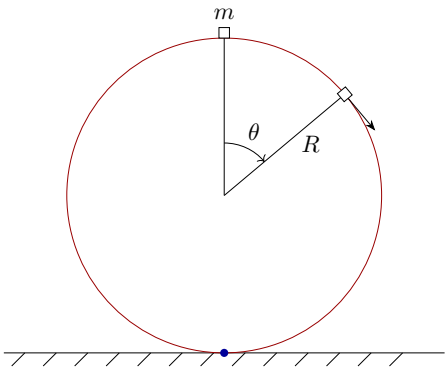
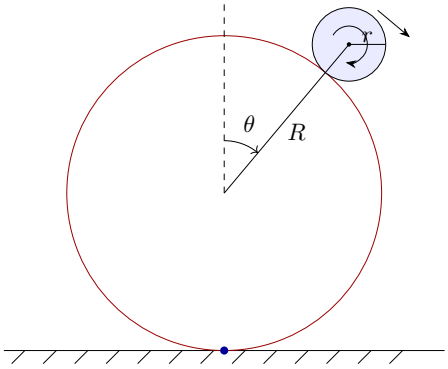
Problem 1 Problem 4.23 in Taylor.

Problem 2 Problem 4.36 in Taylor.

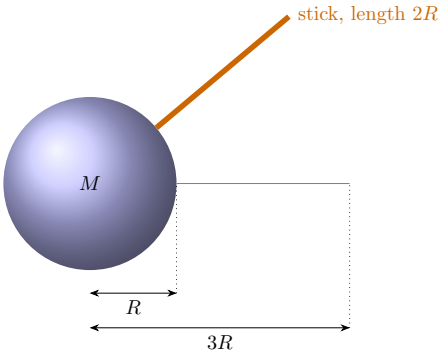
Problem 3 A negligibly small mass, m, sits motionless on top of a large frictionless sphere of radius R. The sphere is fixed to the ground. At what angle does the mass lose contact with the sphere (after a flea gently sneezes on the mass, setting it in motion)?



Problem 4 Redo Problem 3 but replace the small mass m with a sphere of radius r which starts from rest on top of the large sphere and rolls without slipping. At what angle does the small sphere lose contact with the large sphere?



Problem 5 Consider a planet of mass M and radius R. A very long stick of length $2R$ extends from just above the surface of the planet out to radius $3R$.



1. If initial conditions have been set up so that the stick moves in a circular orbit while always pointing radially, what is the period of the orbit?
2. How does this period compare to that of a satellite in a circular orbit of radius $2R$?

Problem 6 A mass $m = 2.0\,\text{kg}$ is attached to a horizontal spring with spring constant $k = 32\,\text{N/m}$. When the block is pulled out to $x = 0.5\,\text{m}$, it is given an initial velocity of $3.0\,\text{m/s}$.

a) Find the equation of motion in the form $x(t) = A\cos(\omega t + \phi)$ — i.e. determine the constants A, ω, and ϕ.

b) Plot — using a suitable package — $x(t)$ and $v(t)$.