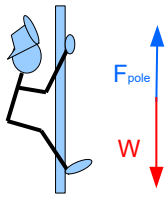
Chapter 5 Problem 48 [†]



Given
$m = 90.0\ kg$
$a = 5.00\ m/s^2$

Solution
a) Find an equation that gives the vertical force on the pole.

From the free-body diagram, the force of the pole on the fireman is upward and the force of gravity is downward. The fireman is acceleration down the pole. Therefore, using Newton's 2nd law gives

$$\Sigma \vec{F}_i = m\vec{a}$$

$$\vec{F}_p + \vec{W} = m\vec{a}$$

$$F_p - mg = -ma$$

Solving for the force of the pole gives

$$F_p = mg - ma = m(g - a)$$

b) What is the magnitude of the applied force?

By Newton's 3rd law the force the pole applies to the man is equal and opposite of the force of the fireman on the pole. The magnitude of the force will be the same, but the direction is opposite. The magnitude of the force is

$$F_p = (90.0\ kg)(9.80\ m/s^2 - 5.00\ m/s^2) = (90.0\ kg)(4.80\ m/s^2)$$

$$F_p = 432\ N$$

[†]Problem from University Physics by Ling, Sanny and Moebs (OpenStax)