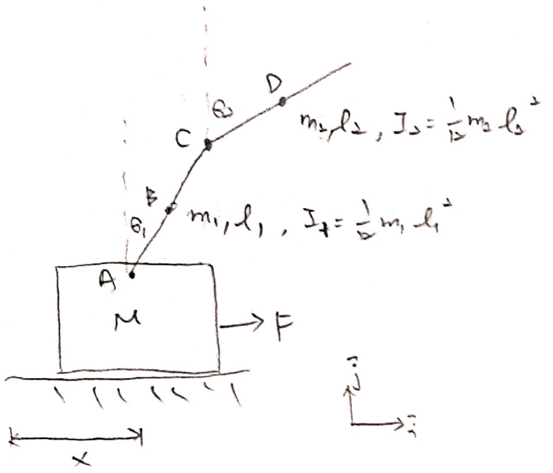

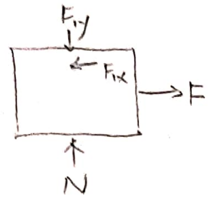

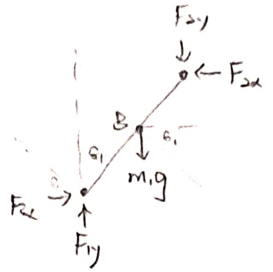

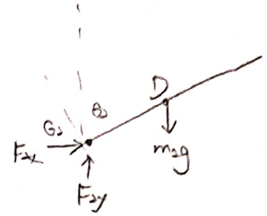

$\vec{a}_A = \ddot{x}\,\hat{i}$

$F - F_{1x} = M\ddot{x}$

$N - F_{1y} = 0$

$$\vec{a}_B = \frac{l_1}{2}\ddot{\theta}_1(\cos\theta_1\,\hat{i} - \sin\theta_1\,\hat{j}) - \frac{l_1}{2}\dot{\theta}_1^2(\sin\theta_1\,\hat{i} + \cos\theta_1\,\hat{j}) + \vec{a}_A$$

$$= \left(\frac{l_1}{2}\ddot{\theta}_1\cos\theta_1 - \frac{l_1}{2}\dot{\theta}_1^2\sin\theta_1 + \ddot{x}\right)\hat{i} + \left(-\frac{l_1}{2}\ddot{\theta}_1\sin\theta_1 - \frac{l_1}{2}\dot{\theta}_1^2\cos\theta_1\right)\hat{j}$$

$$F_{1x} - F_{2x} = m_1\frac{l_1}{2}(\ddot{\theta}_1\cos\theta_1 - \dot{\theta}_1^2\sin\theta_1) + m_1\ddot{x}$$

$$F_{1y} - F_{2y} - m_1 g = m_1\frac{l_1}{2}(-\ddot{\theta}_1\sin\theta_1 - \dot{\theta}_1^2\cos\theta_1)$$

$$F_{1x}\frac{l_1}{2}\cos\theta_1 + F_{2x}\frac{l_1}{2}\cos\theta_1 - F_{1y}\frac{l_1}{2}\sin\theta_1 - F_{2y}\frac{l_1}{2}\sin\theta_1 = -I_1\ddot{\theta}_1$$

$$\vec{a}_c = (\ddot{x} + l_1\ddot{\theta}_1\cos\theta_1 - l_1\dot{\theta}_1^2\sin\theta_1)\,\vec{i} + (-l_1\ddot{\theta}_1\sin\theta_1 - l_1\dot{\theta}_1^2\cos\theta_1)\,\vec{j}$$

$$\vec{a}_2 = \vec{a}_c + \frac{l_2}{2}\ddot{\theta}_2(\cos\theta_2\,\vec{i} - \sin\theta_2\,\vec{j}) - \frac{l_2}{2}\dot{\theta}_2^2(\sin\theta_2\,\vec{i} + \cos\theta_2\,\vec{j})$$

