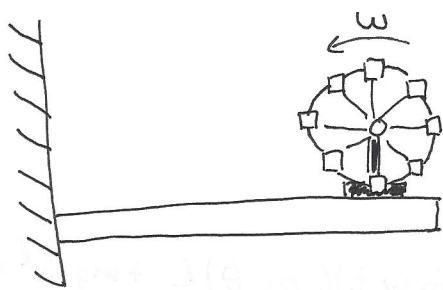
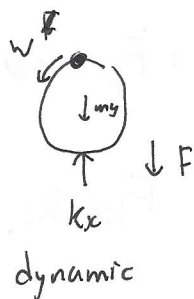


The world's smallest Ferris wheel ($m = 20\text{kg}$) is mounted on the end of a horizontal beam for no apparent reason. The wheel is mounted eccentrically in such a way that the eccentricity is equivalent to a mass of 5kg located 0.15m away from the axis of rotation. The static weight of the Ferris wheel causes a deflection of 20mm in the beam. Given that the wheel spins at a rate of 15rad/s , find the steady-state amplitude of vibration.



Solution:



$$k = \frac{F}{\Delta y} = \frac{mg}{\Delta y} = \frac{20(9.81)}{0.02} = 9810 \text{ N/m}$$

$$\omega_n = \sqrt{\frac{k}{m}} = \sqrt{\frac{9810}{20}} = 22.147 \text{ rad/s}$$

$$F_0 = mr\omega^2 = 5(0.15)(15)^2 = 168.75 \text{ N}$$

$$x_p = \left| \frac{F_0/k}{1 - \left(\frac{\omega}{\omega_n}\right)^2} \right| = \frac{168.75/9810}{1 - \left(\frac{15}{22.147}\right)^2}$$

$$= 0.0318 \text{ m}$$