Answer on Question #54623, Physics / Mechanics | Kinematics | Dynamics

An elevator manufacturing company is stress-testing a new elevator in an airless test shaft. The elevator is traveling at an unknown velocity when the cable snaps. The elevator falls 2.50 meters before hitting the bottom of the shaft. The elevator was in free fall for 0.900 seconds. Determine its velocity when the cable snapped. As usual, up is the positive direction.

Solution:

Given:

Initial height: h_0 = 2.50 m

Final height: h = 0

Time: t = 0.900 s

Final velocity: v = 0 m/s

Initial velocity: v_0 =?

Whether explicitly stated or not, the value of the acceleration in the kinematic equations is $g = -9.8\ m/s^2$ for any freely falling object.

The kinematic equation is

$$h = h_0 + v_0 t - \frac{gt^2}{2} = 0$$

Thus,

$$v_0 = \frac{\left(\frac{gt^2}{2} - h_0\right)}{t} = \frac{gt}{2} - \frac{h_0}{t} = 9.8 * \frac{0.900}{2} - \frac{2.50}{0.900} = 1.632\ \text{m/s}$$

Answer: 1.632 m/s