Acceleration Example:

A ball is thrown up at 25 $\frac{m}{s}$. How long is it in the air before it's moving down at 15 $\frac{m}{s}$?

$a = -9.8 \frac{m}{s^2}$

$V_f = -15 \frac{m}{s}$

$V_i = 25 \frac{m}{s}$

$t =$

$a = \frac{V_f - V_i}{t}$

$t = \frac{V_f - V_i}{a}$

$= \frac{(-15) - (25)}{(-9.8)}$

$= \frac{-40}{-9.8}$

$t = 4.1\ s$

What is the displacement at this point?

$V_{AV} = \frac{d}{t}$ $V_{AV} = \frac{V_i + V_f}{2}$

Sep 18-1:38 PM

Deriving Kinematic equations:

$V_{AV} = \frac{d}{t}$ $V_{AV} = \frac{V_i + V_f}{2}$

$\frac{d}{t} = \frac{V_i + V_f}{2}$

$d = \left(\frac{V_i + V_f}{2}\right) t$ ① d, V_i, V_f, t

$a = \frac{V_f - V_i}{t}$ ② d, V_i, V_f, a, t

Rearrange ③ $at = V_f - V_i$

$V_i + at = V_f$ sub into ①

$V_i = V_f - at$

$d = \left(\frac{(V_f - at) + V_f}{2}\right) t$

$d = \left(\frac{V_i + (V_i + at)}{2}\right) t$

$= \left(\frac{2V_i + at}{2}\right) t$

$= \frac{2V_i t + at^2}{2}$

$= \frac{2V_i t}{2} + \frac{at^2}{2}$

$d = V_i t + \frac{1}{2} a t^2$ ③ V_i, V_f

$d = V_f t - \frac{1}{2} a t^2$ ④ V_i

Solve ② for t

$t = \frac{V_f - V_i}{a}$ sub into ①

$d = \left(\frac{V_i + V_f}{2}\right)\left(\frac{V_f - V_i}{a}\right)$

$= \frac{(V_i + V_f)(V_f - V_i)}{2a}$

$= \frac{(V_i V_f + V_f^2 - V_i^2 - V_i V_f)}{2a}$

$d = \frac{V_f^2 - V_i^2}{2a}$

$2ad = V_f^2 - V_i^2$

$V_f^2 = V_i^2 + 2ad$ ⑤ t

From last example

$V_i = 25 \frac{m}{s}$

$V_f = -15 \frac{m}{s}$

$a = -9.8 \frac{m}{s^2}$

$d = ?$

$d = \frac{V_f^2 - V_i^2}{2a}$

$= \frac{(-15)^2 - (25)^2}{2(-9.8)}$

$= \frac{225 - 625}{-19.6}$

$= \frac{-400}{-19.6}$

$= 20.4\ldots$

Sep 18-2:10 PM

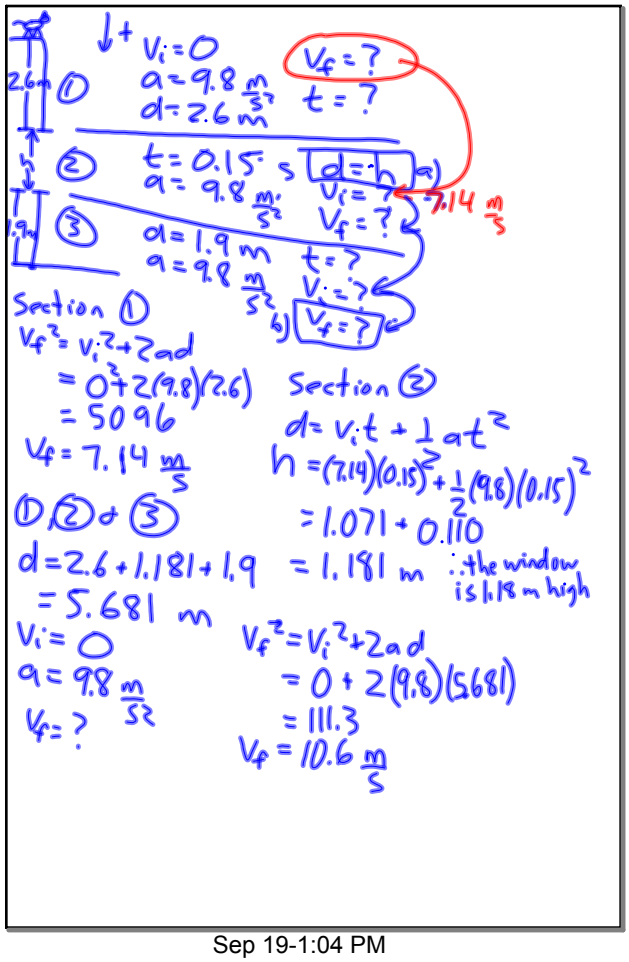
Example:

An observant physics student notices a rat falling from the top of their school. She determined that it took 0.15 s for the rat to pass the second storey window, which is 1.9 m off the ground, and 2.6 m from the top of the school.

a) How tall is the window?

b) what speed did the rat have when it landed?

Sep 19-12:58 PM



Sep 19-1:04 PM