Projectile Motion

Ch. 4.5-4.6
Preview of Today’s Class

• Description/Explanation of Projectile Motion
  
  \((x \text{ and } y \text{ components independent})\)

• Demonstrations

• The Range Equation

• Sample Problems
Projectile Motion

**x components**

\[ v_{0x} = v_0 \cos \theta_0 = v_x \]

\[ a_x = 0 \]

**y components**

\[ v_{0y} = v_0 \sin \theta_0 \neq v_y \]

\[ a_y = -9.8 \text{ m/s}^2 \]

\[ t \text{ is common to } x \text{ and } y \]

No \( t_x \) or \( t_y \)!
Range equation

\[ R = v_{0x}t + \frac{1}{2}a_xt^2 = (v_0 \cos \theta_0)t \]

\[ y = 0 = v_{0y}t + \frac{1}{2}a_yt^2 = v_0 \sin \theta_0 t - \frac{1}{2}gt^2 \]

\[ t = \frac{2v_0 \sin \theta_0}{g} \]

\[ R = \frac{2v_0^2}{g} \cos \theta_0 \sin \theta_0 = \frac{v_0^2}{g} \sin 2\theta_0 \]
A stone is catapulted at time $t = 0$ with an initial velocity of magnitude 20.0 m/s and at an angle of 40.0° above the horizontal.

What are the magnitudes of the (a) horizontal and (b) vertical components of displacement from the catapult site at $t = 1.10$ s?

(c) How far from the starting point ($x$-direction) does the stone land?
You throw a ball toward a wall at speed 25.0 m/s and at an angle 40° above the horizontal. The wall is a distance \( d = 22.0 \) m from the release point of the ball.

(a) How far above the release point does the ball hit the wall?

(b) With what horizontal and vertical components of velocity does the ball hit the wall?

(c) When the ball hits the wall, has it passed its highest trajectory?