

HW 2 D.2, E.2, F.2 + extras

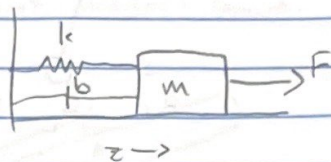
D.2 a)

$$P = \begin{bmatrix} z \\ 0 \\ 0 \end{bmatrix}$$

$$\dot{P} = \begin{bmatrix} \dot{z} \\ 0 \\ 0 \end{bmatrix}$$

$$K = \frac{1}{2} m \dot{P}^T \dot{P}$$

$$= \boxed{.5 m \cdot \dot{z}^2}$$

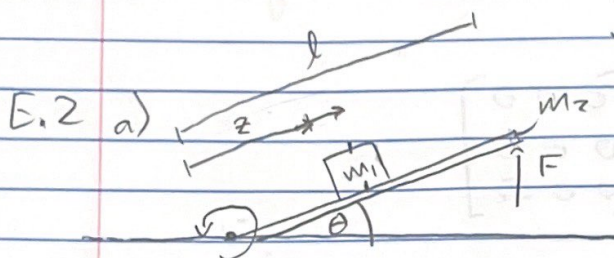


$$m = 5 \text{ kg}$$

$$k = 3 \text{ N/m}$$

$$b = .5 \text{ Ns/m}$$

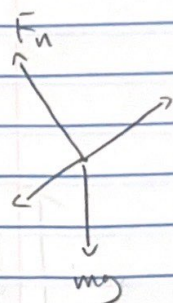
no rotational energy



$$m = .35 \text{ kg}$$

$$l = .5 \text{ m}$$

$$\omega = \dot{\theta}$$



$$P_1 = \begin{bmatrix} z \cos \theta \\ z \sin \theta \\ 0 \end{bmatrix}$$

$$\dot{P}_1 = \dot{V}_1 = \begin{bmatrix} -z \sin \theta + \dot{\theta} z \cos \theta \\ z \cos \theta + \dot{\theta} z \sin \theta \\ 0 \end{bmatrix}$$

$$K_1 = \frac{1}{2} m_1 \dot{V}_1^2 = \frac{1}{2} m (\dot{P})^2 = \frac{1}{2} m_1 \dot{V}_1^T \dot{V}_1$$

$$\omega = \begin{bmatrix} 0 \\ 0 \\ \dot{\theta} \end{bmatrix}$$

$$P_2 = \begin{bmatrix} l \cos \theta \\ l \sin \theta \\ 0 \end{bmatrix}$$

$$\dot{P}_2 = \begin{bmatrix} -l \sin \theta + \dot{\theta} l \cos \theta \\ l \cos \theta + \dot{\theta} l \sin \theta \\ 0 \end{bmatrix}$$

$$K_r = \frac{1}{2} \omega^T J \omega$$

$$J = \begin{bmatrix} 0 & 0 & 0 \\ 0 & \frac{m l^2}{3} & 0 \\ 0 & 0 & \frac{m l^2}{3} \end{bmatrix}$$

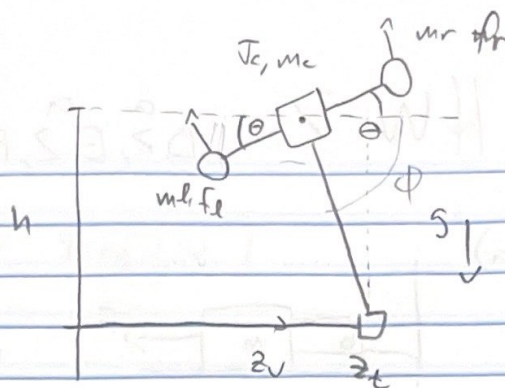
$$K_{r2} = \frac{m l^2 \dot{\theta}^2}{6}$$

$$K_{2e} = \frac{1}{2} m_2 \dot{V}_2^T \dot{V}_2$$

$$K_T = K_1 + K_{2e} + K_{or}$$

$$= \frac{1}{6} l^2 m_2 \dot{\theta}^2 + \frac{1}{2} l^2 m_1 \dot{z}^2 + \dot{z}^2$$

F.2 left rotor



$$P_l = \begin{bmatrix} z_v - d \cos \theta \\ h - d \sin \theta \\ 0 \end{bmatrix}$$

$$P_r = \begin{bmatrix} z_v + d \cos \theta \\ h + d \sin \theta \\ 0 \end{bmatrix}$$

$$P_c = \begin{bmatrix} z_v \\ h \\ 0 \end{bmatrix}$$

$$w = \begin{bmatrix} 0 \\ 0 \\ \theta \end{bmatrix}$$

$$J = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & J_c \end{bmatrix}$$

$$K_t = \frac{1}{2} J_c \dot{\theta}^2 + d^2 m \dot{\theta}^4 + m \dot{\theta}^2 \dot{z}^2 + \frac{1}{2} m_c \dot{z}^2$$