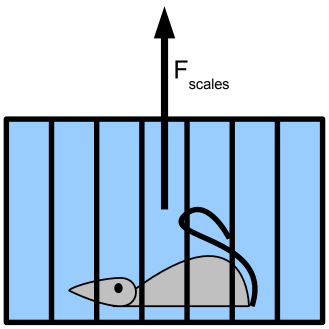
Chapter 4 Problem 49 †



Given
$F_s = 0.46\ N$
$m_c = 320\ g = 0.320\ kg$
$a = 0.40\ m/s^2$

Solution
Find the mass of the rat.

Since we are on the space station, there is no gravitational force. Therefore, the free-body diagram of the force on the cage and rat is illustrated above. Using Newton's 2nd law gives

$$\Sigma F = ma$$

The only force is that of the scale and the mass consists of both the rat and the cage. Therefore,

$$F_s = (m_c + m_r)a$$

Solving for the mass of the rat gives

$$\frac{F_s}{a} = m_c + m_r$$

$$m_r = \frac{F_s}{a} - m_c$$

Substituting in the provided values gives

$$m_r = \frac{0.46\ N}{0.40\ m/s^2} - 0.320\ kg = 0.830\ kg$$

Therefore, the mass of the rat is 830 g.

†Problem from Essential University Physics, Wolfson