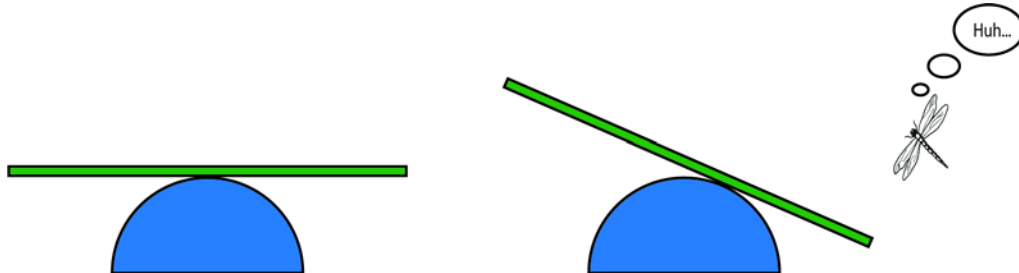


# 2019 Physics Prize Problem

## Teeter-totter



A teeter-totter consists of a thin uniform beam of length  $4R$  balanced atop a hemisphere of radius  $R$  that is fixed in position, in a uniform gravitational field  $g$ . Show that the oscillations of the beam about its equilibrium position are approximately simple harmonic for small oscillations, and find the period (in units of  $\sqrt{R/g}$ ). Then find the period of oscillations having an amplitude of  $30^\circ$ , measured between the beam and the horizontal, as accurately as possible. Assume that the hemisphere is sufficiently rough that the beam rolls on it without slipping.

### The Porter Prize and Andreas Prize

The Porter Prize was established by Carroll Porter '32, and the Andreas Prize was established in memory of Edgar L Andreas '69. Combined income from these two endowed prize funds is awarded annually to the student who submits the best solution to a complex physical problem by the use of iterative techniques. Any student at Knox may enter. Solutions should be turned in to Prof. Tom Moses, D116 SMC by 4 p.m. on **April 29**. Your submission should include a description of the method of solution, a documented listing of any computer code you develop for the solution, and any relevant computer printouts or plots.