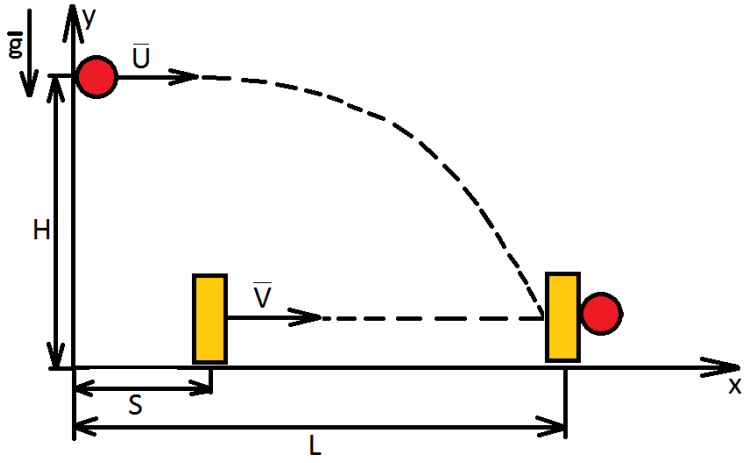
Kaitlin is going off to her physics class, jogging down the sidewalk at a speed of 4.10m/s . Her husband Scott suddenly realises that she left in such a hurry that she forgot her sandwich, so he runs to the window of their apartment, which is a height 40.7m above the street level and directly above the footpath, to throw it to her. Scott throws it horizontally at a time 5.50s after Kaitlin has passed below the window, and she catches it on the run. You can ignore air resistance.

a.With what initial speed must Scott throw the sandwich so Kaitlin can catch it just before it hits the ground?
b.Where is Kaitlin when she catches the sandwich?

Solution:



Let U – velocity of the sandwich, V- the speed of jogging, t_1=5.5s

We find the time at which Kaitlin will catch sandwich. The equation of motion for the sandwich along the Y-axis:

$$y: H = \frac{gt_2^2}{2}$$

$$t_2 = \sqrt{\frac{2H}{g}}(1)$$

Distance is Kaitlin ran to catch a sandwich:

$$L = S + Vt_2 = Vt_1 + Vt_2 = V(t_1 + t_2)(2)$$

The equation of motion for the sandwich X-axis:

$$x: L = Ut_2(3)$$

$$(1)in(3)\ and\ (1)in\ (2):$$

$$L = U\sqrt{\frac{2H}{g}};\quad L = V\left(t_1 + \sqrt{\frac{2H}{g}}\right)$$

Equate the right sides of equations:

$$U\sqrt{\frac{2H}{g}} = V\left(t_1 + \sqrt{\frac{2H}{g}}\right)$$

$$U = V\left(t_1\sqrt{\frac{g}{2H}} + 1\right) = 4.1\frac{m}{s}\left(5.5s\sqrt{\frac{10\frac{m}{s^2}}{2 * 40.7m}} + 1\right) = 12\frac{m}{s}$$

$$L = U\sqrt{\frac{2H}{g}} = 12\frac{m}{s}\sqrt{\frac{2 * 40.7m}{10\frac{m}{s^2}}} = 34.23\ m$$

Answer: a) initial speed $U = 12\frac{m}{s}$

b) Kaitlin will be at a distance $L = 34.23\ m$ away from the window