

## J99M.2—Particle Rolling on a Hyperboloid

### Problem

A particle of mass  $m$  moves on the surface  $x^2 + y^2 - z^2 = R^2$ , subject to a uniform force due to gravity  $g$  directed along the negative  $z$  axis. Deduce the frequency of small oscillations about orbits that lie in a plane normal to the  $z$  axis. For what values of  $z$  are such orbits unstable?