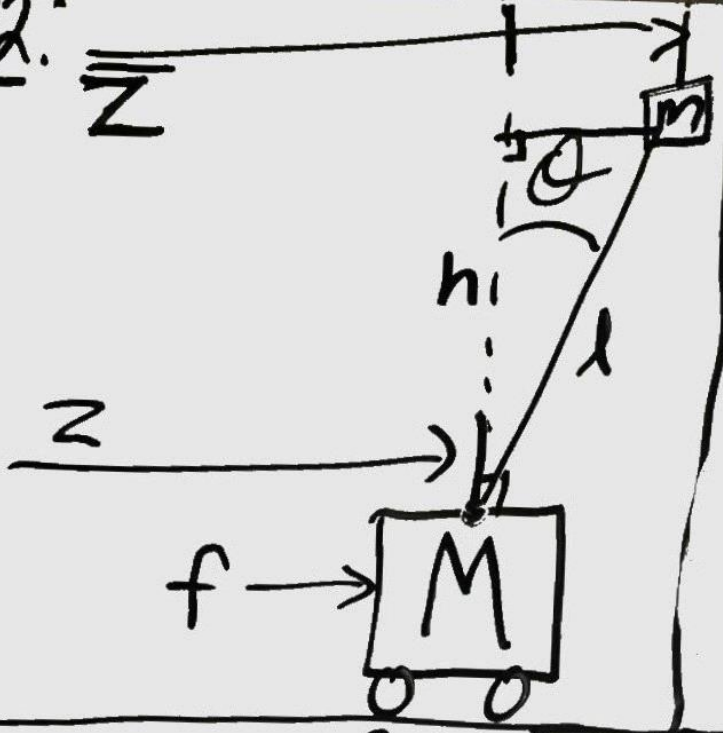
DP2:



$\bar{z} = z + l\sin\theta$

$\dot{\bar{z}} = \dot{z} + l\dot{\theta}\cos\theta$

$h = l\cos\theta$

$\dot{h} = -l\dot{\theta}\sin\theta$

$$E_K = \frac{1}{2}M\dot{z}^2 + \frac{1}{2}m(\dot{\bar{z}}^2 + \dot{h}^2)$$

$$= \frac{1}{2}M\dot{z}^2 + \frac{1}{2}m\left((\dot{z} + l\dot{\theta}\cos\theta)^2 + (-l\dot{\theta}\sin\theta)^2\right)$$

$$\left(\dot{z}^2 + 2l\dot{\theta}\dot{z}\cos\theta + l^2\dot{\theta}^2(\cos^2\theta + \sin^2\theta)\right)$$

$$E_K = \frac{1}{2}(M+m)\dot{z}^2 + \frac{1}{2}m\left(2l\dot{\theta}\cos\theta + l^2\dot{\theta}^2\right)$$

$$E_p = mgh = mg(l\cos\theta)$$

$$L = \frac{1}{2}(M+m)\dot{z}^2 + ml\dot{z}\dot{\theta}\cos\theta + \frac{1}{2}ml^2\dot{\theta}^2 - mg(l\cos\theta)$$