$$= (\ddot{x} + l_1\ddot{\theta}_1\cos\theta_1 - l_1\dot{\theta}_1^2\sin\theta_1 + \frac{l_2}{2}\ddot{\theta}_2\cos\theta_2 - \frac{l_2}{2}\dot{\theta}_2^2\sin\theta_2)\,\vec{i}$$

$$+ (-l_1\ddot{\theta}_1\sin\theta_1 - l_1\dot{\theta}_1^2\cos\theta_1 - \frac{l_2}{2}\ddot{\theta}_2\sin\theta_2 - \frac{l_2}{2}\dot{\theta}_2^2\cos\theta_2)\,\vec{j}$$

$$F_{2x} = m_2(\vec{a}_2)_x$$

$$F_{2y} - m_2 g = m_2(\vec{a}_2)_y$$

$$F_{2x}\frac{l_2}{2}\cos\theta_2 - F_{2y}\frac{l_2}{2}\sin\theta_2 = -J_2\ddot{\theta}_2$$

F	F_{1x}	F_{1y}	F_{2x}	F_{2y}	
1	-1				$M\ddot{x}$
	1		-1		$m_1\ddot{x} + m_1\frac{l_1}{2}\ddot{\theta}_1\cos\theta_1 - m_1\frac{l_1}{2}\dot{\theta}_1^2\sin\theta_1$
		1		-1	$m_1 g - m_1\frac{l_1}{2}\ddot{\theta}_1\sin\theta_1 - m_1\frac{l_1}{2}\dot{\theta}_1^2\cos\theta_1$
			11		$m_2\ddot{x} + m_2 l_1\ddot{\theta}_1\cos\theta_1 - m_2 l_1\dot{\theta}_1^2\sin\theta_1 + m_2\frac{l_2}{2}\ddot{\theta}_2\cos\theta_2 - m_2\frac{l_2}{2}\dot{\theta}_2^2\sin\theta_2$
				1	$m_2 g - m_2 l_1\ddot{\theta}_1\sin\theta_1 - m_2 l_1\dot{\theta}_1^2\cos\theta_1 - m_2\frac{l_2}{2}\ddot{\theta}_2\sin\theta_2 - m_2\frac{l_2}{2}\dot{\theta}_2^2\cos\theta_2$

$$F = (M+m_1+m_2)\ddot{x} + \left(m_1\frac{l_1}{2} + m_2 l_1\right)\cos\theta_1\,\ddot{\theta}_1 + \left(m_2\frac{l_2}{2}\right)\cos\theta_2\,\ddot{\theta}_2 - \left(m_1\frac{l_1}{2} + m_2 l_1\right)\sin\theta_1\,\dot{\theta}_1^2 - \left(m_2\frac{l_2}{2}\right)\sin\theta_2\,\dot{\theta}_2^2 \qquad — ①$$

$$F_{1x} = (m_1+m_2)\ddot{x} + \left(m_1\frac{l_1}{2} + m_2 l_1\right)\cos\theta_1\,\ddot{\theta}_1 + \left(m_2\frac{l_2}{2}\right)\cos\theta_2\,\ddot{\theta}_2 - \left(m_1\frac{l_1}{2} + m_2 l_1\right)\sin\theta_1\,\dot{\theta}_1^2 - \left(m_2\frac{l_2}{2}\right)\sin\theta_2\,\dot{\theta}_2^2$$

$$F_{1y} = (m_1+m_2)g - \left(m_1\frac{l_1}{2} + m_2 l_1\right)\sin\theta_1\,\ddot{\theta}_1 - \left(m_2\frac{l_2}{2}\right)\sin\theta_2\,\ddot{\theta}_2 - \left(m_1\frac{l_1}{2} + m_2 l_1\right)\cos\theta_1\,\dot{\theta}_1^2 - \left(m_2\frac{l_2}{2}\right)\cos\theta_2\,\dot{\theta}_2^2$$

