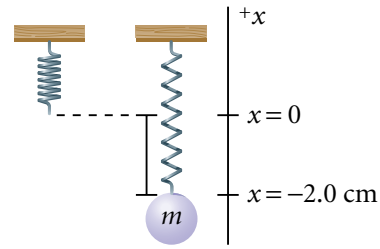
SAMPLE PROBLEM A

Hooke's Law

PROBLEM

If a mass of 0.55 kg attached to a vertical spring stretches the spring 2.0 cm from its original equilibrium position, what is the spring constant?



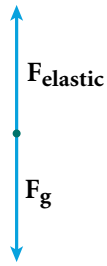
SOLUTION

1. DEFINE

Given: $m = 0.55\ \text{kg}$ $x = -2.0\ \text{cm} = -0.020\ \text{m}$
$g = 9.81\ \text{m/s}^2$

Unknown: $k = ?$

Diagram:



2. PLAN

Choose an equation or situation: When the mass is attached to the spring, the equilibrium position changes. At the new equilibrium position, the net force acting on the mass is zero. So the spring force (given by Hooke's law) must be equal and opposite to the weight of the mass.

$$\mathbf{F_{net}} = 0 = \mathbf{F_{elastic}} + \mathbf{F_g}$$

$$F_{elastic} = -kx$$

$$F_g = -mg$$

$$-kx - mg = 0$$

Rearrange the equation to isolate the unknown:

$$kx = -mg$$

$$k = \frac{-mg}{x}$$

3. CALCULATE

Substitute the values into the equation and solve:

$$k = \frac{-(0.55\ \text{kg})(9.81\ \text{m/s}^2)}{-0.020\ \text{m}}$$

$$\boxed{k = 270\ \text{N/m}}$$

CALCULATOR SOLUTION

The calculator answer for k is 269.775. This answer is rounded to two significant figures, 270 N/m.

4. EVALUATE

The value of k implies that 270 N of force is required to displace the spring 1 m.