21.1
\[ H = \frac{P^2}{2m} + \frac{1}{2}k\left[\sqrt{(b-y)^2 + a^2} - l\right]^2 + mg \cdot y \]

\[ \frac{\partial H}{\partial P} = \frac{P}{m} = \dot{y} \]

\[ \frac{\partial H}{\partial y} = k \frac{\left[\sqrt{(b-y)^2 + a^2} - l\right]}{\sqrt{(b-y)^2 + a^2}} \left[-(b-y)\right] + mg = -\ddot{p} \]

21.2 I'll just do the math...

\[ H = \frac{P^2}{2(m_1+m_2+2/\kappa^2)} + m_1g \cdot y - mg \cdot y \]

(This depends on choice of coordinates)

\[ \frac{\partial H}{\partial P} = \frac{P}{m_1 + m_2 + 2/\kappa^2} = \dot{y}_0 \]

\[ \frac{\partial H}{\partial y} = m_1 g - m_2 g = -\ddot{p} \]
22.1 Here the centrifugal potential and the Coulomb potential are both positive, so bound orbits are not allowed. 

\[ U_c = \frac{\ell^2}{2\mu r^2} \]

The centrifugal potential moves the turning point to a larger value of \( r \) than if it were not there.