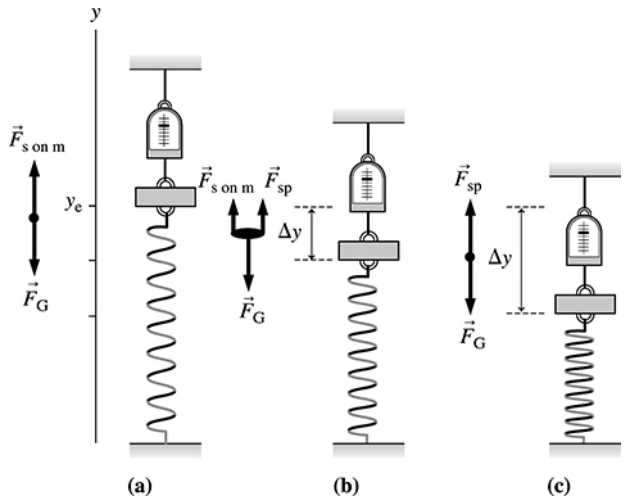
10.17. **Model:** Assume that the spring is ideal and obeys Hooke's law. We also model the 5.0 kg mass as a particle.

Visualize: We will use the subscript s for the scale and sp for the spring.



Solve: **(a)** The scale reads the upward force $F_{\text{s on m}}$ that it applies to the mass. Newton's second law gives

$$\sum (F_{\text{on m}})_y = F_{\text{s on m}} - F_G = 0 \Rightarrow F_{\text{s on m}} = F_G = mg = (5.0\text{ kg})(9.8\text{ m/s}^2) = 49\text{ N}$$

(b) In this case, the force is

$$\sum (F_{\text{on m}})_y = F_{\text{s on m}} + F_{sp} - F_G = 0 \Rightarrow 20\text{ N} + k\Delta y - mg = 0$$

$$\Rightarrow k = (mg - 20\text{ N})/\Delta y = (49\text{ N} - 20\text{ N})/0.02\text{ m} = 1450\text{ N/m}$$

The spring constant for the lower spring is 1.45×10^3 N/m.

(c) In this case, the force is

$$\sum (F_{\text{on m}})_y = F_{sp} - F_G = 0 \Rightarrow k\Delta y - mg = 0$$

$$\Rightarrow \Delta y = mg/k = (49\text{ N})/(1450\text{ N/m}) = 0.0338\text{ m} = 3.4\text{ cm}$$