TTK4130 MODELING AND SIMULATION | A 4

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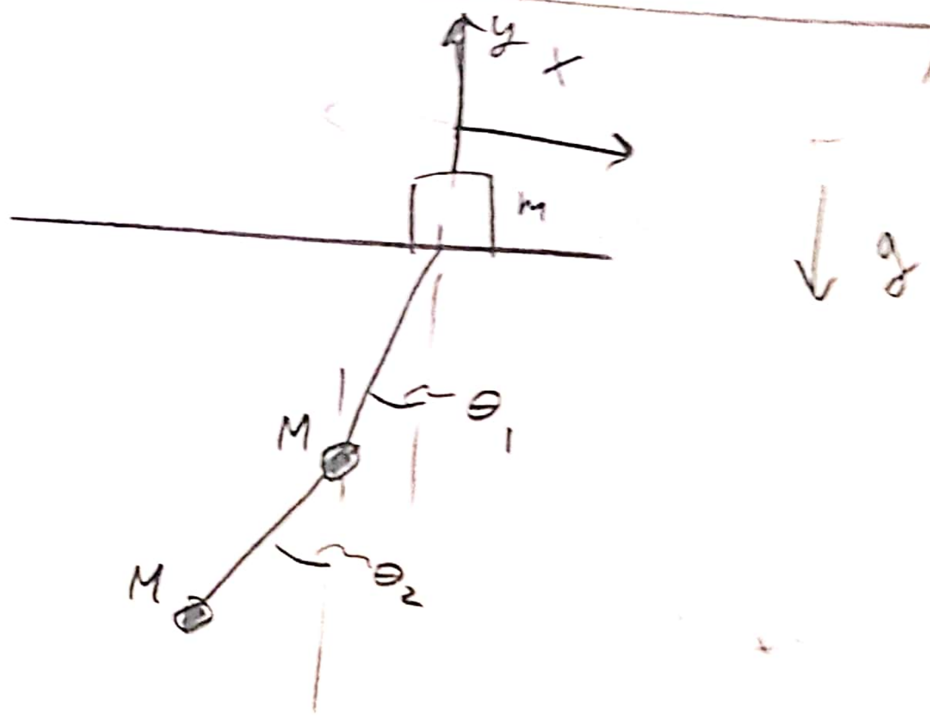
$\boxed{1}$



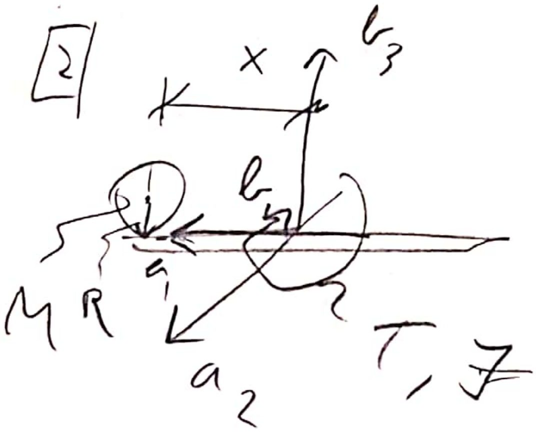
a) We see from the figure that the two masses have location

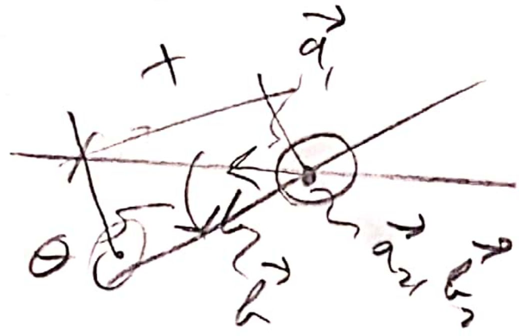
$$P_1 = \begin{bmatrix} x - L\sin\theta_1 \\ -L\cos\theta_1 \end{bmatrix} \text{ and } P_2 = P_1 + \begin{bmatrix} -L\sin\theta_2 \\ -L\cos\theta_2 \end{bmatrix}$$

b) See attached code.

c) The results are reasonable, the pendulum moves
reasonable.

$\boxed{2}$

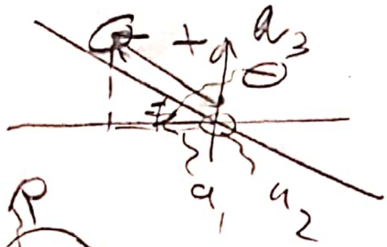


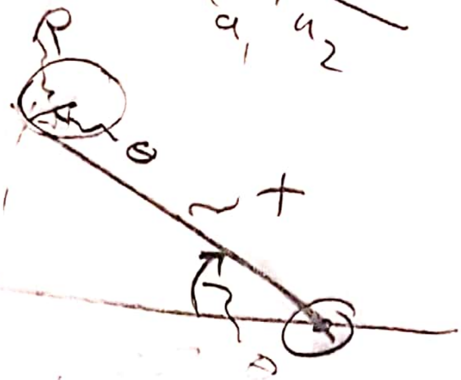


A assumes rotation about $\vec{a}_2$ & $\vec{b}_2$

a) A assumes ~~g~~ in a-frame:

$$P = \begin{bmatrix} x\cos\theta - R\sin\theta \\ 0 \\ x\sin\theta + R\cos\theta \end{bmatrix}$$





b) The angular velocity is

$$\omega = \dot{\theta} + \dot{x}/R$$

c) The kinetic energy is a sum of ~~translation~~ translation and rotation energy, where rotation is both about its own axis and the plank's joint.

$$T_{ball} = \frac{1}{2} M \dot{p}^T \dot{p} + \frac{1}{2} \left(\underbrace{\frac{2}{5} M R^2 + M p^T p}_{\text{Steiners' theorem}} \right) \dot{\theta} + \frac{1}{2} \left(\frac{2}{5} M R^2 \right) \cdot \left(\frac{\dot{r}}{R} \right)$$

d) $T_{beam} = \frac{1}{2} J_{beam} \cdot \dot{\theta}^2$

e) See attached code

f) —— " ——

g) The results are reasonable, the ball doesn't glitch out or do anything funny.

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