Announcements – 12 Sep 2013

1. **Exam 1 starts today!**
   a. Ends Wed, 2 pm. Late fee after Tues, 2 pm. Closed Saturday!
   b. Covers chapters 2, 3 (plus one question on units)
   c. Covers through today's lecture
   d. Covers through HW 4 (due Tues, but I recommend you do it earlier!)
   e. No time limit; I expect around an hour and a half on average
   f. Closed notes, closed book
   g. First page is very like the "List of equations" in syllabus
   h. All calculators allowed, please don't store "illegal" info.
   i. To study, I recommend you review
      i. HW problems
      ii. Class lectures - including clicker quizzes, worked problems, warmup questions, and demos
      iii. "Chapter Summaries of Mathematical Relations" in syllabus
      iv. Exams posted to website

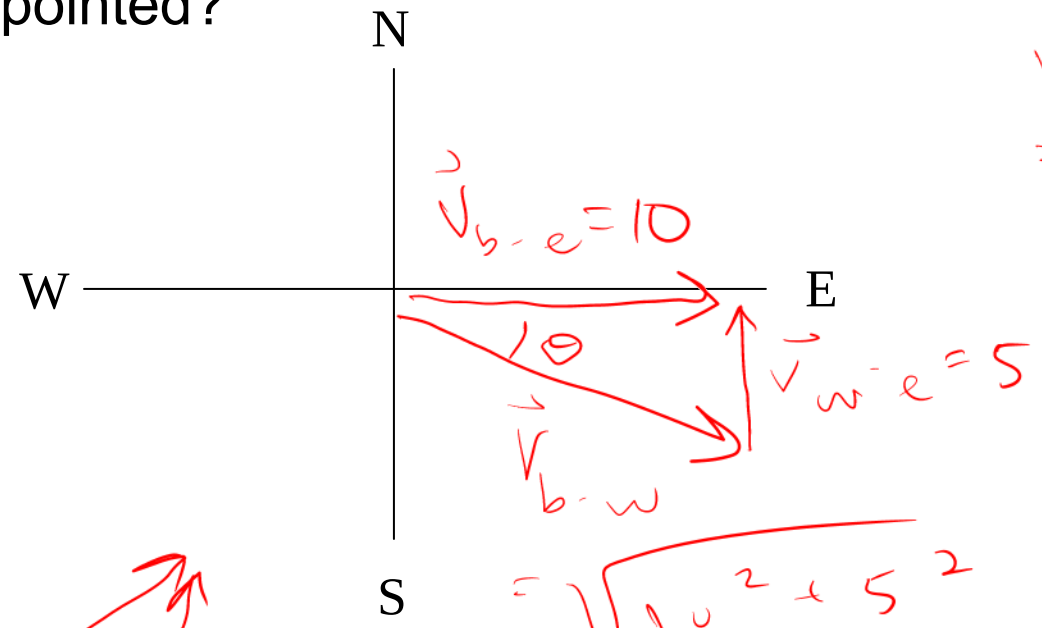
2. **TA-led exam review session -** Tonight, 6:30 – 8 pm, W140 Benson

3. **A Cappella Auditions!** – Many of the groups in the BYU a cappella club are having a joint audition Tuesday at 6 pm, Varsity Theater. All parts needed, male and female. Prepare 30-60 seconds of music to sing. They will also do range checks and tonal memory checks.
→ facebook page: www.facebook.com/acappellaclub
→ talk to me after class or send me an email if you want more info about the A Cappella Club!

4. **Jacob Buchanan**: are you here? (section 3)

Continued from last time…

A captain wants her boat to sail exactly **E** on a map, with a speed relative to the *earth* of 10 mph. There is a 5 mph current to the **N**? How fast will the boat have to go, and in what direction will the boat need to be pointed?



