Tennis Player's Shot

A tennis player standing 12.6 meters from the net and hits a ball at 3 degrees above the horizontal. The ball must rise .33 meters if it is to clear the net at the top of its arc. What must the initial velocity be?

Problem 3.27

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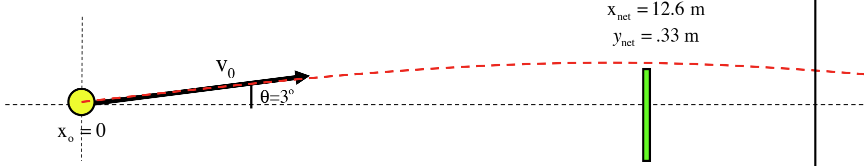
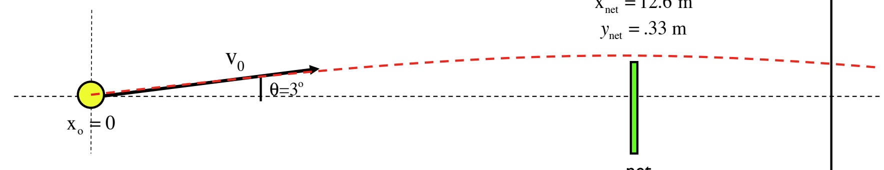


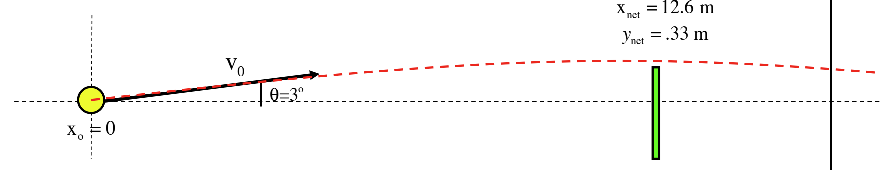


For the y-direction: Remembering that at the net the y-component of the velocity must be zero (it's at the top of the arc), we can write:

$$v_{net,y} = v_{o,y} + a_y t$$

$$\Rightarrow \quad 0 = v_o \sin 3^o + \left(-9.8 \text{ m/s}^2\right) t$$

$$\Rightarrow \quad t = \frac{v_o \sin 3^o}{\left(9.8 \text{ m/s}^2\right)}$$



For the y-direction, we can also write:

$$y_2 = y_1 + v_{1,y} t + (1/2) a_y t^2$$

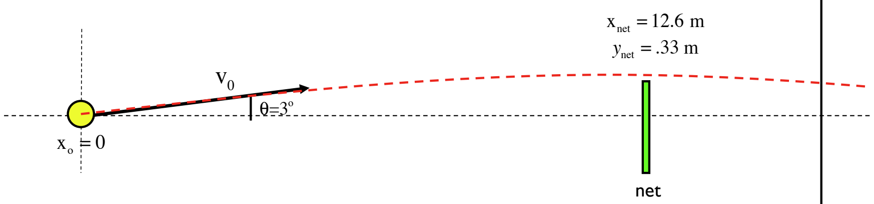
$$\Rightarrow \quad y_2 = 0 + \left(v_o \sin 3^o\right)\left(\frac{v_o \sin 3^o}{9.8 \text{ m/s}^2}\right) + (1/2)\left(-9.8 \text{ m/s}^2\right)\left(\frac{v_o \sin 3^o}{9.8 \text{ m/s}^2}\right)^2$$

$$\Rightarrow \quad y_2 = \frac{\left(v_o \sin 3^o\right)^2}{9.8 \text{ m/s}^2} - (1/2)\frac{\left(v_o \sin 3^o\right)^2}{9.8 \text{ m/s}^2}$$

$$\Rightarrow \quad y_2 = \frac{\left(v_o \sin 3^o\right)^2}{2\left(9.8 \text{ m/s}^2\right)}$$

$$\Rightarrow \quad .33 \text{ m} = \frac{\left(v_o \sin 3^o\right)^2}{2\left(9.8 \text{ m/s}^2\right)}$$

$$\Rightarrow \quad v_o = 48.6 \text{ m/s}$$



Interesting, you can do this entire problem without using the x-direction information at all!