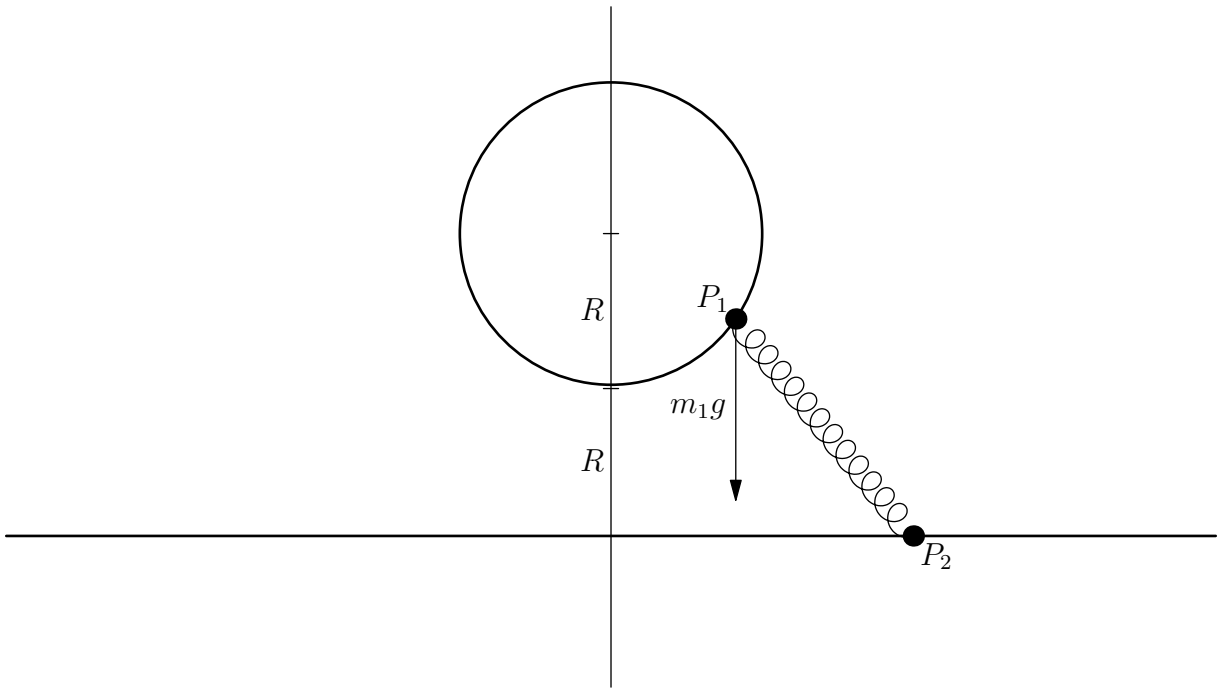
M98M.2—Masses Connected by a Spring

Problem

Consider a system of two particles, each of mass m, in a constant gravitational field g. Particle P_1 moves without friction on the vertical circle of radius R. P_2 moves without friction along the horizontal line. The two particles are connected by a perfect spring whose elastic constant is k. The spring is prestressed so that the tension is proportional to the length, $T = kr$, when the spring length is r.



a) What are the position(s) of equilibrium? Specify for each whether the position is stable or unstable.

b) For each of the stable position(s), and for each normal mode of small oscillations, sketch the motions of the particles.

c) Find the frequencies of the normal modes of small oscillations around the stable positions.