1 Lagrangian

The Lagrangian for the system is given by

$$L = T - V \tag{1}$$

with T being the kinetic energy and V being the potential energy. These can be further split up into the kinetic and potential energy for each pendulum. We get

$$T_1 = \frac{1}{2}m_1(\dot{x}_1^2 + \dot{y}_1^2), \quad T_2 = \frac{1}{2}m_2(\dot{x}_2^2 + \dot{y}_2^2) \tag{2}$$

And

$$V_1 = m_1 g y_1, \quad V_2 = m_2 g y_2 \tag{3}$$

We further choose to use the angles the pendulums make with the negative y-direction as the generalized coordinates. The conversions are

$$x_1 = r_1 \sin\theta_1, \quad y_1 = -r_1 \cos\theta_1, \quad x_2 = r_1 \sin\theta_1 + r_2 \sin\theta_2, \quad y_2 = -r_1 \cos\theta_1 - r_2 \cos\theta_2 \tag{4}$$

and

$$\theta_1 = \arctan(y_1/x_1) + \pi/2 \bmod 2\pi \quad \theta_2 = \arctan\frac{y_2 - y_1}{x_2 - x_1} + \pi/2 \bmod 2\pi \tag{5}$$