Announcements – 9/8/09

0. Meet our T.A.! Sara Hyde

1. Course homepage via: **physics.byu.edu → Class web pages → Physics 105 (Colton J)**

2. (Class-wide email sent) Iclicker problem from last time—scores didn't get recorded. Clicker quizzes from lectures 1 and 2 will show up as "0 out of 0" on your grade report. They won't count against your free clicker quizzes.

3. **Second homework assignment** is due tonight at 11:59 pm.
   a. If you missed the first one, you do get three free late assignments (all other late work is counted 50%).
   b. HW 3 is due Thursday night.

4. **Exam 1 starts Thursday!**
   a. We'll finish up discussing some 2D kinematics problems the first half of Thursday lecture, then do exam review for the second half of the lecture.

5. TA-led **exam review session** Thursday, 7:00 - 8:30 pm, in C-215 ESC

6. HW 1 solutions posted in glass cases in hallway next to Tutorial Lab, across from "turn in boxes" (near N357 ESC)
   → other HW solutions will be posted 1-2 days after the HW was due

Which part of today's assignment was particularly hard or confusing?

The section on relative velocity.

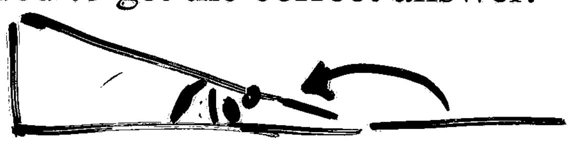
This would be so much easier with Calculus. How willing are you to review a bit of calculus in or out of class (maybe for a group)?

Can the projectile be something like a car? Where it has an initial velocity but still gains velocity despite gravity.

I dont quite understand how your acceleration can be changing from positive to negative as you travel around a corner or curve in your car? Or did i just totally get that wrong.

→ more difficult!

Why sometimes 180 degrees must be added to get the correct answer.



General comments:

Yikes!! This chapter was a big jump from what we were learning, but much more interesting than I ever expected Physics to be. It may just be my favorite science course this semester which was unexpected.

I'm a history major, but at the moment, this is my most favorite, manageable class.

I am really enjoying the class. Thanks, Dr. Colton.

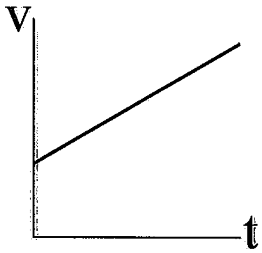
can you explain limits a little more, they are slightly confusing

i like the google group :)

Can we go over last week's homework in class?

Review Equations

For **constant acceleration**…



$$v_{ave} = \frac{v_0 + v_f}{2}$$

"Three basic kinematic equations"

velocity-time: $\boxed{v = v_0 + at}$ (v vs. t = straight line)

