Projectiles

- Projectile motion is a combination of horizontal and vertical motion
- Assume zero air resistance
- Horizontal velocity is constant
- Vertical acceleration is constant

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Equations

- Use same equations as for rectilinear motion
- Typically solve for time in the air, then solve for horizontal distance, maximum height, or initial velocity

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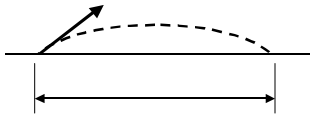
Sample Problem

- A ball is shot from a tube at an initial velocity of 88 ft/s @ 30°. How high and how far will it go?



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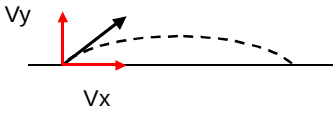
Determine Velocity Components

- Vx = 88 ft/s x cos 30°
- Vy = 88 ft/s x sin 30°



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Determine Time of Flight

- Determine when s = zero (hits ground) in the vertical mode.

$$s_y = v_y t + \frac{1}{2} a t^2$$

$$0 = (88\ ft/s \cdot \sin 30)t - \frac{1}{2}(32.2\ ft/s^2)t^2$$

$$0 = (44\ ft/s)t - (16.1\ ft/s^2)t^2$$

$$t = 0 \ \ and \ \ t = 2.7 \ \text{sec}$$

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Determine Horizontal Distance

- Note: horizontal travel is at a constant velocity

$$s_x = s_0 + v_x t$$

$$s_x = 0 + [(88\ ft/s)\cos 30] \times 2.7 \text{ sec}$$

$$s_x = 206\ ft.$$

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Maximum Altitude

- Maximum height occurs when vertical velocity = zero
- Need to find time to reach maximum altitude (half of total time)
- Then solve for vertical distance

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Solved Equations

$$v = v_0 + at$$

$$0 = (88\ ft/s \times \sin 30) - (32.2\ ft/s^2)t$$

$$t = 1.37\ \text{sec}$$

$$s_y = s_0 + v_y t + \frac{1}{2}at^2$$

$$s_y = 0 + (44\ ft/s \times 1.37 s) - (16.1)(1.37)^2$$

$$s_y = 30\ ft$$

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