Answer on Question #42939 – Physics - Mechanics | Kinematics | Dynamics

6. A baseball player hits a ball from 1.3 m above the ground with an initial velocity of 36 m/s at an angle of 45 deg. Will it clear a 7.5 m wall located 125 m away?

Solution:

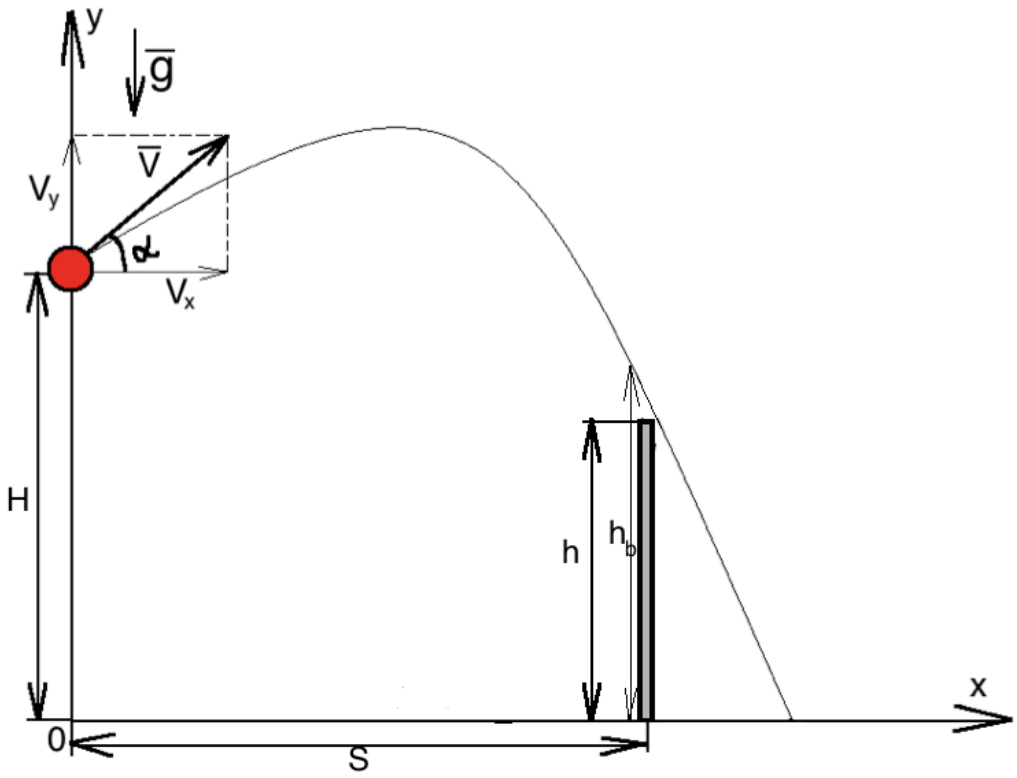
$S = 125\text{m} -$ horizontal range of the wall;

$V = 36\frac{\text{m}}{\text{s}} -$ initial speed of the ball;

$\alpha = 45^{\text{o}} -$ the angle between the velocity and the horizontal;

$H = 10\text{m} -$ initial height;

$h = 7.5\text{m} -$ height of the wall;



Equation of the motion for the ball, directed at angle α: ($t -$ time of the flight)

$V_x = V\cos\alpha;\ V_y = V\sin\alpha;$

x: $S = V_x t = Vt\cos\alpha$

$$t = \frac{S}{V\cos\alpha} \qquad (1)$$

If the height of the ball (h_b) will be more then H when it's distance will be S, ball will clear the wall away:

$$y: h_b - H = Vt\sin\alpha - \frac{gt^2}{2}$$

$$h_b = H + Vt\sin\alpha - \frac{gt^2}{2} \qquad (2)$$

$(1)\text{in}(2)$:

$$h_b = H + V\frac{S}{V\cos\alpha}\sin\alpha - \frac{g\left(\frac{S}{V\cos\alpha}\right)^2}{2} = H + S\tan\alpha - \frac{g}{2}\left(\frac{S}{V\cos\alpha}\right)^2$$

$$= 10\text{m} + 125\text{ m}\cdot\tan 45^o - \frac{9.8\frac{\text{m}}{\text{s}^2}}{2}\left(\frac{125\text{ m}}{36\frac{\text{m}}{\text{s}}\cos 45^o}\right)^2 = 16.85\text{m}$$

$h_b > h$ because $16.85\text{ m} > 7.5\text{ m} \Longrightarrow$ ball will clear the wall away:

Answer: ball will clear the wall away: