$$\begin{cases} \chi_{1} = 1, \sin 0, \\ \chi_{1} = 1, \sin 0, \\ \chi_{2} = 1, \cos 0, \\ \chi_{2} = 1, \cos 0, \\ \chi_{3} = 1, \cos 0, \\ \chi_{4} = 1, \cos 0, \\ \chi_{5} = 1, \cos 0, \\ \chi_{7} = 1, \cos 0, \\ \chi_{8} =$$

$$\begin{split} & = \frac{m_1}{2} \, \mathcal{D}_1^2 \, + \frac{m_2}{2} \, \mathcal{D}_2^2 \, - m_0^2 \, \mathcal{V}_1 \, - m_0^2 \, \mathcal{V}_2 \\ & = \frac{m_1}{2} \, \left[ \, \mathcal{L}_1^2 \cos^2 \! \mathcal{O}_1 \cdot \dot{\mathcal{O}}_1^2 \, + \, \mathcal{L}_1^2 \sin^2 \! \mathcal{O}_1^2 \cdot \dot{\mathcal{O}}_1^2 \, \right] \, + \frac{m_2}{2} \, \left[ \, \left( \, \mathcal{L}_1 \cos \! \mathcal{O}_1 \cdot \dot{\mathcal{O}}_1 \, + \, \mathcal{L}_2 \cos \! \mathcal{O}_2 \cdot \dot{\mathcal{O}}_2 \, \right)^2 \, + \, \left( \, \mathcal{L}_1 \sin \! \mathcal{O}_1 \cdot \dot{\mathcal{O}}_1 \, + \, \mathcal{L}_2 \sin \! \mathcal{O}_2 \cdot \dot{\mathcal{O}}_2 \, \right)^2 \\ & \quad + m_0^2 \, \mathcal{L}_1 \cos \! \mathcal{O}_1 \, + \, m_0^2 \, \left( \, \mathcal{L}_1 \cos \! \mathcal{O}_1 \cdot \, + \, \mathcal{L}_2 \cos \! \mathcal{O}_2 \, \right) \\ & \quad = \frac{m_1}{2} \, \mathcal{L}_1^2 \, \dot{\mathcal{O}}_1^2 \, + \, \frac{m_2}{2} \, \left( \, \mathcal{L}_1^2 \, \dot{\mathcal{O}}_1^2 \, + \, \mathcal{L}_2^2 \, \dot{\mathcal{O}}_2^2 \, + \, 2 \, \mathcal{L}_1 \, \mathcal{L}_2 \, \dot{\mathcal{O}}_1 \, \dot{\mathcal{O}}_2 \, \left( \cos \! \mathcal{O}_1 \cos \! \mathcal{O}_2 \, + \, \sin \! \mathcal{O}_1 \sin \! \mathcal{O}_2 \, \right) \right) \\ & \quad + m_0^2 \, \mathcal{L}_1 \cos \! \mathcal{O}_1 \, + \, m_0^2 \, \left( \, \mathcal{L}_1 \cos \! \mathcal{O}_1 \cdot \, + \, \mathcal{L}_2 \cos \! \mathcal{O}_2 \, \right) \\ & \quad = \frac{1}{2} \, \left( \, m_1 + \, m_2 \right) \, \mathcal{L}_1^2 \, \dot{\mathcal{O}}_1^2 \, + \, \frac{m_2}{2} \, \left( \, \mathcal{L}_2^2 \, \dot{\mathcal{O}}_2^2 \, + \, 2 \, \mathcal{L}_1 \, \mathcal{L}_2 \, \dot{\mathcal{O}}_1 \, \dot{\mathcal{O}}_2 \, \cos \! \left( \mathcal{O}_1 - \mathcal{O}_2 \, \right) \, \right) \\ & \quad + \, m_0^2 \, \mathcal{L}_1 \cos \! \mathcal{O}_1 \, + \, m_0^2 \, \left( \, \mathcal{L}_1 \cos \! \mathcal{O}_1 \, + \, \mathcal{L}_2 \cos \! \mathcal{O}_2 \, \right) \\ & \quad + \, m_0^2 \, \mathcal{L}_1 \cos \! \mathcal{O}_1 \, + \, m_0^2 \, \left( \, \mathcal{L}_1 \cos \! \mathcal{O}_1 \, + \, \mathcal{L}_2 \cos \! \mathcal{O}_2 \, \right) \\ & \quad + \, m_0^2 \, \mathcal{O}_1 \, + \, m_0^2 \, \left( \, \mathcal{L}_1 \cos \! \mathcal{O}_1 \, + \, \mathcal{L}_2 \cos \! \mathcal{O}_2 \, \right) \\ & \quad + \, m_0^2 \, \mathcal{O}_1 \, + \, m_0^2 \, \left( \, \mathcal{L}_1 \cos \! \mathcal{O}_1 \, + \, \mathcal{O}_2 \, \mathcal{O}_1 \, \right) \right] \\ & \quad + \, m_0^2 \, \mathcal{O}_1 \, + \, m_0^2 \, \left( \, \mathcal{O}_1 \, + \, \mathcal{O}_2 \, \mathcal{O}_1 \, + \, \mathcal{O}_2 \, \mathcal{O}_2 \, \right) \\ & \quad + \, m_0^2 \, \mathcal{O}_1 \, + \, m_0^2 \, \mathcal{O}_2 \, \mathcal{O}_1 \, + \, \mathcal{O}_2 \, \mathcal{O}_2 \, \right) \\ & \quad + \, m_0^2 \, \mathcal{O}_1 \, + \, m_0^2 \, \mathcal{O}_2 \, \mathcal{O}_2 \, + \, \mathcal{O}_2 \, \mathcal{O}_3 \, \mathcal{O}_3 \, \right) \\ & \quad + \, m_0^2 \, \mathcal{O}_1 \, + \, m_0^2 \, \mathcal{O}_2 \, \mathcal{O}_1 \, + \, \mathcal{O}_3 \, \mathcal{O}_3 \, \right) \\ & \quad + \, m_0^2 \, \mathcal{O}_1 \, + \, m_0^2 \, \mathcal{O}_2 \, \mathcal{O}_3 \, + \, \mathcal{O}_3 \, \mathcal{$$

