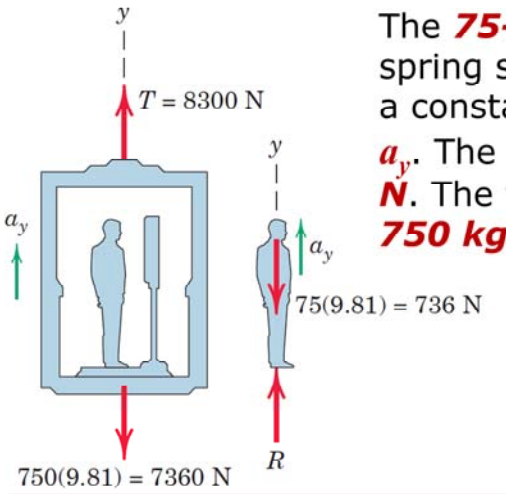
Rectilinear Motion: Another Exercise



The ***75-kg*** man stands on a spring scale in an elevator with a constant upward ***acceleration*** a_y. The cable ***tension*** T is ***8300 N***. The total system ***mass*** is ***750 kg***.

Find the ***reading*** R (in Newtons) of the scale.

Sample Problem 3/1

A 75-kg man stands on a spring scale in an elevator. During the first 3 seconds of motion from rest, the tension T in the hoisting cable is 8300 N. Find the reading R of the scale in newtons during this interval and the upward velocity v of the elevator at the end of the 3 seconds. The total mass of the elevator, man, and scale is 750 kg.

Solution. The force registered by the scale and the velocity both depend on the acceleration of the elevator, which is constant during the interval for which the forces are constant. From the free-body diagram of the elevator, scale, and man taken together, the acceleration is found to be

$$[\Sigma F_y = ma_y] \qquad 8300 - 7360 = 750a_y \qquad a_y = 1.257 \text{ m/s}^2$$

The scale reads the downward force exerted on it by the man's feet. The equal and opposite reaction R to this action is shown on the free-body diagram of the man alone together with his weight, and the equation of motion for him gives

① $$[\Sigma F_y = ma_y] \qquad R - 736 = 75(1.257) \qquad R = 830 \text{ N} \qquad \textit{Ans.}$$

The velocity reached at the end of the 3 seconds is

$$[\Delta v = \int a\,dt] \qquad v - 0 = \int_0^3 1.257\,dt \qquad v = 3.77 \text{ m/s} \qquad \textit{Ans.}$$