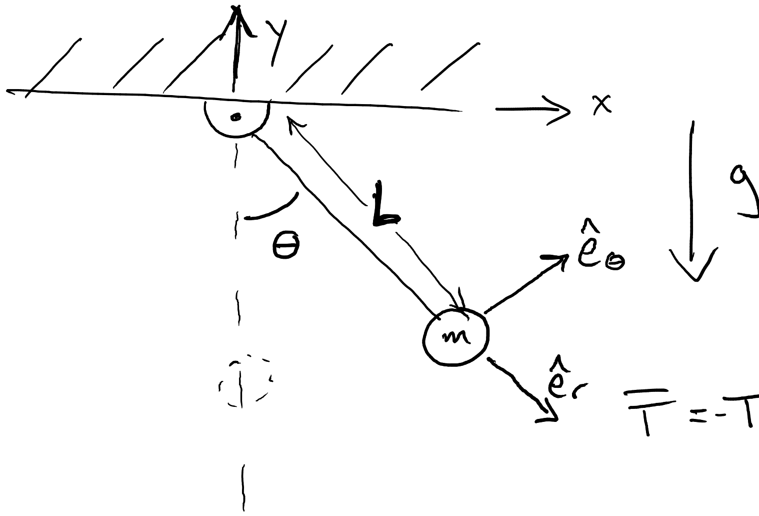
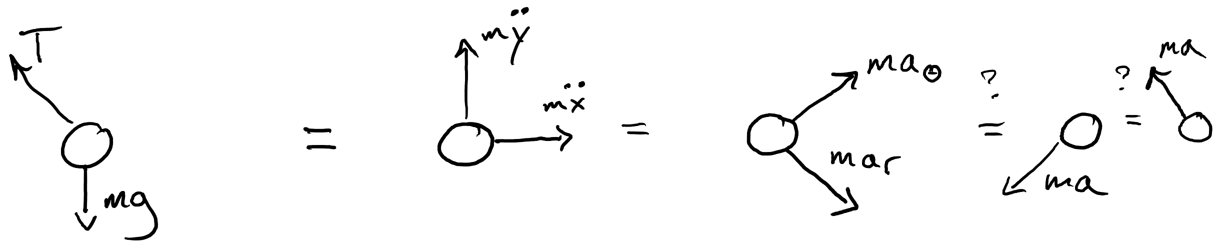


$\vec{T} = -T(\sin\theta\,\hat{i} - \cos\theta\,\hat{j}) = -T\hat{e}_r$

①



FBD = KD

$$x^2 + y^2 = L^2$$

$$\tan\theta = \frac{x}{y}$$

$$\sin\theta = \frac{x}{L}$$

$$\cos\theta = \frac{y}{L}$$

$$\Sigma F_x = -T\sin\theta = m\ddot{x}$$

$$\Sigma F_y = T\cos\theta - mg = m\ddot{y}$$

$$x = L\sin\theta$$

$$y = -L\cos\theta$$

$$y = -L\cos\theta$$

$$\dot{y} = L\dot{\theta}\sin\theta$$

$$\ddot{y} = L\ddot{\theta}\sin\theta + L\dot{\theta}^2\cos\theta$$

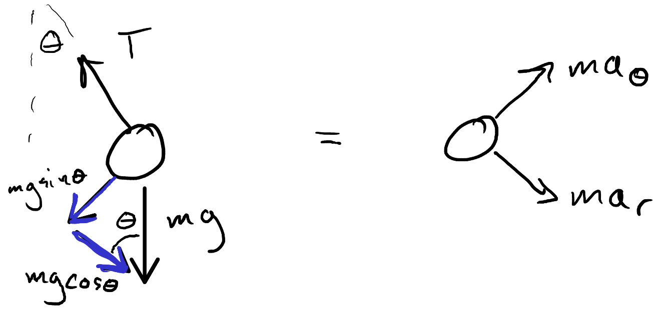
$$\dot{x} = L\dot{\theta}\cos\theta$$

$$\ddot{x} = \frac{d}{dt}\left(L\dot{\theta}\cos\theta\right)$$

$$\ddot{x} = L\ddot{\theta}\cos\theta - L\dot{\theta}^2\sin\theta$$

① $-T\sin\theta = mL(\ddot{\theta}\cos\theta - \dot{\theta}^2\sin\theta)$

② $T\cos\theta - mg = mL(\ddot{\theta}\sin\theta + \dot{\theta}^2\cos\theta)$



velocity + accel in polar coords

$$^{\mathcal{I}}\mathbf{v}_{P/O} = \dot{r}\mathbf{e}_r + r\dot{\theta}\mathbf{e}_\theta$$

$$^{\mathcal{I}}\mathbf{a}_{P/O} = (\ddot{r}\boxed{-r\dot{\theta}^2})\mathbf{e}_r + (2\dot{r}\dot{\theta} + \boxed{r\ddot{\theta}})\mathbf{e}_\theta.$$

pend $\hat{e}_r$ pend $\hat{e}_\theta$

r = constant = L

$\dot{r} = 0$

$\ddot{r} = 0$

① $\hat{e}_r \rightarrow \quad -T + mg\cos\theta = ma_r$

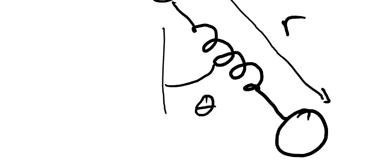
② $\hat{e}_\theta \rightarrow \quad -mg\sin\theta = ma_\theta$

constraint force eqn $\Longrightarrow$ ① $-T + mg\cos\theta = m(-L\dot{\theta}^2)$

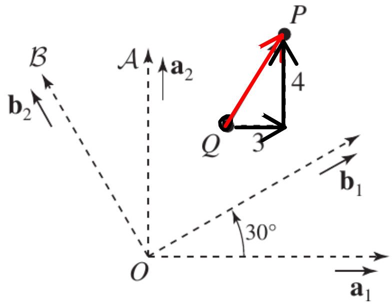
$\boxed{\text{my eom}}$ $\Longrightarrow$ ② $\boxed{-mg\sin\theta = mL\ddot{\theta}}$

2nd order ODE* $\Rightarrow$ F=ma

$$\boxed{\ddot{\theta} = \frac{-g}{L}\sin\theta} \quad \underline{\text{eom}}$$



3.1 Express $\mathbf{r}_{P/Q}$ shown in Figure 3.34 using vector components in frame $\mathcal{A}$. Now express $\mathbf{r}_{P/Q}$ using vector components in frame $\mathcal{B}$.



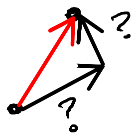


Figure 3.34 Problem 3.1.

$$\vec{r}_{P/Q} = 3\,\hat{a}_1 + 4\,\hat{a}_2 = ?\;\hat{b}_1 + ?\;\hat{b}_2$$

$$\hat{b}_1 = \cos\theta\,\hat{a}_1 + \sin\theta\,\hat{a}_2$$

$$\hat{b}_2 = -\sin\theta\,\hat{a}_1 + \cos\theta\,\hat{a}_2$$