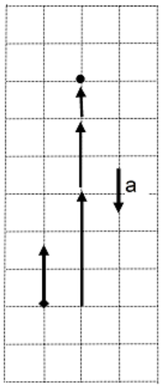
I-79

A 100 kg man concerned about his weight decides to weigh himself in an elevator. He stands on a bathroom scale in an elevator that is moving upward at 3.0 m/s. As the elevator reaches his floor, it slows to a stop over a distance of 2.0 m.

Motion Diagram **Motion Information** **Free-Body Diagram**



Event 1: The instant the elevator begins to slow.

$t_1 = 0$ s

$r_1 = 0$ m

$v_1 = 3.0$ m/s

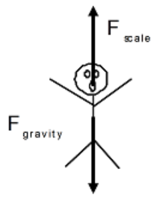
Event 2: The instant it stops.

$t_2 =$

$r_2 = +2.0$ m

$v_2 = 0$ m/s

$a_{12} =$



Mathematical Analysis

Since there are only two unknown kinematic quantities, we can determine them by our two kinematic equations.

$$v_2 = v_1 + a_{12}(t_2 - t_1)$$
$$0 = 3 + a_{12}t_2 - 0)$$
$$a_{12} = \frac{-3}{t_2}$$

Now substitute this expression into the other equation:

$$r_2 = r_1 + v_1(t_2 - t_1) + \frac{1}{2}a_{12}(t_2 - t_1)^2$$
$$2 = 3t_2 + \frac{1}{2}a_{12}t_2{}^2$$
$$2 = 3t_2 + \frac{1}{2}(\frac{-3}{t_2})t_2{}^2$$
$$2 = 3t_2 - 1.5t_2$$
$$2 = 1.5t_2$$
$$t_2 = 1.33s$$

Substitute this result back into the original equation:

$$a_{12} = \frac{-3}{1.33}$$
$$a_{12} = -2.25m/s^2$$

Now apply Newton's Second Law to the man:

$$\Sigma F = ma$$
$$F_{scale} - F_{gravity} = (100)(-2.25)$$
$$F_{scale} - (100)(9.8) = -225$$
$$F_{scale} = 755N$$