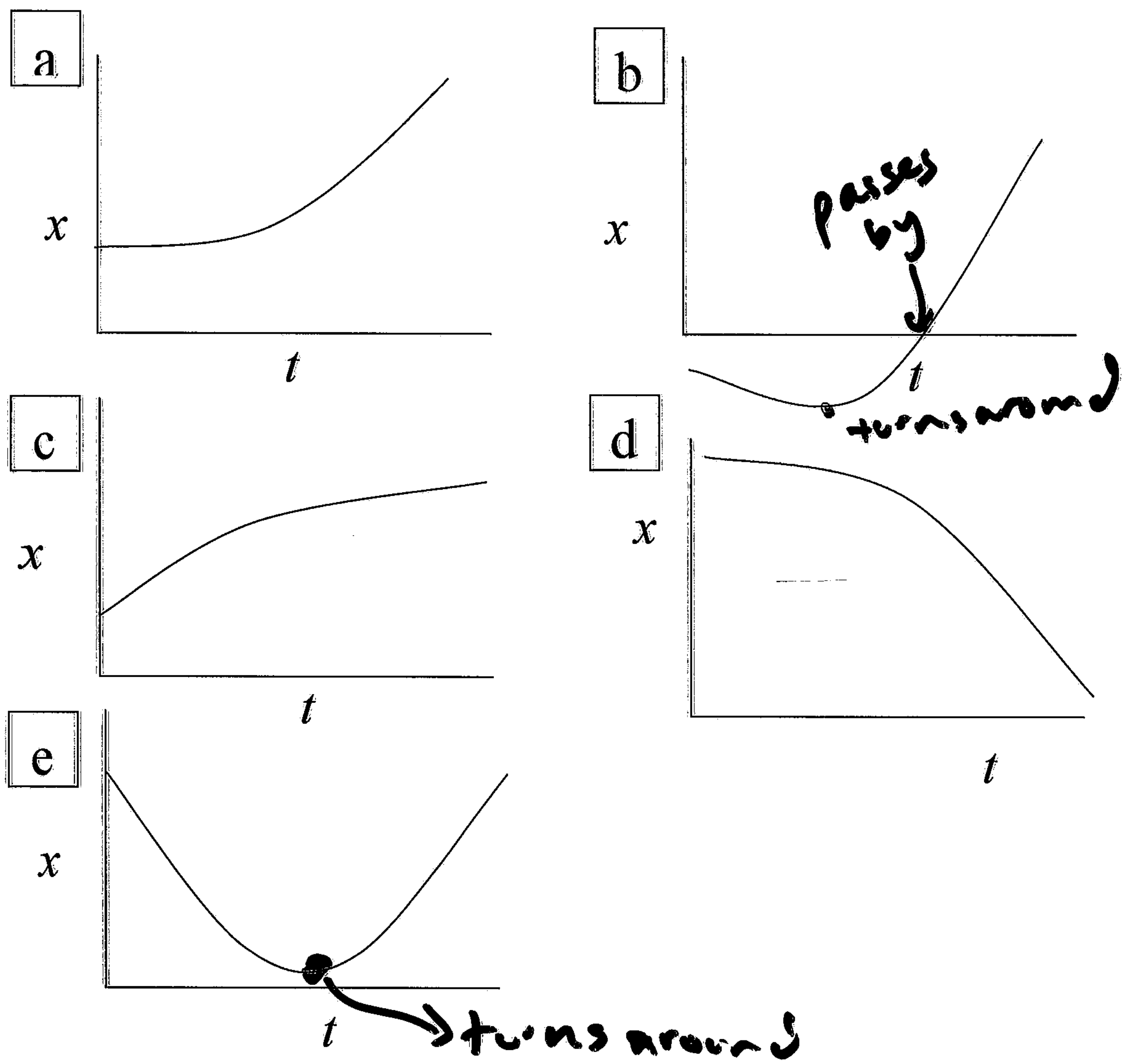
position-time: $\boxed{x = x_0 + v_0 t + \frac{1}{2}at^2}$ (x vs. t = parabola)

velocity-position: $\boxed{v_f^{\,2} = v_0^{\,2} + 2a\Delta x}$

Freefall: Penny & Feather demo
"Milkdrop" demo

The "Moving Man" applet:

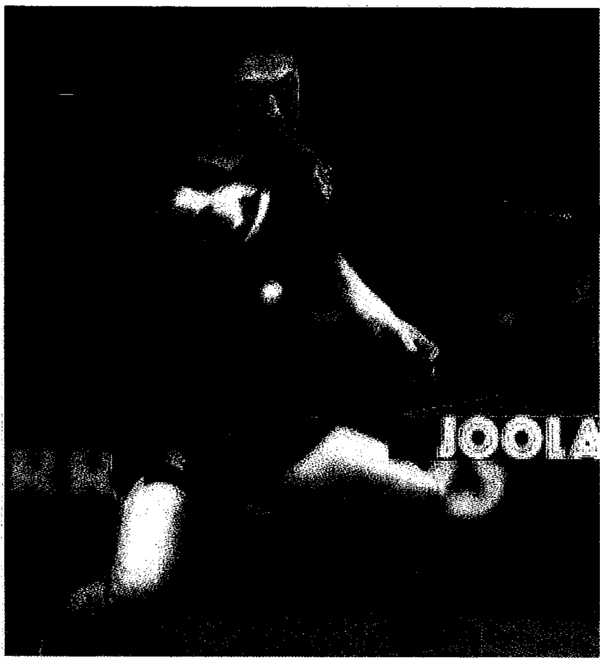
http://phet.colorado.edu/new/simulations/sims.php?sim=The_Moving_Man



Clicker quizzes: There is a lamppost at $x = 0$. Which x vs t curve describes:

Q1. a car **slowing down** as it moves **away** from the lamppost C
Q2. a car moves **toward** the lamppost, but **slows down** and **turns around** and speeds up E
Q3. a car **speeding up** as it moves **toward** the lamppost D
Q4. a car that moves away from the lamppost, turns around and **passes** the lamppost B

Table Tennis



Ma Lin
2008 Olympic champion

Question: What is the direction of the ball's acceleration during the contact (hit) between paddle and ball?

