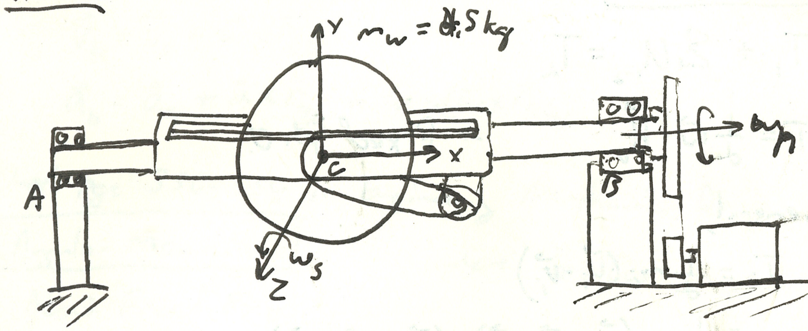
1/8/09

Given:



Bearings @ A, B, C

$\omega_s = 200 \frac{rev}{min}\left(\frac{1 min}{60 s}\right)\left(\frac{2\pi\, rad}{rev}\right) = 20.94$ rad/s   209.4

$\omega_n = 600 \frac{rev}{min}\left(\frac{1}{60}\right)\left(\frac{2\pi\, rad}{rev}\right) = 62.83$ rad/s

25.43

$m_w = 2.5$ kg

$m_n = 1$ kg

Initial assumptions:

- Disregard mass of spin drive motor, let's get an initial estimate of loading conditions just due to angular momentum. → Then develop more detailed analysis
- Similarly disregard, or just assume simple disc spinning and massless shaft, gears

Find:

i) reaction forces at bearings A, B

ii) reaction forces @ C bearings

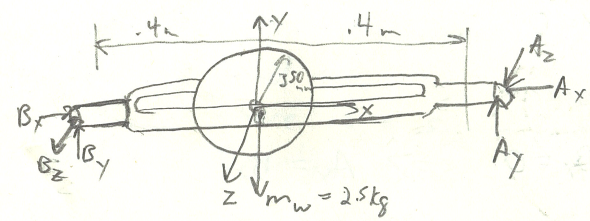
$I_x = I_y = \frac{1}{4}mr^2 = \frac{1}{4}(2.5 kg)(.35 m)^2 = 0.07656\ kg\,m^2$

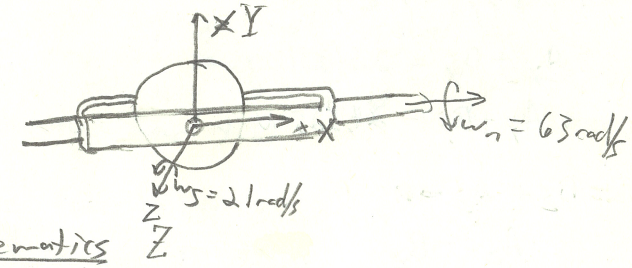
$I_z = \frac{1}{2}mr^2 = \frac{1}{2}(2.5 kg)(.35 m)^2 = 0.15313\ kg\,m^2$

1/8/09
1/9/09

Analysis:

Free Body Diagram





Kinematics

Set X, Y, Z to the x, y, z coordinate frame

Flywheel has $\vec{\omega} = \vec{\omega}_s + \vec{\omega}_n$

$= 21\hat{k} + 63\hat{\imath}$

$\vec{\omega} = 63\hat{\imath} + 21\hat{k}$

$\Rightarrow \omega_x = 63$ rad/s

$\omega_y = 0$

$\omega_z = 21$ rad/s

Time derivative w.r.t. to X, Y, Z axes however, I don't believe $\vec{\omega}$ will change w/ time

$\dot{\omega}_x = 0 \quad \dot{\omega}_y = 0 \quad \dot{\omega}_z = 0$

Equations of Motion

let $\vec{\Omega} = \vec{\omega}_n = 63\hat{\imath}$, so $\vec{\Omega} \neq \vec{\omega}$

$\sum M_x = I_x\dot{\omega}_x^{\,0} - I_y\Omega_z\omega_y^{\,0} + I_z\Omega_y^{\,0}\omega_z$

$0 = 0 - 0 + 0$

$\sum M_y = I_y\dot{\omega}_y^{\,0} - I_z\Omega_x\omega_z + I_x\Omega_z^{\,0}\omega_x$

$-A_z(.4m) + B_z(.4m) = -(.153)(63\ rad/s)(21\ rad/s)$

$-A_z + B_z = -506.4775\ kg\,m\frac{rad^2}{s^2}$ 2042.8 N