$$F_{2x} = (m_2)\ddot{x} + (m_2 l_1)\cos\theta_1\,\ddot{\theta}_1 + \left(m_2\frac{l_2}{2}\right)\cos\theta_2\,\ddot{\theta}_2 - (m_2 l_1)\sin\theta_1\,\dot{\theta}_1^2 - \left(m_2\frac{l_2}{2}\right)\sin\theta_2\,\dot{\theta}_2^2$$

$$F_{2y} = (m_2)g - (m_2 l_1)\sin\theta_1\,\ddot{\theta}_1 - \left(m_2\frac{l_2}{2}\right)\sin\theta_2\,\ddot{\theta}_2 - (m_2 l_1)\cos\theta_1\,\dot{\theta}_1^2 - \left(m_2\frac{l_2}{2}\right)\cos\theta_2\,\dot{\theta}_2^2$$

$$F_{1x}\cos\theta_1 - F_{1y}\sin\theta_1 + F_{2x}\cos\theta_1 - F_{2y}\sin\theta_1 = -I_1\ddot{\theta}_1\frac{2}{l_1}$$

$$(m_1+m_2)\cos\theta_1\,\ddot{x} - (m_1+m_2)\sin\theta_1\,g + \left(m_1\frac{l_1}{2} + m_2 l_1\right)\ddot{\theta}_1 + \left(m_2\frac{l_2}{2}\right)\cos(\theta_2-\theta_1)\,\ddot{\theta}_2 - \left(m_2\frac{l_2}{2}\right)\sin(\theta_2-\theta_1)\,\dot{\theta}_2^2$$

$$(m_2)\cos\theta_1\,\ddot{x} - (m_2)\sin\theta_1\,g \quad (m_2 l_1)\ddot{\theta}_1 + \left(m_2\frac{l_2}{2}\right)\cos(\theta_2-\theta_1)\,\ddot{\theta}_2 - \left(m_2\frac{l_2}{2}\right)\sin(\theta_2-\theta_1)\,\dot{\theta}_2^2 = -I_1\ddot{\theta}_1\,1/\frac{l}{2}$$

$$\left(m_1\frac{l_1}{2} + m_2 l_1\right)\cos\theta_1\,\ddot{x} - \left(m_1\frac{l_1}{2} + m_2 l_1\right)\sin\theta_1\,g + \left(I_1 + m_1\frac{l_1^2}{4} + m_2 l_1^2\right)\ddot{\theta}_1 + \left(m_2\frac{l_1 l_2}{2}\right)\cos(\theta_2-\theta_1)\,\ddot{\theta}_2 - \left(m_2\frac{l_1 l_2}{2}\right)\sin(\theta_2-\theta_1)\,\dot{\theta}_2^2 = 0$$

$$— ②$$

$$F_{2x}\cos\theta_2 - F_{2y}\sin\theta_2 = -I_2\ddot{\theta}_2\,1/\frac{l_2}{2}$$

$$(m_2)\cos\theta_2\,\ddot{x} - (m_2)\sin\theta_2\,g + (m_2 l_1)\cos(\theta_2-\theta_1)\,\ddot{\theta}_1 + \left(m_2\frac{l_2}{2}\right)\ddot{\theta}_2 - (m_2 l_1)\sin(\theta_1-\theta_2)\,\dot{\theta}_1^2 = -I_2\ddot{\theta}_2\,1/\frac{l_2}{2}$$

$$\left(m_2\frac{l_2}{2}\right)\cos\theta_2\,\ddot{x} - \left(m_2\frac{l_2}{2}\right)\sin\theta_2\,g + \left(m_2\frac{l_1 l_2}{2}\right)\cos(\theta_2-\theta_1)\,\ddot{\theta}_1 + \left(I_2 + m_2\frac{l_2^2}{4}\right)\ddot{\theta}_2 - \left(m_2\frac{l_1 l_2}{2}\right)\sin(\theta_1-\theta_2)\,\dot{\theta}_1^2 = 0 \qquad — ③$$