For a system with N particles moving in 3 dimensions, the virtual work is defined through

$$\delta W = \sum_{i=1}^{3N} F_i \delta x_i$$

(see section 1.6) where F_i are the Cartesian components of the forces and δx_i are the virtual displacements in Cartesian coordinates. Expressed in generalized coordinates, this becomes

$$\delta W = \sum_{\alpha=1}^{n} Q_\alpha \delta q_\alpha$$

where q_α are the n generalized coordinates and

$$Q_\alpha = \sum_{i=1}^{3N} F_i \frac{\partial x_i}{\partial q_\alpha}$$

is the generalized force.

The principle of virtual work says that when a system is in equilibrium $\delta W = 0$.

Using the principle of virtual work, and using θ as the generalized coordinate, find the equilibrium value of θ for the system below. Evaluate your result for $m_1 \gg m_2, m_1 > m_2, m_1 = m_2$ *and* $m_1 < m_2$