$\vec{V}_{b\text{-}e} = \vec{V}_{b\text{-}w} + \vec{V}_{w\text{-}e}$

$\vec{V}_{b\text{-}e} = 10$

$\vec{V}_{w\text{-}e} = 5$

$\vec{V}_{b\text{-}w}$

$= \sqrt{10^2 + 5^2}$

$= 11.1$ mph

$\tan\theta = \frac{5}{10}$

$\theta = \tan^{-1}\left(\frac{5}{10}\right)$

$= 26.6°$

Answer: 11.18 m/s, 26.6° south of east

2D Motion: Basic Concept

Motions in perpendicular directions are **independent**

Demo: Cart & ball

Demo: “Shooter & dropper” (2 balls: one shot & one dropped)

Dr. Stokes’ flash animation: baseball velocity components
http://stokes.byu.edu/teaching_resources/baseball_flash.html

From Thursday's warmup

Which geometrical shape does a 2D projectile follow?

a. line
b. circle
c. ellipse
d. parabola
e. hyperbola

Why is that?

http://en.wikipedia.org/wiki/Parabola

http://www.aapt.org/Programs/contests/pc08.cfm

Today's Lecture

Dr. Stokes' flash animation: baseball velocity components
http://stokes.byu.edu/teaching_resources/baseball_flash.html

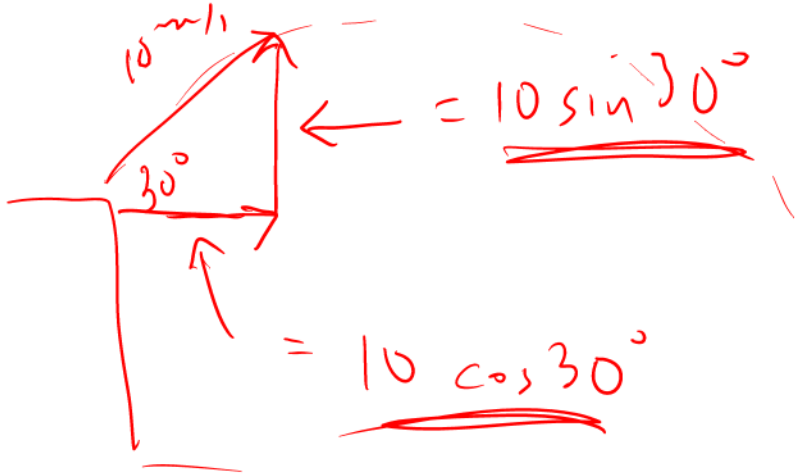
Equations

x-direction

$$v_x = v_{0x} + a_x t$$

$$x = x_0 + v_{0x} t + \tfrac{1}{2} a_x t^2$$

$$v_{fx}^{\ 2} = v_{0x}^{\ 2} + 2 a_x \Delta x$$



y-direction

$$v_y = v_{0y} + a_y t \longrightarrow v_y = v_{0y} - gt$$

$$y = y_0 + v_{0y} t + \tfrac{1}{2} a_y t^2 \longrightarrow y = y_0 + v_{0y} - \tfrac{1}{2} g t$$

$$v_{fy}^{\ 2} = v_{0y}^{\ 2} + 2 a_y \Delta y \longrightarrow v_{fy}^{\ 2} = v_{0y}^{\ 2} - 2 g \Delta y$$

2-D Projectile motion:

projectile: an
object in free fall

$a_x = 0$ $\quad$ $a_y = -g$

$(= -9.8 \text{ m/s}^2)$

Clicker Quiz

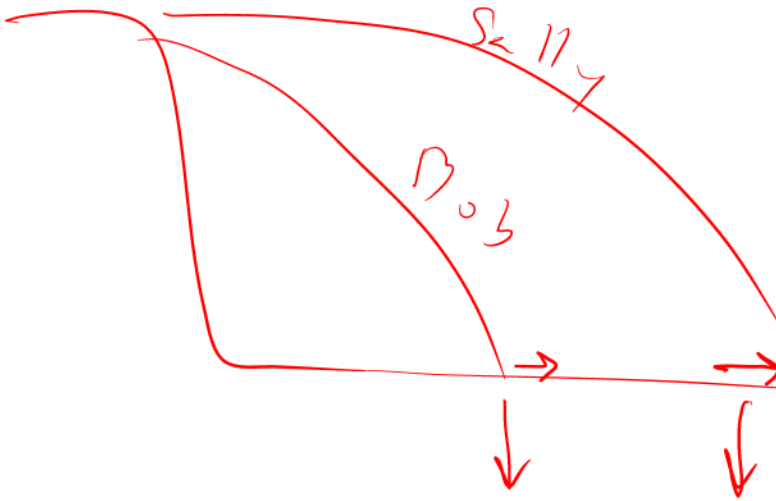
Sally and Bob each throw a rock horizontally from a cliff. Sally throws her rock hard. Bob throws his more easily.