$$\frac{\partial L}{\partial \dot{Q}_{1}} = (m_{1} + m_{2}) \mathcal{L}_{1}^{2} \dot{Q}_{1} + m_{2} \mathcal{L}_{1} \mathcal{L}_{2} \dot{Q}_{2} \cos (Q_{1} - Q_{2})$$

$$\frac{\partial L}{\partial \dot{Q}_{1}} = -m_{2} \mathcal{L}_{1} \mathcal{L}_{2} \dot{Q}_{1} \dot{Q}_{2} \sin (Q_{1} - Q_{2}) - m_{1} \mathcal{Q}_{1} \sin Q_{1} - m_{2} \mathcal{Q}_{1} \sin Q_{1}$$

$$\frac{d}{d\mathcal{L}} \frac{\partial L}{\partial \dot{Q}_{1}} - \frac{\partial L}{\partial \dot{Q}_{1}} = 0$$

$$\Leftrightarrow (m_{1} + m_{2}) \mathcal{L}_{1}^{2} \dot{Q}_{1} + m_{2} \mathcal{L}_{1} \mathcal{L}_{2} \dot{Q}_{2} \cos (Q_{1} - Q_{2}) - m_{2} \mathcal{L}_{1} \mathcal{L}_{2} \dot{Q}_{2} \left(\dot{Q}_{1}^{2} - \dot{Q}_{3}^{2}\right) \sin (Q_{1} - Q_{2})$$

$$+ m_{2} \mathcal{L}_{1} \mathcal{L}_{2} \dot{Q}_{1} \dot{Q}_{2} \sin (Q_{1} - Q_{2}) + (m_{1} + m_{2}) \mathcal{Q}_{1} \sin Q_{1} = 0$$

$$\frac{\partial L}{\partial \dot{Q}_{2}} = m_{2} L_{2}^{2} \dot{Q}_{2} + m_{2} L_{1} L_{2} \dot{Q}_{1}, \cos (Q_{1} - Q_{2})$$

$$\frac{\partial L}{\partial \dot{Q}_{2}} = m_{2} L_{1} L_{2} \dot{Q}_{1} \dot{Q}_{2} \sin (Q_{1} - Q_{2}) - m_{2} Q_{1} L_{2} \sin Q_{2}$$

$$\frac{d}{d L} \left( \frac{\partial L}{\partial \dot{Q}_{2}} \right) - \frac{\partial L}{\partial Q_{2}} = 0$$

$$\Leftrightarrow m_{2} L_{2}^{2} \ddot{Q}_{2} + m_{2} L_{1} L_{2} \dot{Q}_{1} \cos (Q_{1} - Q_{2}) - m_{2} L_{1} L_{2} \dot{Q}_{1} (\dot{Q}_{1} - \dot{Q}_{2}) \sin (Q_{1} - Q_{2})$$

$$- m_{2} L_{1} L_{2} \dot{Q}_{1} \dot{Q}_{2} \sin (Q_{1} - Q_{2}) + m_{2} Q_{1} L_{2} \sin Q_{2} = 0$$

$$\begin{pmatrix} (m_1+m_2) \, l_1^2 & m_2 \, l_1 \, l_2 \cos(Q_1-Q_2) \\ m_2 \, l_1 \, l_2 \cos(Q_1-Q_2) & m_2 \, l_2^2 \\ \end{pmatrix} \begin{pmatrix} \ddot{Q}_2 \\ \ddot{Q}_2 \end{pmatrix}$$

$$= \begin{pmatrix} -m_2 \, l_1 \, l_2 \, \dot{Q}_2^2 & \sin(Q_1-Q_2) - (m_1+m_2) \, g \, l_1 \sin Q_1 \\ m_2 \, l_1 \, l_2 \, \dot{Q}_1^2 & \sin(Q_1-Q_2) - m_2 \, g \, l_2 \sin Q_2 \end{pmatrix}$$