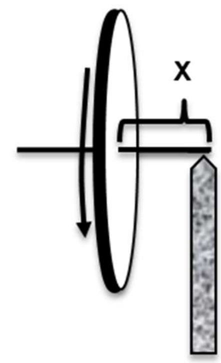
$3 \cdot 5/6 /s = \omega_F$

$\frac{5}{2} /s = \omega_F$

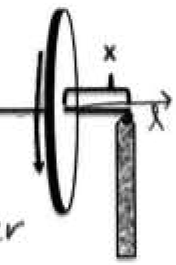
Yes, it changes by a factor of 3. The angular momentum is still conserved because there are no outside τ but ω changes because she decreased her I which must increase ω

c)

2) In the picture at right, a wheel is supported on a pedestal only on the right side, and is let go, spinning clockwise when viewed from the left, as shown.
   a) Does the wheel have any angular momentum? If so, please label it.
   b) Is there any torque on the wheel? If so, what is it from and what is the direction of this torque?



b) Yes, using a momentum lens, the disk has a ΔL caused by gravity, as gravity is a τ acting on the wheel and τ cause angular acceleration. The direction is out of the paper since gravity would cause it to rotate ↺
→ $\vec{\Delta L}$



a) Yes, the wheel has angular momentum before it is let go to the right from the spinning of the wheel. Once it is let go, the τ caused by gravity causes there to be a change in angular momentum, so the wheels angular momentum is to the right plus out of the paper, so it will rotate around the pedestal as well as continue to rotate around its own center.

Name____