Q1: Which spends the longest time falling?

a. Sally's
b. Bob's
c. same

Q2: Which rock is going fastest (vector magnitude) just before it hits the ground?

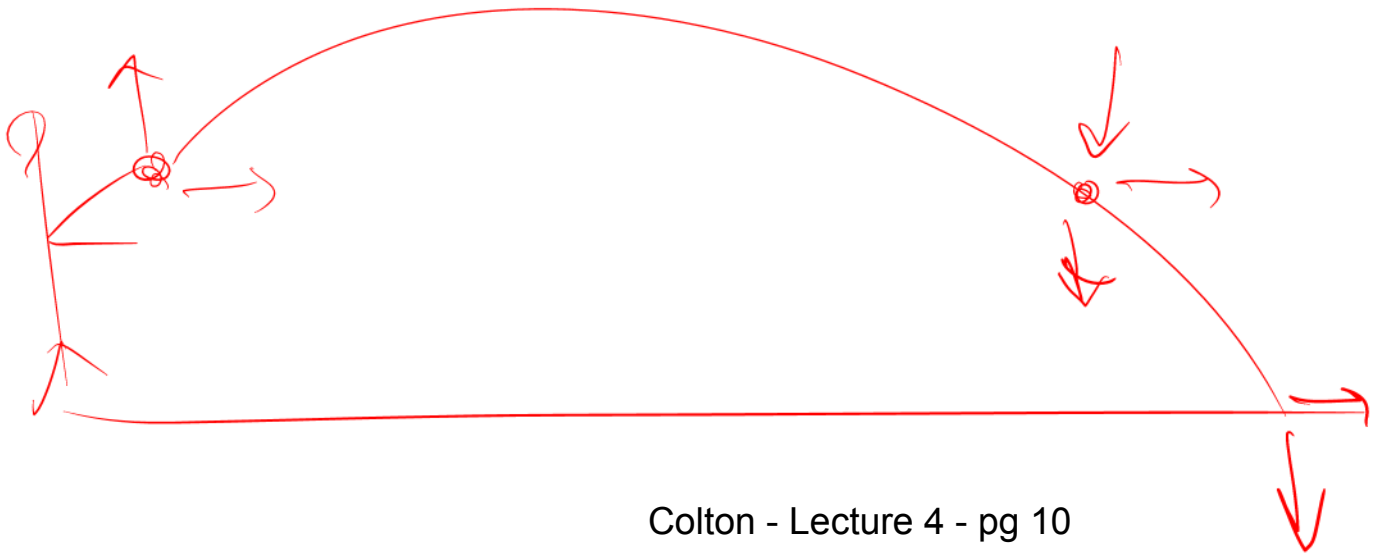
a. Sally's
b. Bob's
c. same



Warmup Question

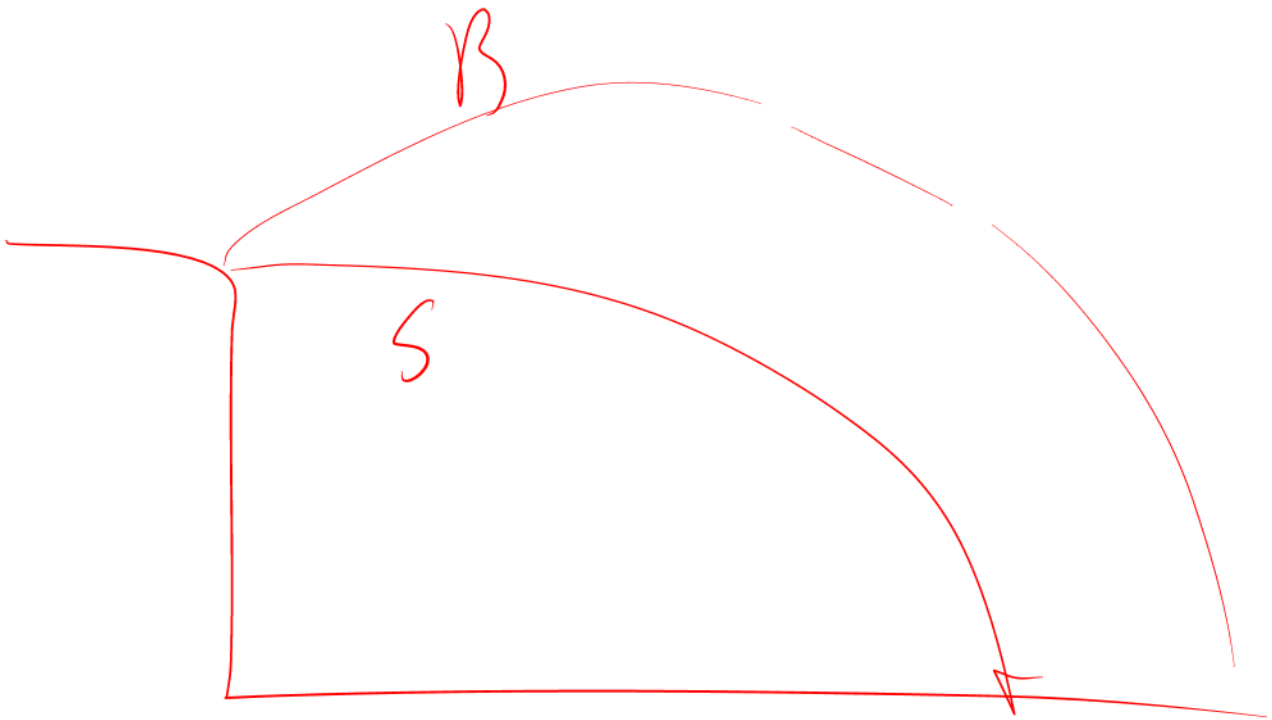
I throw a ball at an upward angle across a flat field. Neglecting air resistance, at what part of its path does the ball have its maximum speed?

a. right before it hits the ground
b. halfway to the top
c. at the top of its path
d. right after it leaves my hand
e. There's not enough information to say



Question

Sally throws a rock horizontally from a cliff. Bob throws his at an angle above horizontal. They throw at the same speed. Whose hits first?



Demo: Monkey gun

Clicker quiz: What will happen?

A. Bullet will pass over monkey
B. Bullet will pass under monkey
C. Bullet will hit monkey

Warmup question

A ball is thrown upwards at an angle. Ralph thought that since the ball is still moving upwards for a while after it is thrown, it must have some upwards acceleration in the air after it leaves my hand that continues to propel the ball. I told him "No, that's not quite what is happening." Can you help Ralph understand what *is* happening?

"Pair share"–I am now ready to share my neighbor's answer if called on.

a. Yes

Warmup question

In 2D projectile problems, usually you use equations from one of the directions to figure out the time the projectile is in the air. (Look over the book examples, see if they do this.)

