HW Feb 12, Johannes Byle

4.8 We can model the sphere as a circle when viewed from the side. Thus the energies are:

$$T = \frac{1}{2}mv^2$$

$$U = mgz = mgRcos\theta$$

Since energy is constant in the system:

$$T = E_0 - U$$

$$\frac{1}{2}mv^2 = mgR(1 - cos\theta)$$

Since radial acceleration is $a = \frac{v^2}{r}$:

$$\frac{mv^2}{R} = mgcos\theta - N$$

$$mg(2 - 2cos\theta) = mgcos\theta - N$$

$$N = mg(3cos\theta - 2)$$

This is zero when

$$\theta = cos^{-}1\left(\frac{2}{3}\right) \approx 48^{\circ}$$