Reminders 07-22-09:

- Read Chapter 6; *(make sure you thoroughly read through the chapters we cover)*
- 5th Webassign due Thursday 11:59PM
- Hand in 4th Assignment Problems Today
- ***Exam 3 Chapters 6-8 Next Thursday*** .

Objectives:

- 2D Motion
- Exam 2

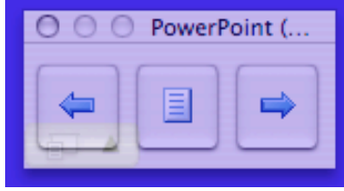
Projectile Motion

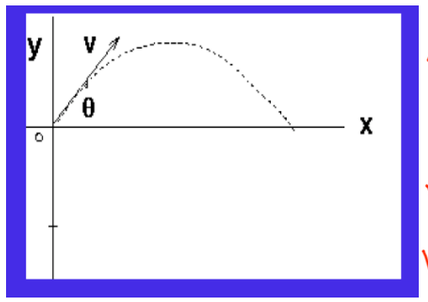
- What happens (ignore air friction)?
  - Now the initial velocity of the object has x and y-components, where

$v_{iy} = v_i \sin\theta$ (initial velocity in vertical dir.)

and

$v_{ix} = v_i \cos\theta$ (initial velocity in horizontal dir).





$\Delta y = 0$

$a = -9.80 \frac{m}{s^2}$

$V_{ix} = V_i \cos\theta$

$V_{iy} = V_i \sin\theta$

find t

$0 = V_i \sin\theta\, t - \frac{1}{2} g t^2$

$= t\left(V_i \sin\theta - \frac{1}{2} g t\right)$

0

$V_i \sin\theta - \frac{1}{2} g t = 0$

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

$t = \frac{2 V_i \sin\theta}{g}$

Find t another way

$V_{f\,y\,top} = 0$

$0 = V_i \sin\theta - g t_{up}$

$t_{up} = \frac{V_i \sin\theta}{g}$

but $t_{up} = t_{down}$

so $t = 2 t_{up} = \frac{2 V_i \sin\theta}{g}$

$\Delta x = V_i \cos\theta \left[\frac{2 V_i \sin\theta}{g}\right]$

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

$$\Delta x = \frac{v_i^2}{g}\left(2\cos\theta\sin\theta\right)$$

$$2\cos\theta\sin\theta = \sin 2\theta$$

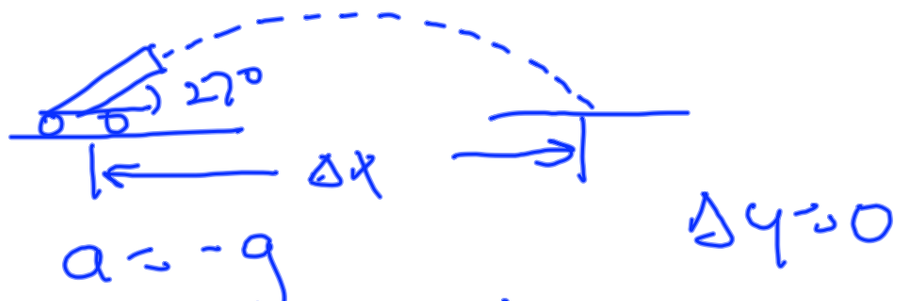
$$\Delta x = \frac{v_i^2}{g}\sin 2\theta$$

Range equation ($\Delta y = 0$)

max range at 45°

2 angles yield same range ($\theta_1 + \theta_2 = 90$)

- **A cannon fires a cannon ball on level ground. The cannon ball has a muzzle velocity of 201 m/s and was fired at an angle of 27° above the horizontal.**
  - **What is the range of this projectile?**
  - **What other elevation will give the same range?**