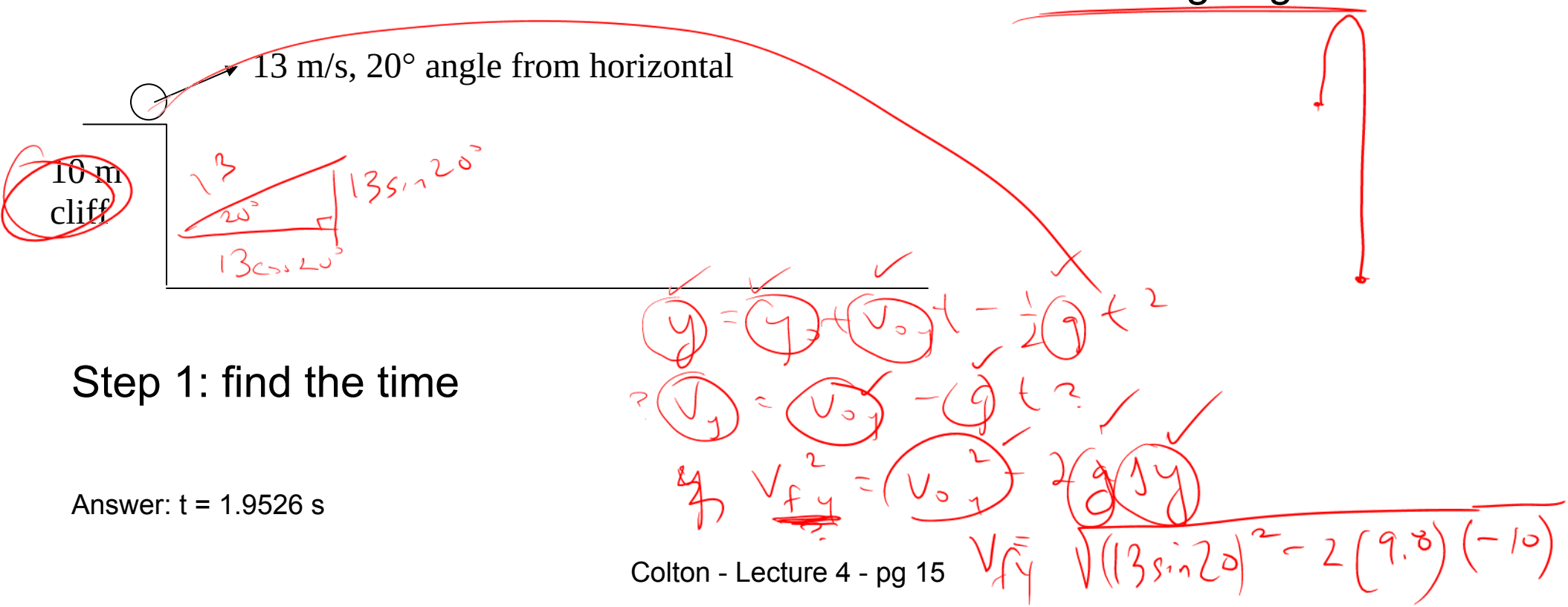
a. True
b. False

Range problems

Usually use the **y-equations** to figure out the **time** it takes
→Then use the **x-equations** to figure out **how far** it has traveled in that time

Exception: Sometimes the nature of the problem means the x-equations determine the time it takes—for example, if the projectile runs into a wall

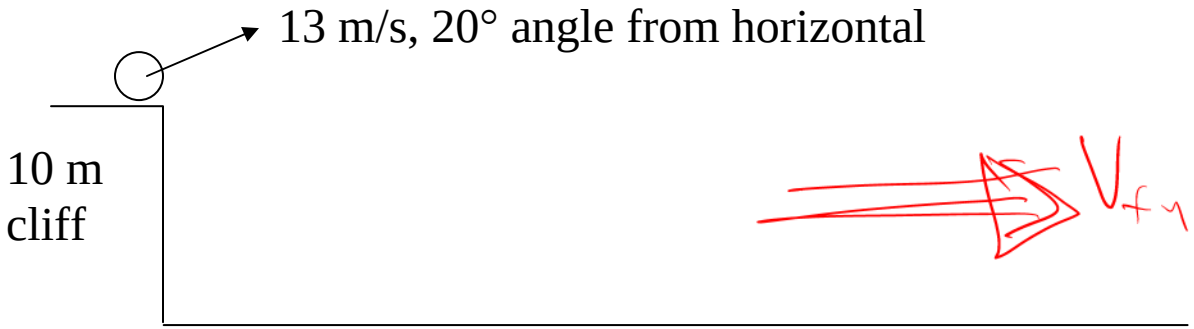
Worked Problem: Where does the ball hit? How fast is it going then?



Step 1: find the time

Answer: t = 1.9526 s

Worked Problem, cont.: Where does the ball hit? How fast is it going then?



