

The JETS Challenge

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Challenge 96 – The Elevator Challenge

Problem:

On March 23, 1857, E.G. Otis installed the world's first safety passenger elevator into the E.V. Haughwout and Company Store in New York. It rose at a speed of 40 feet per minute. Today the world's fastest elevator is in the Taipei Financial Center. The elevator has a vertical rise of 388 meters high to reach the top. It goes up at a maximum speed of 1,010 meters per minute (mpm) taking about 38 seconds. The designers had to develop a new safety device about 3.1 times the capacity of a conventional safety device. The surface temperature of the safety shoe exceeds 1,000° C as it brings a car dropping at a speed of 1,275 mpm to a full stop within approximately 40 meters. This causes a negative acceleration given by the equation:

$$a = V^2 / 2L$$

where a = rate of deceleration in m/s^2
 V = initial velocity in m/s
 L = stopping distance in m

Once the rate of deceleration is known, the stopping time can be determined by the equation:

$$a \cdot t^2 / 2 + V \cdot t + L = 0$$

where a = rate of deceleration in m/s^2
 t = time in seconds
 V = initial velocity in m/s
 L = stopping distance in m

Find the emergency stopping time in seconds.