$a = -g$

$g = 9.80\ m/s^2$

$V_i = 201 \quad \theta = 27°$

$$\Delta x = \frac{V_i^2}{g}\sin 2\theta = \frac{\left(201\ \frac{m}{s}\right)^2}{9.80\ \frac{m}{s^2}}\sin 2(27)$$

$$= \frac{\left(201\ \frac{m}{s}\right)^2}{9.80\ m/s^2}\sin 54° = 3300\ m$$

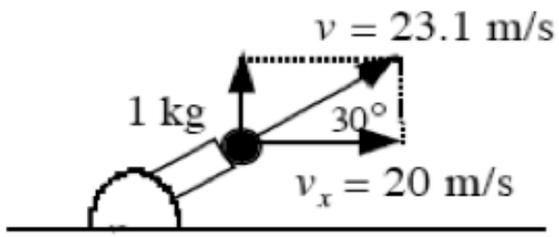
$$= 3.3\ km$$

$\theta = 90° - 27° = 63°$

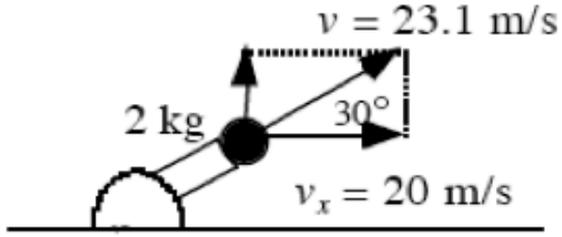
The pictures below depict cannonballs of two different masses projected upward and forward. The cannonballs are projected at various angles above the horizontal, but all are projected with the same horizontal component of velocity.

Rank according to the horizontal distance traveled by the balls.

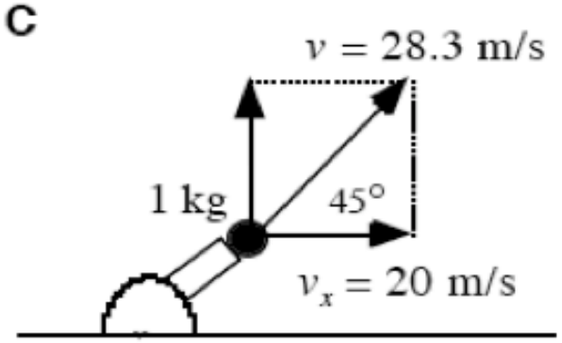
A



B

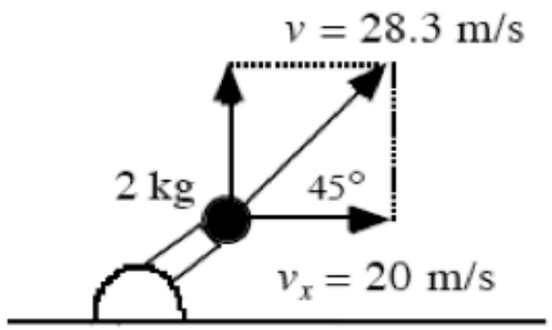


C

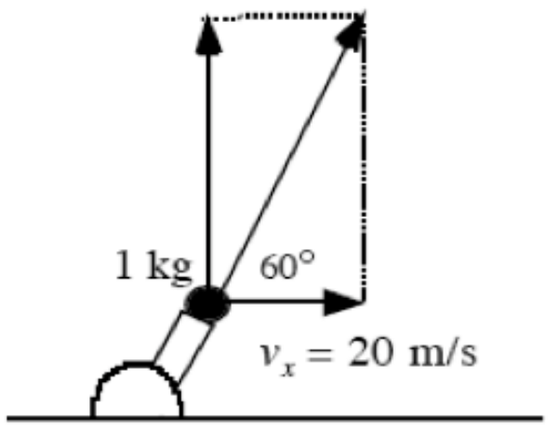


E & F yield largest Range!

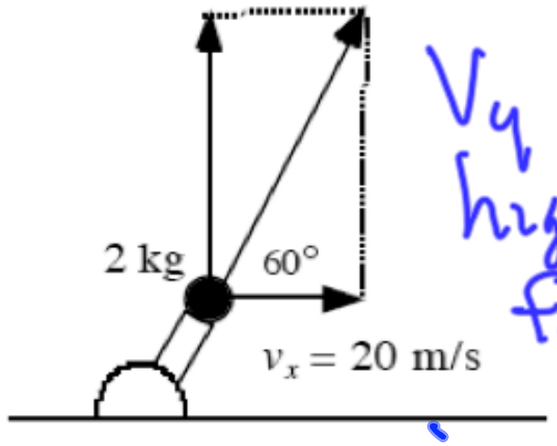
D



E



F



V_y is highest for E & F

Largest 1_____ 2_____ 3_____ 4_____ 5_____ 6_____ Smallest

All distances traveled are the same. _____

Please carefully explain your reasoning.