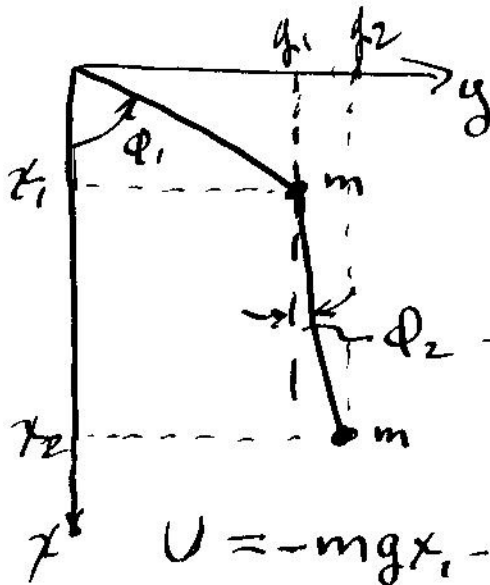


7-7



$$x_1 = l \cos \phi_1; \quad y_1 = l \sin \phi_1$$

$$x_2 = l \cos \phi_1 + l \cos \phi_2$$

$$y_2 = l \sin \phi_1 + l \sin \phi_2$$

$$T = \frac{1}{2} m (\dot{x}_1^2 + \dot{y}_1^2) + \frac{1}{2} m (\dot{x}_2^2 + \dot{y}_2^2)$$

$$= \frac{m}{2} l^2 [2\dot{\phi}_1^2 + \dot{\phi}_2^2 + 2\dot{\phi}_1\dot{\phi}_2 \cos(\phi_1 - \phi_2)]$$

$$U = -mgx_1 - mgx_2 = -mgl[2\cos \phi_1 + \cos \phi_2]$$

$L = T - U$ leads to:

$$2\ddot{\phi}_1 + \ddot{\phi}_2 \cos(\phi_1 - \phi_2) + \dot{\phi}_2^2 \sin(\phi_1 - \phi_2) + 2\frac{g}{l} \sin \phi_1 = 0$$

$$\ddot{\phi}_2 + \ddot{\phi}_1 \cos(\phi_1 - \phi_2) - \dot{\phi}_1^2 \sin(\phi_1 - \phi_2) + \frac{g}{l} \sin \phi_2 = 0$$