

$$a) \quad m\ddot{y} = N - mg$$

$$N = mg - \frac{L}{2} [\ddot{\theta}^2 \cos\theta + \ddot{\theta} \sin\theta] m$$

$$y = \frac{L}{2} \cos\theta$$

$$\dot{y} = -\frac{L}{2} \dot{\theta} \sin\theta$$

$$\ddot{y} = -\frac{L}{2} \ddot{\theta}^2 \cos\theta - \frac{L}{2} \ddot{\theta} \sin\theta$$

$$b) \quad I_{cm} \ddot{\theta} = \frac{L}{2} N \sin\theta$$

$$\frac{1}{12} m L^2 \ddot{\theta} = \frac{L}{2} N \sin\theta \rightarrow m \frac{L}{6} \ddot{\theta} = \left[mg - \frac{L}{2} [\ddot{\theta}^2 \cos\theta + \ddot{\theta} \sin\theta] \right] \sin\theta$$

$$c) \quad \ddot{\theta} \frac{L}{6} = g \sin\theta - \frac{L}{2} \ddot{\theta}^2 \cos\theta \sin\theta - \frac{L}{2} \ddot{\theta} \sin\theta^2$$

$$\ddot{\theta} \left[\frac{1}{6} + \frac{1}{2} \sin\theta^2 \right] = g \sin\theta - \frac{1}{2} \ddot{\theta}^2 \cos\theta \sin\theta$$

$$\ddot{\theta} = \frac{\left[g - \frac{1}{2} \ddot{\theta}^2 \cos\theta \right] \sin\theta}{\frac{1}{6} + \frac{1}{2} \sin\theta^2} \quad \left(\frac{2}{2} \right)$$

$$\ddot{\theta} = \frac{\left[\frac{2g}{L} - \ddot{\theta}^2 \cos\theta \right] \sin\theta}{\frac{1}{3} + \sin\theta^2}$$