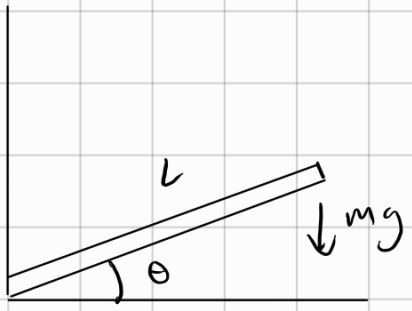
$$\tau = I(\ddot{\theta}) + B(\dot{\theta}) + G(\theta)$$



$$\tau = mg\,L\cos(\theta)$$
$$\uparrow\ G$$

$$t = G\cos(\theta) \rightarrow G = \frac{\tau}{\cos(\theta)}$$

if $\tau = 1 \rightarrow \theta = -1.348829 \rightarrow G = \frac{1}{\cos(-1.348824)}$

$$\boxed{G = 4.542375873}$$

if $G = 4.542375873$, $T = B(\dot{\theta})$, $B = \frac{T}{\dot{\theta}}$

$T = 10000 \rightarrow \dot{\theta} = 15890.334$ $\quad B = \frac{10000}{15890.334} = .6296$

$$\boxed{B = .6296}$$

if $T = 5000$, $\quad \ddot{\theta} = (v_{new} - v_{old}) \times 500$ $\quad I = \frac{T}{\ddot{\theta}}$

$v_{old} = 0$ $\quad v_{new} = 107.87 \rightarrow 53,500$

$v_{old} = 107.87$ $\quad v_{new} = 214.37 \rightarrow 53,500$

$I = 5000 / 53,500 = .093$ (close but not enough)

I did I in the code, same steps as I did here

$$\boxed{I = .092620}$$

Part 2: $I(-K_p(\theta - \theta_{ref}) - K_v(\dot{\theta}_{ref}) + B\dot{\theta} + G\theta$