Question #79755, Physics / Classical Mechanics

Mary ants throw a can straight up into the air and then hit it with second can. She wants the collision to occur at a height h=10m above the throw point. In addition she knows that she needs t1=4.0s between successive throws. Assume that she throws both cans at same speed. Take g=9.81m/s^2.find the initial speed of the cans?

Solution

Let the height of the first can be x, that of the second can be y; and both cans be thrown at speed v.

$$x(t) = v\,t - g\frac{t^2}{2}$$

$$y(t) = v\,(t - t_1) - g\frac{(t - t_1)^2}{2}$$

$$x(t) = y(t) = h$$

From the first height equation:

$$v = \frac{h}{t} + \frac{gt}{2}$$

Substituted into the second equation:

$$h = \left(\frac{h}{t} + \frac{gt}{2}\right)(t - t_1) - \frac{g(t - t_1)^2}{2}$$

$$10 = \left(\frac{10}{t} + 9.81\frac{t}{2}\right)(t - 4) - \frac{9.81(t - 4)^2}{2}$$

$$t = 4.457 \; s.$$

$$v = \frac{10}{4.457} + \frac{9.81}{2}4.457 = 24.1\frac{m}{s}.$$

Answer: $24.1\frac{m}{s}$.

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