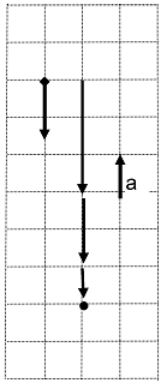
I-82

A decorative light fixture in an elevator consists of a 2.0 kg light suspended by a cable from the ceiling of the elevator. From this light, a separate cable suspends a second 0.80 kg light. The elevator is moving downward at 4.0 m/s when someone presses the emergency stop button. The elevator comes to rest in 1.2 seconds.

Motion Diagram
Free-Body Diagrams



Motion Information

Event 1: The stop button is pressed.

$t_1 = 0$ s

$r_1 = 0$ m

$v_1 = 4.0$ m/s

Event 2: The elevator stops.

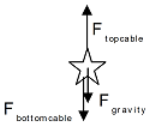
$t_2 = 1.2$ s

$r_2 =$

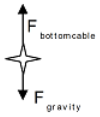
$v_2 = 0$ m/s

$a_{12} =$

the top light



the bottom light



Mathematical Analysis

Since there are only two unknown kinematic quantities, we can determine them by our two kinematic equations. Note that both lights have the same kinematic description.

$$0 = 4 + a_{12}(1.2 - 0)$$
$$a_{12} = -3.33 m/s^2$$

$$r_2 = 0 + 4(1.2 - 0) + \frac{1}{2}(-3.33)(1.2 - 0)^2$$
$$r_2 = 2.4m$$

Now apply Newton's Second Law to the two lights:

bottom light

$$-F_{bottomcable} + F_{gravity} = ma$$
$$-F_{bottomcable} + (0.8)(9.8) = (0.8)(-3.33)$$
$$F_{bottomcable} = 10.5N$$

top light

$$-F_{topcable} + F_{bottomcable} + F_{gravity} = ma$$
$$-F_{topcable} + 10.5 + (2.0)(9.8) = (2.0)(-3.33)$$
$$F_{topcable} = 36.8N$$