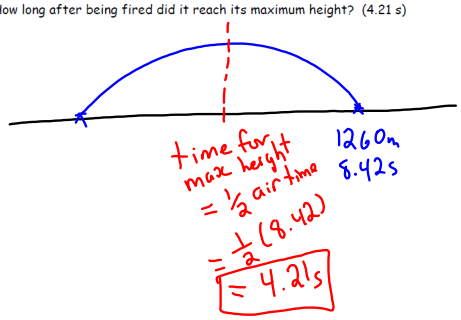
6. A projectile fired at an angle remains in the air for 8.42 s after it is fired. The initial horizontal component of its velocity is +150 m/s.
   a) How far forward did the projectile move forward before it hit the ground? (1.26×10^3 m)
   b) How long after being fired did it reach its maximum height? (4.21 s)



t = ? for max height d_{fy} = ?
$g = -9.81 m/s^2$ } y-dir
$v_{fy} = 0 m/s$
v_{oy} = ?
$d_{oy} = 0 m$

$g = \frac{v_{fy} - v_o}{t}$, $d_{fy} = d_{oy} + v_{oy}t + \frac{1}{2}gt^2$

* Not enough known variables @ max height position!

do know $t_{air} = 8.42 s$ ← $d_{oy} = 0m$, $d_{fy} = 0$

* Find v_{oy}

$d_{fy} = d_{oy} + v_{oy}t + \frac{1}{2}gt^2$

$0 = 0 + v_o(8.42) + \frac{1}{2}(-9.81)(8.42)^2$

$0 = 8.42v_o - 347.75$

$\frac{347.75}{8.42} = v_o$

$41.3 m/s = v_{oy}$

Sub into $g = \frac{v_f - v_o}{t}$ to find time to max height.

$-9.81 = \frac{0 - 41.3}{t}$

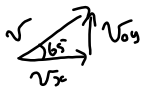
$t = \frac{-41.3}{-9.81}$ $\boxed{t = 4.21 s}$

Launch angle $\Rightarrow \theta = \tan^{-1}\left|\frac{v_{oy}}{v_x}\right|$

$\theta = \tan^{-1}\left(\frac{41.3}{150}\right)$

$\boxed{\theta = 15°}$

With what minimum speed does a baseball have to come off the bat to clear the Green Monster at Fenway Park? The wall is 115.5 m from home plate and 11.3 m high. Assume the batter makes contact 1.0 m off the ground at an angle of 65°.



$v = ?$

$d_{fx} = 115.5\text{ m}$, $d_{ox} = 0$

$d_{fy} = 11.3\text{ m}$ $g = -9.81$

$d_{oy} = 1.0\text{ m}$

x-dir

$v_x = v\cos 65$

$v_x = \frac{d_{fx} - d_{ox}}{t} = \frac{115.5}{t} \Rightarrow v_x = \frac{115.5}{t}$

y-dir

$v_{oy} = v\sin 65$

$d_{fy} = d_{oy} + v_{oy}t + \frac{1}{2}gt^2$

$11.3 = 1.0 + v_{oy}t - 4.9t^2$ Sub $v_{oy} = v\sin 65$ in

$11.3 = 1.0 + (v\sin 65)t - 4.9t^2$

from above

$v_x = v\cos 65$ and $v_x = \frac{115.5}{t}$

$\therefore \quad v\cos 65 = \frac{115.5}{t}$

Solve for t: $t = \frac{115.5}{v\cos 65}$ Sub in equation for d_{fy}

$11.3 = 1.0 + (v\sin 65)t - 4.9t^2$

$11.3 = 1.0 + (v\sin 65)\left(\frac{115.5}{v\cos 65}\right) - 4.9\left(\frac{115.5}{v\cos 65}\right)^2$

PhET this sucker!

Attachments

projectile-motion_en.jar