Announcements (Oct 3)

1. **Homework due tonight by Midnight**
   (note about Tycho and significant figures)
   Office Hours today will be delayed.
   remark about study center.
2. **Clicker registration (via website)**
   http://faculty.washington.edu/storm/121C
   (note that I probably said …/phys121C …).
3. **Lab Manuals.**

Chapter 3 of Tipler & Mosca, section 2

Projectile Motion

1. Basic idea:

a.) **Start with Initial velocity vector, $\vec{V}_0$ -- usually the magnitude and elevation angle, θ, are used, but components could be too. Initial position is (x_0, y_0) at $t = 0$.**

b.) **Projectile proceeds with constant acceleration downward. (ignore air resistance.)**

c.) **Figure out distance and time to get somewhere from $\vec{V}_0$, or vice-versa.**

2. X – motion: (no x-acceleration)

a.) $v_{0x} = v_0 \cos(\theta)$

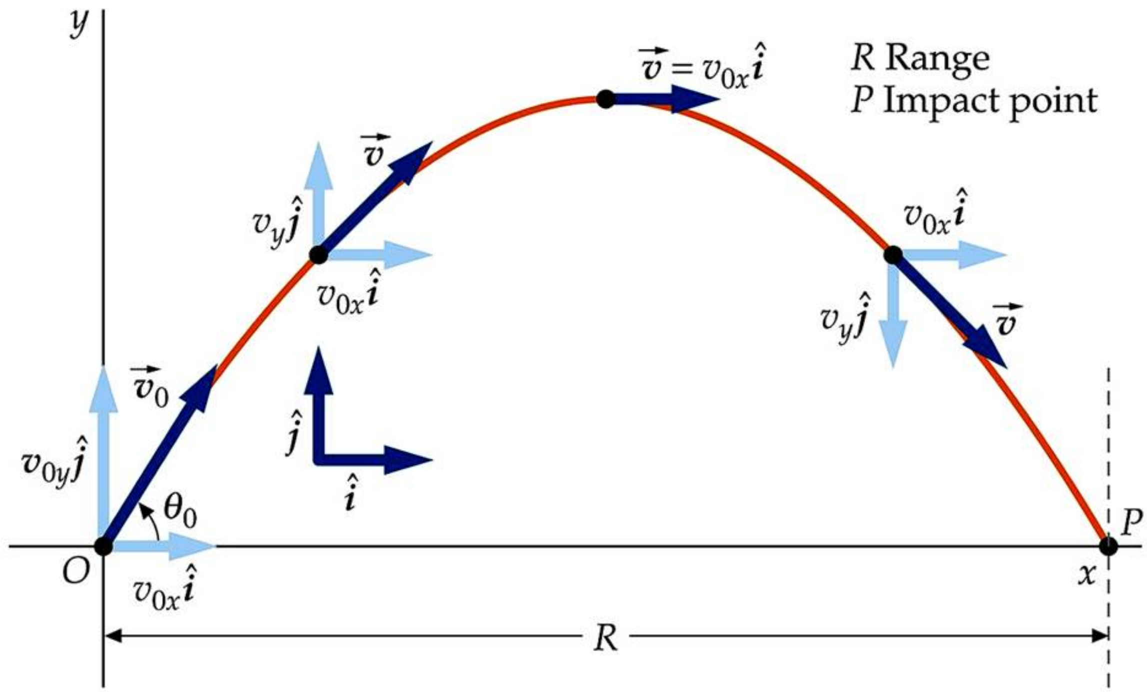
b.) so $x(t) = v_0 \cos(\theta)\, t + x_0$

3. Y – motion. (acceleration is *g* downward)

a.) $v_{0y} = v_0 \sin(\theta)$

b.) so $y(t) = v_0 \sin(\theta)\, t - \frac{1}{2} g t^2 + y_0$

4. Trajectory:



a.) instead of 2 equations, eliminate t, get y(x):

b.) from x motion, $t = \dfrac{x - x_o}{v_{ox}}$ **so**

$$y = y_0 + v_{0y}\left(\frac{x - x_0}{v_{0x}}\right) - \frac{1}{2}g\left(\frac{x - x_o}{v_{0x}}\right)^2$$

this is a parabola. If we start at $x_0 = 0$

$$y = y_0 + \frac{v_{0y}}{v_{0x}}x - \frac{1}{2}g\left(\frac{x}{v_{0x}}\right)^2$$

and if we plug in the elevation angle

$$y = y_0 + \frac{\sin\theta}{\cos\theta}x - \frac{1}{2}g\left(\frac{x}{v_0\cos\theta}\right)^2$$

c.) Example: At what x does $y = y_0$?

i) Quadratic, so 2 solutions. x = 0 (where we started) and

$$\frac{\sin\theta}{\cos\theta} = \frac{1}{2}g\frac{x}{v_0^2\cos^2\theta}$$ **which is**

$$x = \frac{2v_0^2\cos\theta\sin\theta}{g}$$

ii) More complicated if y_{final} not y_0 (need "roots of quadratic" formula).

iii) Could also solve for t when $y = y_0$ and then substitute into the x(t) equation.

iv) Examine using falling time, $v_{0x}t$

5. "Shoot the monkey"

projectile's $\vec{V}_0$ points at the monkey

a.) If $v_{0y} = 0$ (i.e. horizontal initial v)

i) Y motions for projectile and monkey are the same. (namely $y = -1/2\ gt^2$)

ii) so "monkey" and projectile fall the same amount. Projectile hits monkey

b.) If projectile fired at monkey at some angle.

i) In frame of Monkey, which is accelerating at g downward, projectile is moving in straight line. So projectile hits monkey.

ii) In frame of shooter, both monkey and projectile fall with same acceleration. Projectile falls below line to monkey's original position same amount as monkey falls.