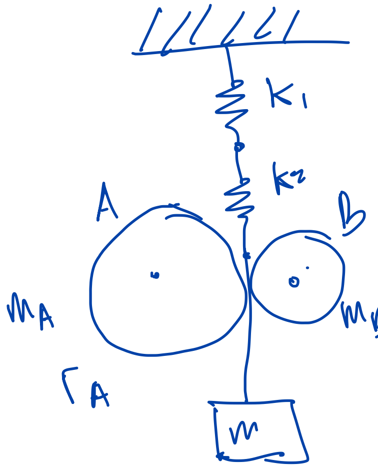
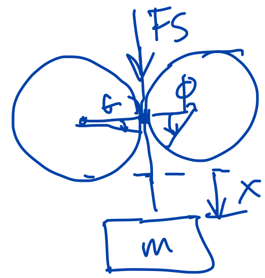
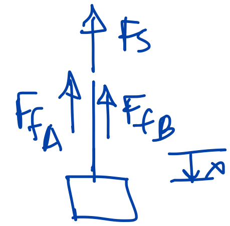
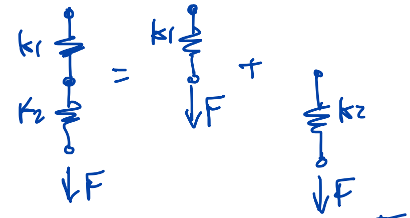






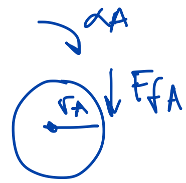


$$x = x_1 + x_2 = \frac{F}{k_1} + \frac{F}{k_2} = F\frac{(k_2+k_1)}{k_1 k_2}$$

$$\Sigma F_x: -F_S - F_{fA} - F_{fB} = m\ddot{x}$$

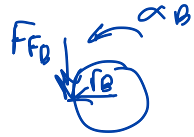
$$F_S = k_{equiv} x$$

$$k_{equiv.} = \frac{k_1 k_2}{k_1 + k_2}$$



$$\Sigma M_A: -F_{fA} \cdot r_A = -I_A \alpha_A$$

$$F_{fA} = \frac{I_A \alpha_A}{r_A}$$



$$\Sigma M_B: F_{fB} \cdot r_B = I_B \alpha_B$$

$$F_{fB} = \frac{I_B \alpha_B}{r_B}$$

$$\ddot{x} = a = \alpha_A r_A = \alpha_B r_B$$

$$\alpha_A = \frac{a}{r_A} \qquad \alpha_B = \frac{a}{r_B}$$

$$F_{fA} = \frac{I_A a}{r_A^2} = \frac{I_A}{r_A^2}\ddot{x}$$

$$F_{fB} = \frac{I_B a}{r_B^2} = \frac{I_B}{r_B^2}\ddot{x}$$

$$\Rightarrow -k_{equiv} x - \frac{I_A}{r_A^2}\ddot{x} - \frac{I_B}{r_B^2}\ddot{x} = m\ddot{x}$$

$$\left(m + \frac{I_A}{r_A^2} + \frac{I_B}{r_B^2}\right)\ddot{x} + \frac{k_1 k_2}{k_1 + k_2} x = 0$$

$$\ddot{x} + \underbrace{\frac{\frac{k_1 k_2}{k_1 + k_2}}{\left(m + \frac{I_A}{r_A^2} + \frac{I_B}{r_B^2}\right)}}_{\omega_n^2} x = 0$$

$$\omega_n^2 \Rightarrow \text{sqrt}$$