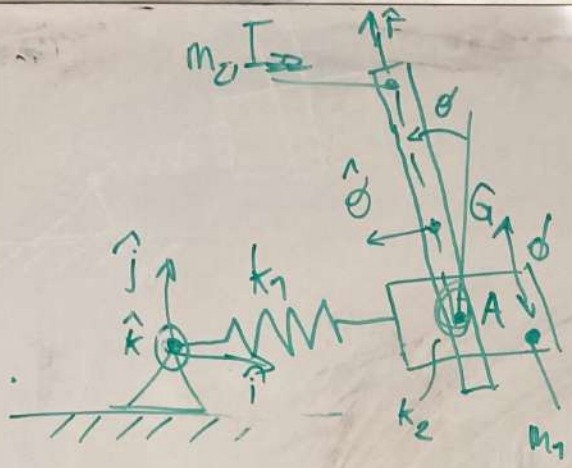

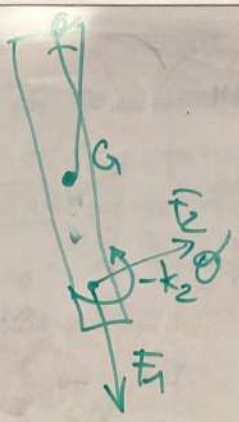

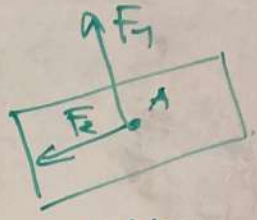

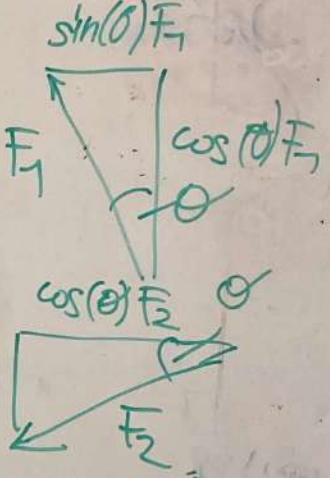

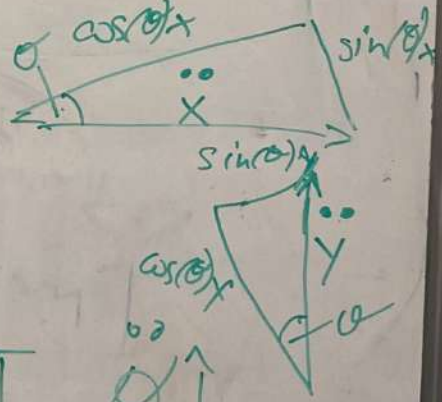

① $\sum F_{x,m_1} = m_1 \ddot{x} = (-k_1 x - \sin(\theta) F_1 - \cos(\theta) F_2)\hat{i}$

② $\sum F_{y,m_1} = m_1 \ddot{y} = (-k_1 y + \cos(\theta) F_1 - \sin(\theta) F_2)\hat{j}$

③ $\sum F_{r,m_2} = m_2 a_{G/O}\hat{r} = -F_1\hat{r}$

④ $\sum F_{\theta,m_2} = m_2 a_{G/O}\hat{\theta} = -F_2\hat{\theta}$

⑤ $\sum \tau_{/G} = \frac{dH_{/G}}{dt} = [-k_2\theta + F_2 d]\hat{k} = I_{zz}\ddot{\theta}\hat{k}$

$a_{G/A} = 0$

$a_{G/O} = a_{A/O} + \omega_{1/O} \times r_{G/A} + \omega_{1/O} \times (\omega_{1/O} \times r_{G/A}) + 2\omega_{1/O} \times v_{G/A}$

$\ddot{x}\hat{i} + \ddot{y}\hat{j} \quad \ddot{\theta} d\hat{\theta} \quad -\dot{\theta}^2 d\hat{r}$

