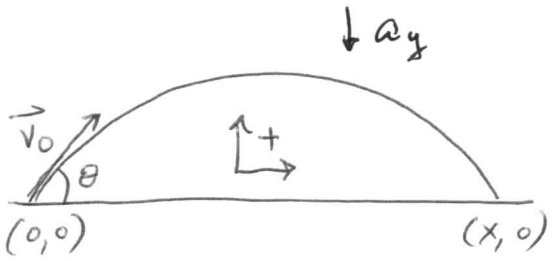
4-31a

Given: $V_0 = 30.0$ m/s

t =	t =
$V_{0x} = V_0 \cos\theta$	$V_{0y} = V_0 \sin\theta$
$V_x =$	$V_y =$
$a_x = 0$	$a_y = -9.8\ m/s^2$
$x_0 = 0$	$y_0 = 0$
$x =$	$y = 0$



Assumption: see book

Goal: Find maximum x.

Solution: Solve for t using vertical dvat. Solve for x using horizontal dvat.

$$y = y_0 + V_{0y}t + \frac{1}{2}a_y t^2$$

$$0 = t\left(V_{0y} + \frac{1}{2}a_y t\right)$$

$$V_{0y} + \frac{1}{2}a_y t = 0$$

$$t = -\frac{2V_{0y}}{a_y}$$

$$= -\frac{2V_0 \sin\theta}{a_y}$$

Solve for x:

$$x = x_0 + V_{0x}t + \frac{1}{2}a_x t^2$$

$$x = (V_0 \cos\theta)\,t$$

$$x = (V_0 \cos\theta)\left(-\frac{2V_0 \sin\theta}{a_y}\right)$$

$$= -\frac{2V_0^2}{a_y}\cos\theta \sin\theta$$

$$\boxed{x = -\frac{V_0^2}{a_y}\sin 2\theta} \qquad (\sin 2\theta = 2\sin\theta\cos\theta)$$

What is maximum?

θ for max x is that θ for which $\sin 2\theta = 1$.

$$2\theta = 90^\circ$$
$$\theta = 45^\circ$$

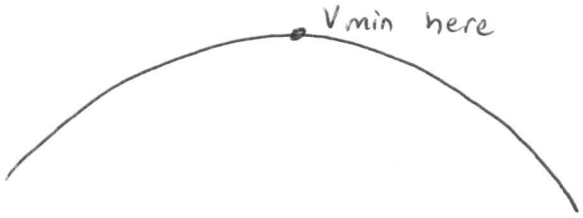
$$x = -\frac{v_0^2}{a_y} \sin 2\theta$$

$$x_{max} = -\frac{v_0^2}{a_y}$$

$$= -\frac{\left(30 \frac{m}{s}\right)^2}{-9.8 \frac{m}{s^2}}$$

$$= 90 \text{ m}$$

b.



$$V_{min} = \sqrt{V_x^2 + V_y^2}$$
$$= \pm V_x$$
$$= \pm v_{0x}$$

$$V_{min} = + v_{0x}$$
$$= v_0 \cos\theta$$
$$= 30 \frac{m}{s} \cos 45^\circ$$
$$= 30 \frac{\sqrt{2}}{2} \frac{m}{s}$$

$$= 15\sqrt{2} \frac{m}{s}$$