$v_{fy} = -14.69$ m/s

$v_{fy} = v_{0y} - gt$

$t = \frac{v_{0y} - v_{fy}}{g}$

$= \frac{(13 \sin 20^\circ) - (-14.69)}{9.8}$

$= 1.95$ sec

Step 2: use the time

$x = x_0 + v_{0x} t$

$= 0 + (13 \cos 20^\circ)\frac{m}{s}(1.95 \text{ sec})$

$= 23.85$ m

$13 \cos 20^\circ$

14.69 m/s

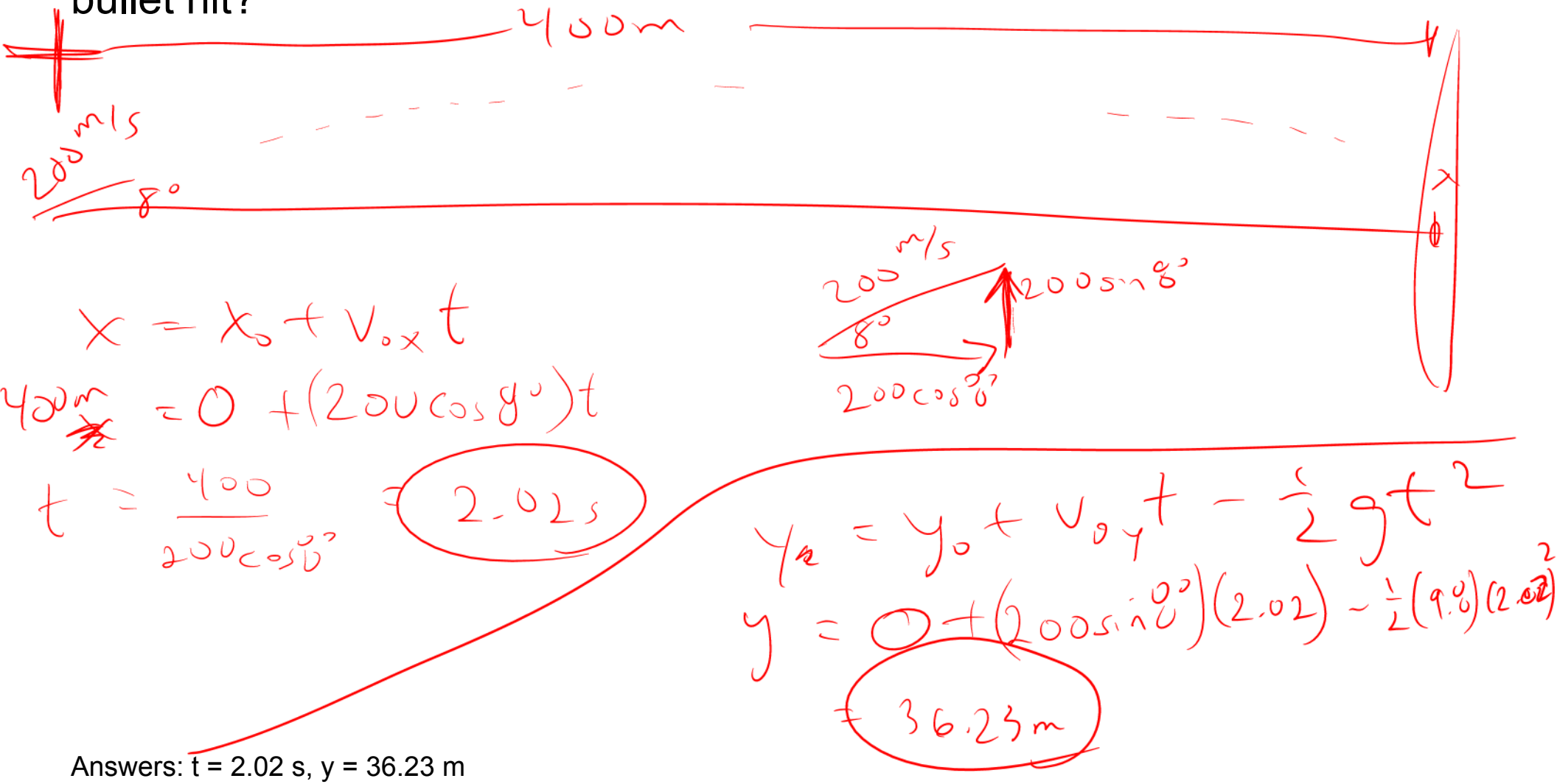
pyth. theorem

19.10 m/s

Answers: t = 1.9526 s, x = 23.85 m, v_{fx} = 12.22 m/s, v_{fy} = 14.69 m/s, $v_{f,tot}$ = 19.10 m/s

Worked Problem

A rifle at the same height as a very large target tries to hit the center, 400 m away. The rifle is shot at 8º above the horizontal. The initial velocity of the bullet is 200 m/s. How far above/below the center does the bullet hit?



Answers: t = 2.02 s, y = 36.23 m

Maximum range

Warmup question: Neglecting air resistance, at what angle should you throw a ball on a flat field in order to get the maximum range? (also neglecting height of person)

a. 30°
b. 45°
c. 60°
d. It depends on the initial speed

Air Resistance

What if you *do* worry about **air resistance**?

Simulation:
http://phet.colorado.edu/new/simulations/sims.php?sim=Projectile_Motion

Exam Review:

→ Some details about what is on the actual exam

→ Problems requested on warmup