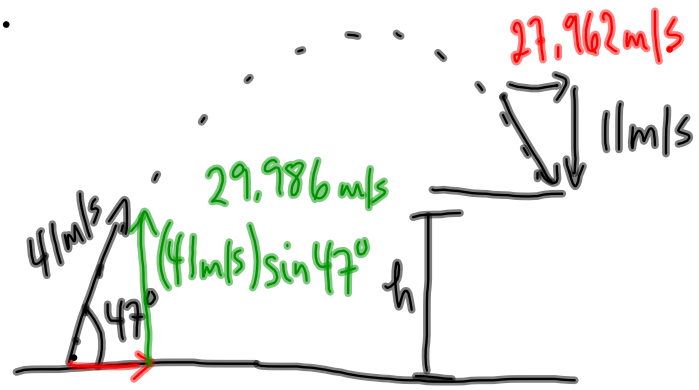
PP|543

10.



Vertically

$V_1 = +29.986\ m/s$

$V_2 = -11\ m/s$

$a = -9.81\ m/s^2$

$\Delta d = ?$

$$V_2^2 = V_1^2 + 2a\Delta d$$

$$\frac{V_2^2 - V_1^2}{2a} = \Delta d$$

$$\Delta d = \frac{(-11\ m/s)^2 - (29.986\ m/s)^2}{2(-9.81\ m/s^2)}$$

$\Delta d = 40\ m$

The fan is 40 m above the level that the ball was hit from.

A Special Projectile

A projectile that returns to the same level ($\Delta d_y = 0$)

Derive expressions for:
1. Δt
2. Δd_x (range)
3. max height.

Vertically (constant acceleration of $-g$)

$v_1 = v\sin\theta$
$\Delta d = 0$
$a = -g$
$\Delta t = ?$

$$\Delta d = v_1 \Delta t + \frac{1}{2}a(\Delta t)^2$$
$$0 = (v\sin\theta)\Delta t - \frac{g}{2}(\Delta t)^2$$
$$\Delta t\left(v\sin\theta - \frac{g}{2}\Delta t\right) = 0$$
$$\Delta t = 0 \quad \text{and} \quad v\sin\theta - \frac{g}{2}\Delta t = 0$$
$$v\sin\theta = \frac{g}{2}\Delta t$$

① $$\Delta t = \frac{2v\sin\theta}{g}$$

Horizontally (constant velocity)

$\Delta t = \frac{2v\sin\theta}{g}$
$v = v\cos\theta$
$\Delta d = ??$

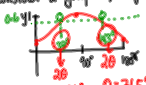
$$v = \frac{\Delta d}{\Delta t}$$
$$\Delta d = v\Delta t$$
$$\Delta d = (v\cos\theta)\left(\frac{2v\sin\theta}{g}\right)$$
$$\Delta d = \frac{(2\sin\theta\cos\theta)v^2}{g}$$

② $$\Delta d = \frac{v^2\sin 2\theta}{g}$$

$2\sin\theta\cos\theta = \sin 2\theta$
TRIG IDENTITY
(very exciting!!)

Maximum range occurs when $\theta = 45°$

Consider a graph of $y = \sin x$



$\theta = 18.5°$ $\theta = 71.5°$

There are two launch angles that will give the same value for Δd_x.
(They are complementary angles)

Vertically: (constant acc)

$v_1 = v\sin\theta$
$a = -g$
$\Delta d = ?$
$v_2 = 0$ (at the max height)
$\Delta t = \frac{1}{2}\left(\frac{2v\sin\theta}{g}\right) = \frac{v\sin\theta}{g}$

$$\Delta d = v_{ave}\Delta t$$
$$v_2^2 = v_1^2 + 2a\Delta d$$
$$0 = v_1^2 + 2a\Delta d$$
$$\Delta d = \frac{-v_1^2}{2a}$$
$$\Delta d = \frac{-(v\sin\theta)^2}{2(-g)}$$

max height → ③ $$\Delta d = \frac{v^2\sin^2\theta}{2g}$$

Summary:
1. time → $\Delta t = \frac{2v\sin\theta}{g}$
2. range → $\Delta d_x = \frac{v^2\sin 2\theta}{g}$
3. max height → $\Delta d_y = \frac{v^2\sin^2\theta}{2g}$

TO DO:
1. mp|547 look over
2. PP|549
3. Assignment (due Thurs) Op570|15-20
4. HW Probe (Mon) - PP|536-537 or PP|543
5. Quiz WED