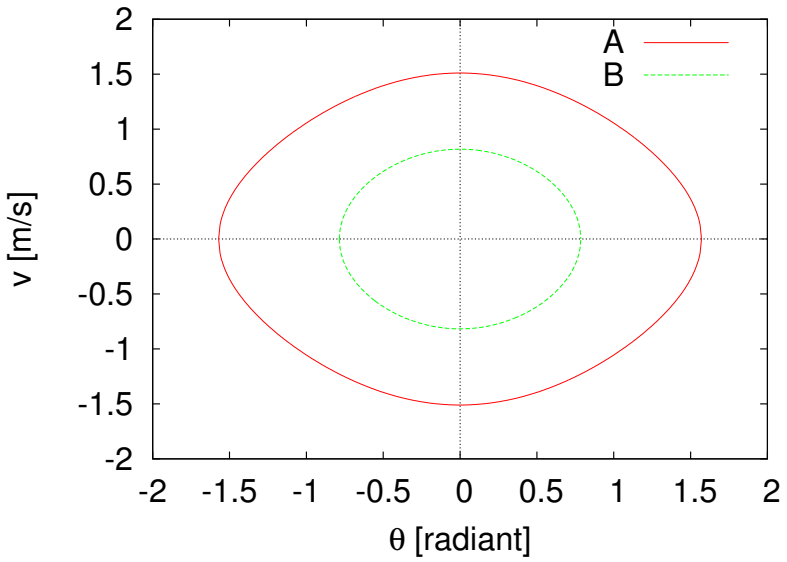

PHY 4936 – Solution 32

The energy is

$$E \;=\; \frac{1}{2}MR^2\dot{\theta}^2\left[\frac{3}{2}-\frac{8}{9\pi}\cos\theta\right]+MgR\left[1-\frac{4}{9\pi}\cos\theta\right].$$

Solving for $v^2 = R^2\dot{\theta}^2$ gives

$$v^2 \;=\; R^2\dot{\theta}^2 \;=\; \frac{2\left[E-MgR\left(1-4\cos\theta/(9\pi)\right]\right.}{M\left[3/2-8\cos\theta/(9\pi)\right]}$$

A. $E \;=\; MgR$:

$$v^2 \;=\; \frac{8gR\cos\theta/(9\pi)}{3/2-8\cos\theta/(9\pi)}\,, \qquad v \;=\; \pm\sqrt{v^2}\,. \tag{1}$$

B. $E \;=\; MgR\left[1-4/(9\pi\sqrt{2})\right]$:

$$v^2 \;=\; \frac{8gR\left[\cos\theta/(9\pi)-1/(9\pi\sqrt{2})\right]}{3/2-8\cos\theta/(9\pi)}\,, \qquad v \;=\; \pm\sqrt{v^2}\,. \tag{2}$$

With $g = 9.81\,[\mathrm{m/s}]$ and $R = 1\,[\mathrm{m}]$ plots of $v(\theta)$ for (1) and (2) are given in the figure.