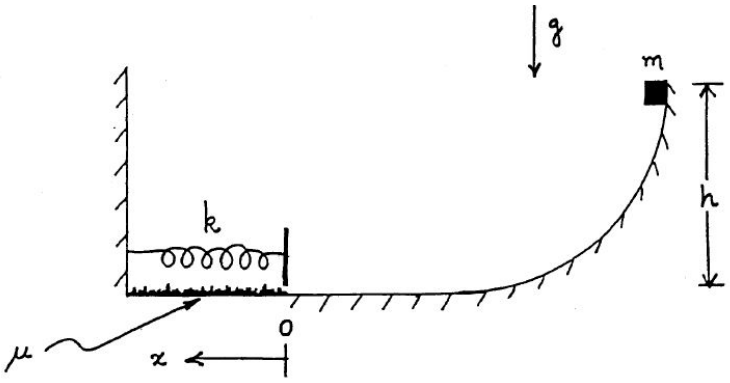
QP48



A block of mass m starts at rest and slides down a frictionless circular ramp from a height h. At the bottom, it hits a massless spring with spring constant k and in addition begins to experience a frictional force. The coefficient of kinetic friction is given by μ.

a) (1 point) What is the speed of the block at the bottom of the ramp just before it hits the spring?

b) (2 points) Find the total horizontal force on the mass after it hits the spring as a function of the coordinate x given in the diagram.

The mass first comes to rest instantaneously at $x = x_s$. It then rebounds back up the ramp, reaching a maximum height $h' < h$. In the following, express your answer in terms of x_s.

c) (2 points) What is the total work done on the mass by the spring and friction between $x = 0$ and $x = x_s$?

d) (2 points) What is the total energy W_f that has been dissipated by friction when the spring first returns to $x = 0$?

e) (2 points) Find the vertical height h' up the ramp to which the block rebounds. You may express your answer in terms of W_f.

f) (1 point) Find x_s in terms of the quadratic shown above.