(61) Energy method revised:

$$I = \frac{m(4\ell^2)}{12} = \frac{m\ell^2}{3}$$

Total energy of rod & x-component of angular momentum are conserved - only forces acting on rod are gravity, acting at CM, and normal force at point of contact.

$\dot{x}(t) = 0$.

$$\dot{y} = -\ell\sin\theta\,\dot{\theta} = v$$

$$mg\ell = mg\ell\cos\theta + \frac{1}{2}mv^2 + \frac{I\dot{\theta}^2}{2}$$

$$\frac{1}{2}m\ell^2\sin^2\theta\,\dot{\theta}^2 + \frac{1}{6}m\ell^2\dot{\theta}^2 = mg\ell(1-\cos\theta)$$

$$\dot{\theta}^2 m\ell^2\left(\frac{1}{2}\sin^2\theta + \frac{1}{6}\right) = mg\ell(1-\cos\theta)$$

$$\dot{\theta} = \sqrt{\frac{2g}{\ell}\frac{(1-\cos\theta)}{(\sin^2\theta + 1/3)}}$$

$$\ddot{\theta} = \frac{d\dot{\theta}}{d\theta}\dot{\theta} = -\frac{2g}{\ell}\frac{(1-\cos\theta)\cos\theta\sin\theta}{(\sin^2\theta + \frac{1}{3})^2} + \frac{g}{\ell}\frac{\sin\theta}{(\sin^2\theta + \frac{1}{3})}$$

$$= \frac{6g}{\ell}\sin\theta\left[\frac{11 - 12\cos\theta + 3\cos(2\theta)}{(5 - 3\cos(2\theta))^2}\right]$$