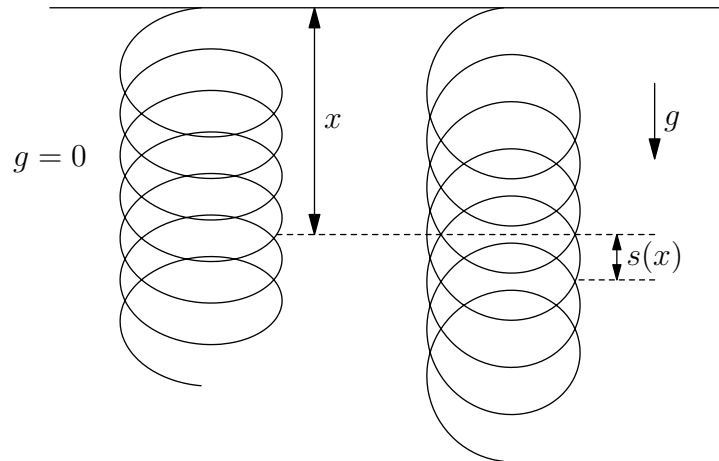


## M01M.1—Massive Spring

### Problem

A spring has spring constant  $K$ , unstretched length  $L$ , and mass per unit length  $\rho$ . The spring is suspended vertically from one end in a constant gravitational field  $g$ , and stretches under its own weight.



- For a point whose distance from the upper end of the spring is  $x$  when unstretched, find its distance  $s(x)$  from its gravity-free position when the spring is stretched.
- Suppose we suddenly ‘turn off’ gravity. (This can be done for example by putting the system in an elevator, which suddenly falls down from rest.) Find the subsequent motion  $s(x, t)$  of the spring.