Johannes Byle

13.3

$$T = \frac{1}{2}(m_1 + m_2 + \frac{1}{2}M)\dot{x}^2$$

$$U = (m_2 - m_1)gx$$

$$\mathcal{L} = T - U = \frac{1}{2}(m_1 + m_2 + \frac{1}{2}M)\dot{x}^2 - (m_2 - m_1)gx$$

$$p_x = \frac{\delta \mathcal{L}}{\delta \dot{x}} = (m_1 + m_2 + \frac{1}{2}M)\dot{x}$$

$$H = p_x \dot{x} - \mathcal{L} = \frac{p_x}{2(m_1 + m_2 + \frac{1}{2}M)} + (m_2 - m_1)gx$$

$$\dot{x} = \frac{p_x}{(m_1 + m_2 + \frac{1}{2}M)}$$

$$\ddot{x} = \frac{\dot{p_x}}{(m_1 + m_2 + \frac{1}{2}M)}$$

13.10

$$T = \frac{1}{2}m(\dot{x}^2 + \dot{y}^2)$$

$$F = \nabla U$$

$$U = -\frac{1}{2}kx^2 + Ky$$

$$H = \frac{1}{2}m(\dot{x}^2 + \dot{y}^2) + Ky - \frac{1}{2}kx^2$$

$$\frac{\delta H}{\delta x} = \frac{\delta}{\delta t}\frac{\delta H}{\delta \dot{x}} = -kx = m\ddot{x}$$

$$\frac{\delta H}{\delta y} = \frac{\delta}{\delta t}\frac{\delta H}{\delta \dot{x}} = K = m\ddot{y}$$

$$y = \frac{K}{2m}t^2$$

$$x = \sin(\sqrt{\frac{k}{m}}t)$$