#1 USE A FRAME 1 ONBOARD, AS GIVEN.

→ ORIGIN AT CENTER OF DISK

MASS LOCATION WRT ORIGIN IN THAT FRAME

$$r_1 = \begin{bmatrix} -0.1 \\ y \\ 0 \end{bmatrix}, \quad \dot{r}_1^{\,1} = \begin{bmatrix} 0 \\ \dot{y} \\ 0 \end{bmatrix}, \quad \ddot{r}_1^{\,1} = \begin{bmatrix} 0 \\ \ddot{y} \\ 0 \end{bmatrix}$$

Angle RATES: ONLY OF THE DISK WRT INERTIAL

$$^1\omega_1 = \begin{bmatrix} 0 \\ 0 \\ \Omega \end{bmatrix} \qquad ^1\dot{\omega}_1^{I} = \begin{bmatrix} 0 \\ 0 \\ \dot{\Omega} \end{bmatrix}$$

$$\ddot{\vec{r}}^{\,I} = \ddot{\vec{r}}^{\,1} + 2\left({}^1\vec{\omega} \times \dot{\vec{r}}^{\,1}\right) + {}^1\dot{\vec{\omega}} \times \vec{r} + {}^1\vec{\omega} \times \left({}^1\vec{\omega} \times \vec{r}\right)$$

- WORK IN FRAME 1
- INERTIAL AND F1 AXES ALIGNED, ORIGINS CO-LOCATED.

SUBSTITUTE FROM ABOVE

$$\ddot{r}_1^{\,I} = \begin{bmatrix} 1.6y - 8\dot{y} + 1.6 \\ \ddot{y} + 0.1 - 16y \\ 0 \end{bmatrix} \qquad F_1 = m\ddot{r}_1^{\,I}$$

FORCES: FROM SPRINGS $\begin{bmatrix} 0 \\ -2ky \\ 0 \end{bmatrix}$ IN F1

$\Rightarrow \quad -2ky = 2(\ddot{y} + 0.1 - 16y)$ SIDE FORCE: $F_x = 3.2y - 16\dot{y} + 3.2$

$$\ddot{y} + (k - 16)y = -0.1$$

#2) INERTIAL + THEN 2 FRAMES — AS GIVEN IN THE PICTURE.

$$^1\omega_1 = \begin{bmatrix} 0 \\ \omega_2 \\ 0 \end{bmatrix} ; \quad ^2\omega_1 = \begin{bmatrix} -\omega \\ 0 \\ 0 \end{bmatrix} ; \quad ^2r_1 = \begin{bmatrix} b \\ 0 \\ 0 \end{bmatrix}$$

$$^3r_2 = \begin{bmatrix} 0 \\ r \\ 0 \end{bmatrix} ; \quad ^3\dot{r}_2^{\,2} = \begin{bmatrix} -\rho r \\ 0 \\ 0 \end{bmatrix} ; \quad ^3\ddot{r}^{\,2} = \begin{bmatrix} 0 \\ -r\rho^2 \\ 0 \end{bmatrix}$$

SUB IN EQ. GIVEN:

r = ~~DIA~~ RADIUS OF SPINNING DISK.

ALL FRAMES ALIGNED.

$$\ddot{r}_1^{\,I} = \begin{bmatrix} -b\omega_2^2 - 2\omega_1\omega_2 r \\ -\rho^2 r - r\omega_1^2 \\ 2\rho r \omega_2 \end{bmatrix}$$

NOTE: SEVERAL PEOPLE TRIED TO COMBINE THE ω_1, ω_2 ROTATIONS INTO ONE, AND THEN USE THE EQUATION FOR ONE ROTATING FRAME, NOT TWO.

PROBLEM: ω_1 IS ABOUT $\vec{X}$, WHICH IS NOT FIXED WRT INERTIAL.

$$^c\vec{\omega} = \omega_2 \vec{Y} - \omega_1 \vec{X} \Rightarrow {}^c\dot{\vec{\omega}}^I = -\omega_1 \dot{\vec{X}}^I \neq 0$$

$$\dot{\vec{X}}^I = {}^c\vec{\omega} \times \vec{X} \Rightarrow -\omega_2 \vec{Z}$$

$$\therefore \; {}^c\dot{\vec{\omega}}^I = -\omega_1(-\omega_2)\vec{Z} = \omega_1\omega_2\vec{Z}$$