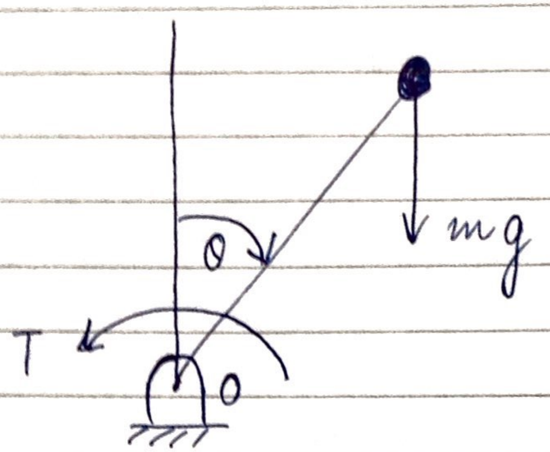
Solutions to Assignment 2.

(a)



Apply Newton-Euler equation about point O,

$$\therefore \sum M_0 = I_0 \ddot{\theta}$$

$$\therefore mgL\sin\theta - T = I_0 \ddot{\theta}$$

(You need to recollect the procedure that we had developed in the previous course i.e., MEC501.
Assume a positive for θ, $\dot{\theta}$ and $\ddot{\theta}$.
Give a displacement in the positive θ direction.
Take moments in the positive θ direction as positive, and vice versa.)

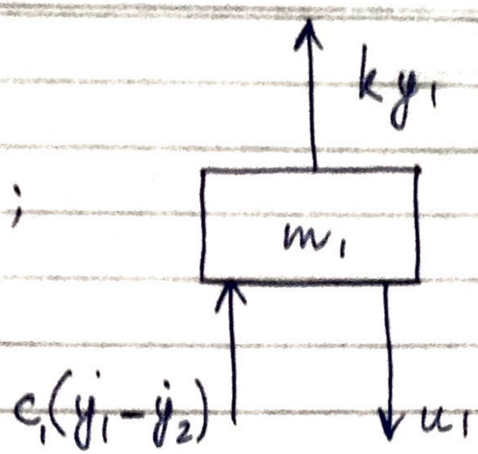
$$\therefore \boxed{\ddot{\theta} - \frac{g}{L}\theta + \frac{T}{mL^2} = 0}$$

$\sin\theta \simeq \theta$ for small θ

$I_0 = mL^2$

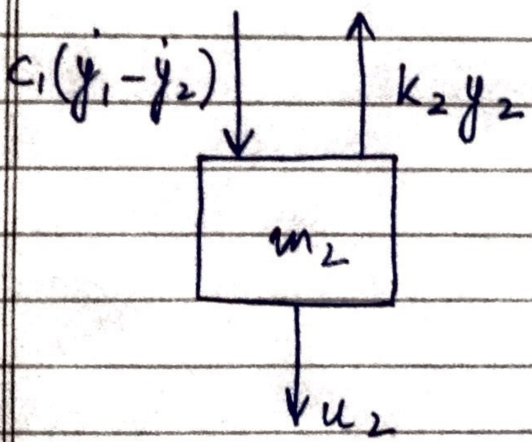
(b)

Assuming $y_1 > y_2$;



$$\therefore \quad -k_1 y_1 - c_1(\dot{y}_1 - \dot{y}_2) + u_1 = m_1 \ddot{y}_1$$

$$\boxed{m_1 \ddot{y}_1 + c_1(\dot{y}_1 - \dot{y}_2) + k_1 y_1 = u_1}$$

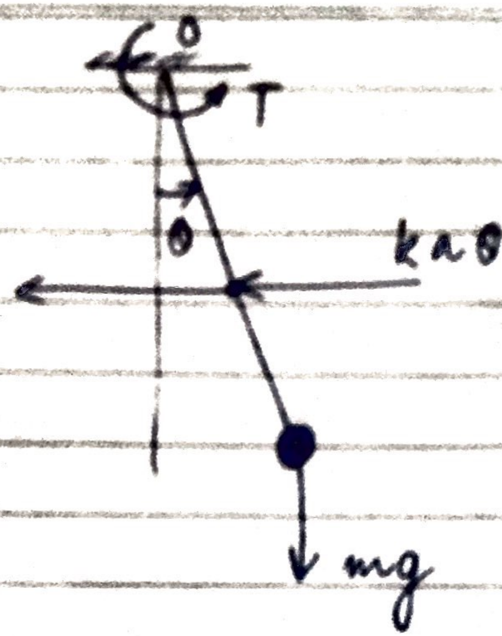


$$\therefore \quad -k_2 y_2 + c_1(\dot{y}_1 - \dot{y}_2) + u_2 = m_2 \ddot{y}_2$$

$$\therefore \quad \boxed{m_2 \ddot{y}_2 + c_1(\dot{y}_2 - \dot{y}_1) + k_2 y_2 = u_2}$$

Note: $c_1(\dot{y}_1 - \dot{y}_2) = -c_1(\dot{y}_2 - \dot{y}_1)$

(c)



This holds of very very small values of θ.

Taking moments about point O,
Assuming θ to be small,

$$-ka^2\theta - ka^2\theta - mgL\sin\theta + T = I_0\ddot{\theta}$$

$$\therefore \quad I_0\ddot{\theta} + (2ka^2 + mgL)\theta = T$$

$$I_0\ddot{\theta} = mL^2$$

$$\therefore \quad \boxed{\ddot{\theta} + \left(\frac{2ka^2}{mL^2} + g/L\right)\theta = \frac{T}{mL^2}}$$