$= \ddot{x}\hat{i} + \ddot{y}\hat{j} + \ddot{\theta} d\hat{\theta} - \dot{\theta}^2 d\hat{r}$

$(-\sin\theta\ddot{x} + \cos\theta\ddot{y} - \dot{\theta}^2 d)\hat{r} + (-\cos\theta\ddot{x} - \sin\theta\ddot{y} + \ddot{\theta} d)\hat{\theta}$

③' $m_2[-\sin(\theta)\ddot{x} + \cos(\theta)\ddot{y} - \dot{\theta}^2 d]$

$\rightarrow F_1 = m_2[\sin(\theta)\ddot{x} - \cos(\theta)\ddot{y} + \dot{\theta}^2 d]$

④' $m_2[-\cos(\theta)\ddot{x} - \sin(\theta)\ddot{y} + \ddot{\theta} d] = -F_2$

$F_2 = m_2[\cos(\theta)\ddot{x} + \sin(\theta)\ddot{y} - \ddot{\theta} d]$

⑤' $-k_2\theta + [m_2(\cos\theta\ddot{x} + \sin(\theta)\ddot{y} - \ddot{\theta} d)]d = I_{zz}\ddot{\theta}$

$(I_{zz} + m_2 d)\ddot{\theta} - m_2 d\cos(\theta)\ddot{x} - m_2 d\sin(\theta)\ddot{y} + k_2\theta = 0$

①' $m_1\ddot{x} + k_1 x + \sin(\theta)F_1 + \cos(\theta)F_2 = 0$

$m_1\ddot{x} + k_1 x + \sin(\theta)m_2[\sin(\theta)\ddot{x} - \cos(\theta)\ddot{y} + \dot{\theta}^2 d]$

$+ \cos(\theta)m_2[\cos(\theta)\ddot{x} + \sin(\theta)\ddot{y} - \ddot{\theta} d]$

$= m_1\ddot{x} + k_1 x + m_2[\sin^2(\theta)\ddot{x} - \sin(\theta)\cos(\theta)\ddot{y} + \sin(\theta)\dot{\theta}^2 d]$

$+ m_2[\cos^2(\theta)\ddot{x} + \cos(\theta)\sin(\theta)\ddot{y} - \cos(\theta)\ddot{\theta} d]$

with $\sin^2(\theta) + \cos^2(\theta) = 1$

$= m_1\ddot{x} + k_1 x + m_2(\ddot{x} + \sin(\theta)\dot{\theta}^2 d - \cos(\theta)\ddot{\theta} d)$

$= (m_1 + m_2)\ddot{x} - \cos(\theta)d\ddot{\theta} + \sin(\theta)d\dot{\theta}^2 + k_1 x = 0$

(2) $m_1 \ddot{y} + k_1 y - \cos(\theta) F_1 + \sin(\theta) F_2 = 0$

$= m_1 \ddot{y} + k_1 y - \cos(\theta) m_2 [\sin(\theta)\ddot{x} - \cos(\theta)\ddot{y} + \dot{\theta}^2 d]$

$+ \sin(\theta) m_2 [\cos(\theta)\ddot{x} + \sin(\theta)\ddot{y} - \ddot{\theta} d]$

$= m_1 \ddot{y} + k_1 y + m_2 [\cos^2(\theta)\ddot{y} + \cos(\theta)\dot{\theta}^2 d + \sin^2(\theta)\ddot{y} - \sin(\theta)\ddot{\theta} d]$

with $\sin^2(\theta) + \cos^2(\theta) = 1$

$\rightarrow m_1 \ddot{y} + k_1 y + m_2 \ddot{y} + m_2 \cos(\theta)\dot{\theta}^2 d - m_2 \sin(\theta)\ddot{\theta} d$

$(m_1 + m_2)\ddot{y} - m_2 \sin(\theta) d\ddot{\theta} + m_2 \cos(\theta) d\dot{\theta}^2 + k_1 y = 0$