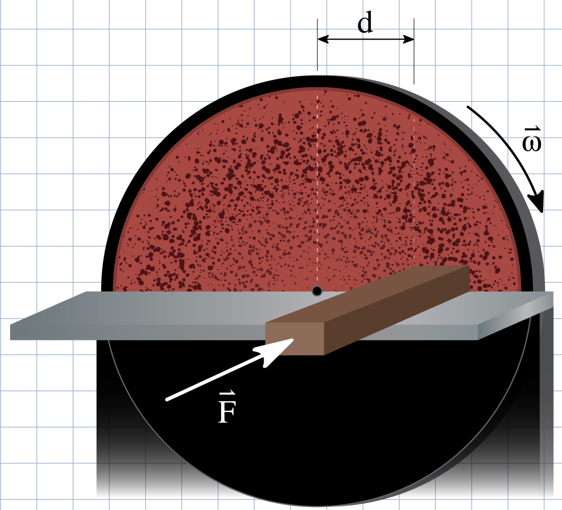
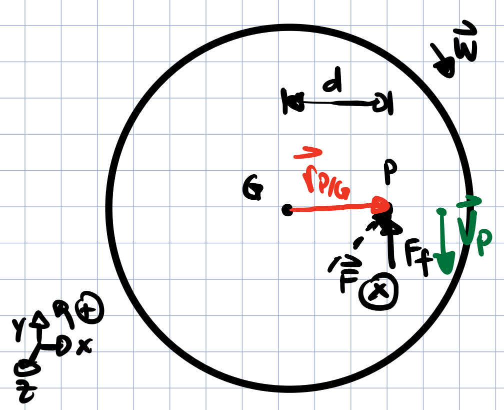
A circular industrial disc sander of radius r = 1m, with a moment of inertia of 0.5 kg m^2 is rotating at a speed of 1100 rpm just after being disconnected from power. A block of wood is pushed against the sander with a constant force at a distance of 5 cm from the center of the sander in order to slow it down. If it takes 20 seconds for the disk to come to a complete stop, what is the required force F applied to the wooden block?

There are no other losses or frictions in the system and take the coefficient of kinetic friction between the wood and sanding disc to be $\mu_k = 0.8$.





$$H_{G_1} + \Delta H_{G_{1\to 2}} = H_{G_2} \to 0$$

$$\Delta H_{G_{1\to 2}} = \sum \int_{t_1}^{t_2} M\,dt$$

$$F_f = \mu_K F$$

$$\vec{H}_G = I_G \vec{\omega}$$

↳ $I_G = 0.5\,kg\,m^2$

↳ $\omega_1 = 2\pi r \cdot \frac{(1100\,rpm)}{60} = 115.2\,rad/s$

↳ $\omega_2 = 0$

$$H_{G1} = (0.5\,kg\,m^2)(115.2\,rad/s) = 57.6\,\frac{kg\,m^2}{s}$$

$$\Delta H_{G_{1-02}} = \int_{t_1=0}^{t_2=20sec} M\,dt = M\int_{t_1=0}^{t_2=20sec} dt = M(20sec) = d\mu_K F(20sec)$$

$$\vec{M} = \vec{r} \times \vec{F} = \vec{r}_{P/G} \times \vec{F}_f \rightarrow M = d\mu_K F$$

$$\hookrightarrow 57.6\,\frac{kg\,m^2}{s} = (0.05m)(0.8)F(20sec)$$

$$\hookrightarrow F = 72\,N \rightarrow \boxed{\vec{F} = -72N\,\hat{k}}$$