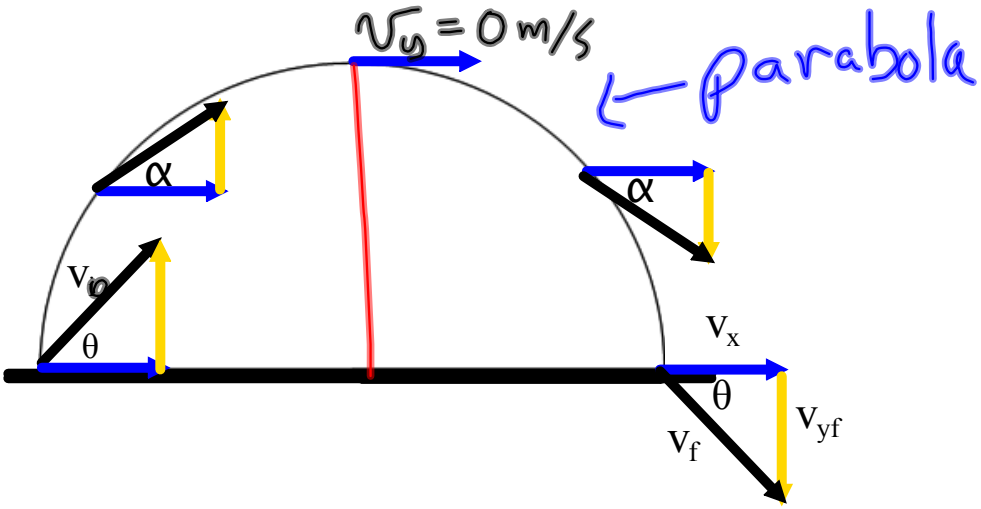
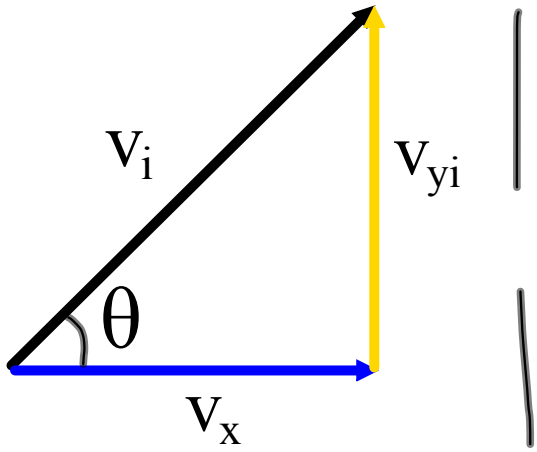
Projectiles Fired At An Angle

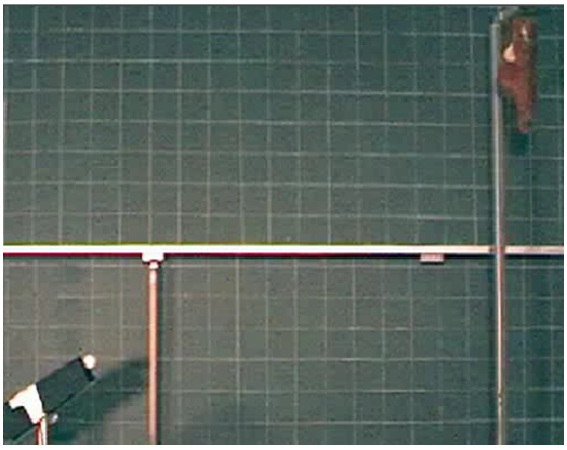
horizontal velocity -> **constant**
vertical velocity -> **changes**

Trajectory





The Monkey and the Hunter



Example: An arrow is shot at an angle of 30.0 with the ground. It has a speed of 49 m/s. Assuming the arrow is shot from ground level and it lands on the ground, answer the following questions.

a) How high will the arrow go? (31 m)
b) Assuming the arrow lands on the ground, what is its range? (2.1×10^2 m)

a) $v_x = 49\cos 30^\circ$ $\quad v_{oy} = 49\sin 30$

$v_x = 42.4\ m/s$ $\quad v_{oy} = 24.5\ m/s$

$v_{fy} = 0\ m/s$ @ max height

$g = -9.81\ m/s^2$; $d_o = 0\ m/s$

$d_y = ?$

$$v_{fy}^2 = v_{oy}^2 + 2a(d_f - d_o)$$

$$0 = (24.5)^2 + 2(-9.81)d_f$$

$$0 = 600.25 - 19.62 d_f$$

$$-600.25 = -19.62 d_f$$

$$\boxed{30.6\ m = d_f}$$

b) $d_x = ?$ $\quad v_x = \frac{d_x}{t}$

Find t

$g = -9.81\ m/s^2$ $\quad v_{oy} = 24.5\ m/s$

$v_{fy} = -24.5\ m/s$

* Back to launch height

$$g = \frac{v_{fy} - v_{oy}}{t}$$

$$-9.81 = \frac{-24.5 - 24.5}{t}$$

$$-9.81 = \frac{-49}{t} \longrightarrow -9.81t = -49$$

$$t = \frac{-49}{-9.81} = 5.0\ s$$

$$v_x = \frac{d_x}{t}$$

$$42.4 = \frac{d_x}{5}$$

$$\boxed{212\ m = d_x}$$