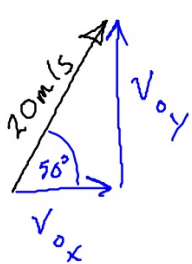


- A football is kicked at 20 m/s, at an angle of 50° (above horizontal). What is the maximum range if the ball must clear a 3.0 m high bar?
- If the ball is kicked the maximum range, it will in fact impact the crossbar. What is its impact velocity?



X	Y
$a = 0$	$a = -9.8 \text{ m/s}^2$
$v_o = 12.86 \text{ m/s}$	$v_o = 15.32 \text{ m/s}$
$\Delta x = ?$	$\Delta y = 3.0 \text{ m}$

To find t use 2 steps
I will show BOTH methods

$$t = ? \quad v_f^2 = v_o^2 + 2a(\Delta y)$$

$$= (15.32)^2 + 2(-9.8)(3)$$

$$v_f = \pm 13.26 \text{ m/s}$$

$$v_f = v_o + a t$$

$$-13.26 = 15.32 + (-9.8)(t)$$

$$\underline{t = 2.917 \text{ sec}}$$

OR $\Delta y = v_0 t + \frac{1}{2} a t^2$

$$3 = 15.32 t - 4.9 t^2$$

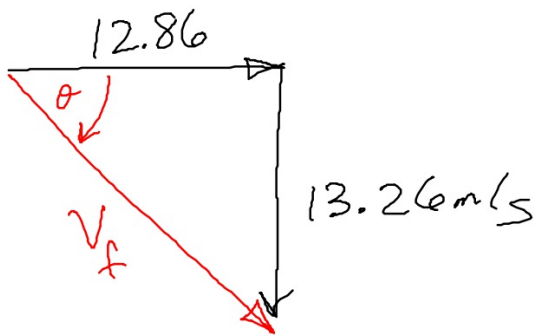
then the quadratic to get $t = 2.917 \text{ sec}$
formula

Now $\Delta x = ?$

$$\Delta x = v_0 t + \frac{1}{2} a t^2$$

$$\Delta x = (12.86)(2.917) + 0 = 37.5 \text{ m}$$

(cont.) $v_f = ?$ $v_{fx} = 12.86 \text{ m/s}$ $v_{fy} = -13.26 \text{ m/s}$



$$\tan \theta = \frac{13.26}{12.86}$$

$$v_f^2 = 12.86^2 + 13.26^2$$

$$v_f = 18.5 \text{ m/s}, -46^\circ$$