A. right
B. left
C. zero

Clicker quiz: What is the direction of acceleration of the ball while traveling to the right, and slowing down due to air resistance? (same choices)

Clicker quiz: What if the ball were tied to a bungee cord connected to his paddle… What is the direction of acceleration at the instant the ball is stopped by the elastic and about to start coming back? (same choices)

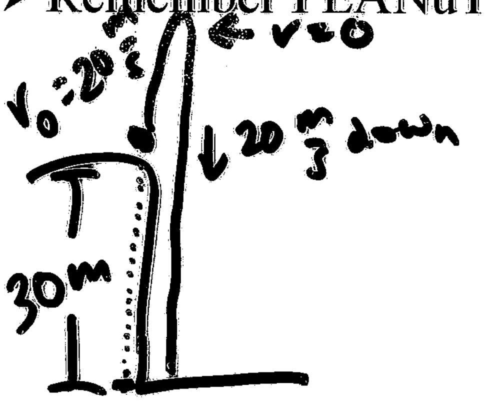
Worked Problem: A rock is thrown upward off a cliff 30 m high, with an initial velocity of 20 m/s.

a) How long does it take to reach the top of its path?

b) What is the velocity just before it hits the ground (30 m below the cliff)?

c) How long does it take to hit the ground?

- Remember PEANuT



$$y = y_0 + v_0 t + \frac{1}{2} a t^2$$

$$v = v_0 + at$$

$$v_f^2 = v_0^2 + 2a\Delta y$$

(a) $v = v_0 + at$

$$0 = 20 - (9.8)t$$

$$t = \frac{20}{9.8} = \boxed{2.04\ s}$$

(b) $v_f^2 = v_0^2 - 2g\Delta y$

$$v_f^2 = 20^2 - 2(9.8)(-30)$$

$$v_f = \sqrt{}$$

$$v_f = \boxed{31.4\ m/s} \text{ downwards}$$

(c) $y = y_0 + v_0 t - \frac{1}{2} g t^2$

$$-30 = 0 + 20t - \frac{1}{2}(9.8)t^2$$

$$4.9t^2 - 20t - 30 = 0$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$t = \frac{-(-20) \pm \sqrt{(-20)^2 - 4(4.9)(-30)}}{2(4.9)}$$

$$\boxed{t = 5.25\ s}$$

throw out negative

Vectors: Magnitude + Direction

30 m/s NE

<u>Examples:</u>

Velocity
Acceleration

Displacement? ✓
Position? ✓

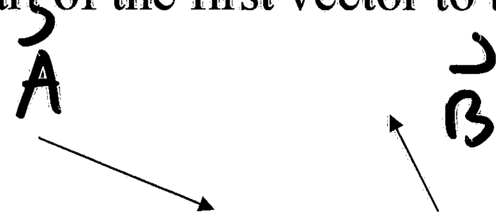
(later) Forces
(in Physics 106) Electric field, magnetic fields

<u>More obscure:</u>
Wind speed
Heat flow
Etc.

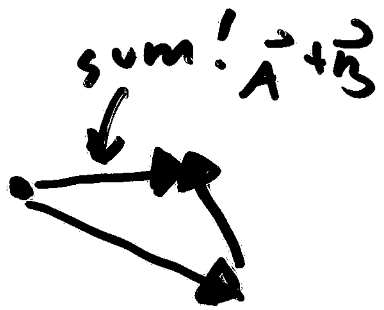
Represented by Arrows

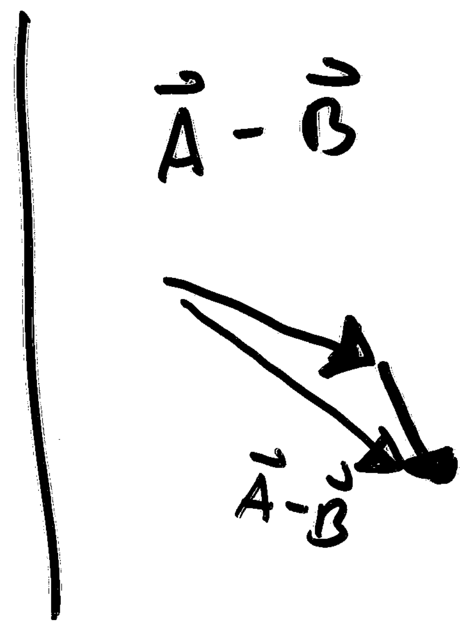
Adding Vectors Graphically: "Tip to Tail"

- Draw the first arrow starting from the origin
- **Begin the next vector starting with its tail where the tip of the previous vector leaves off:** "tip-to-tail"
- Connect up more arrows the same way, if you have additional vectors to add.
- The sum is an arrow from the start of the first vector to the end of the last vector.



Example: Add these two vectors



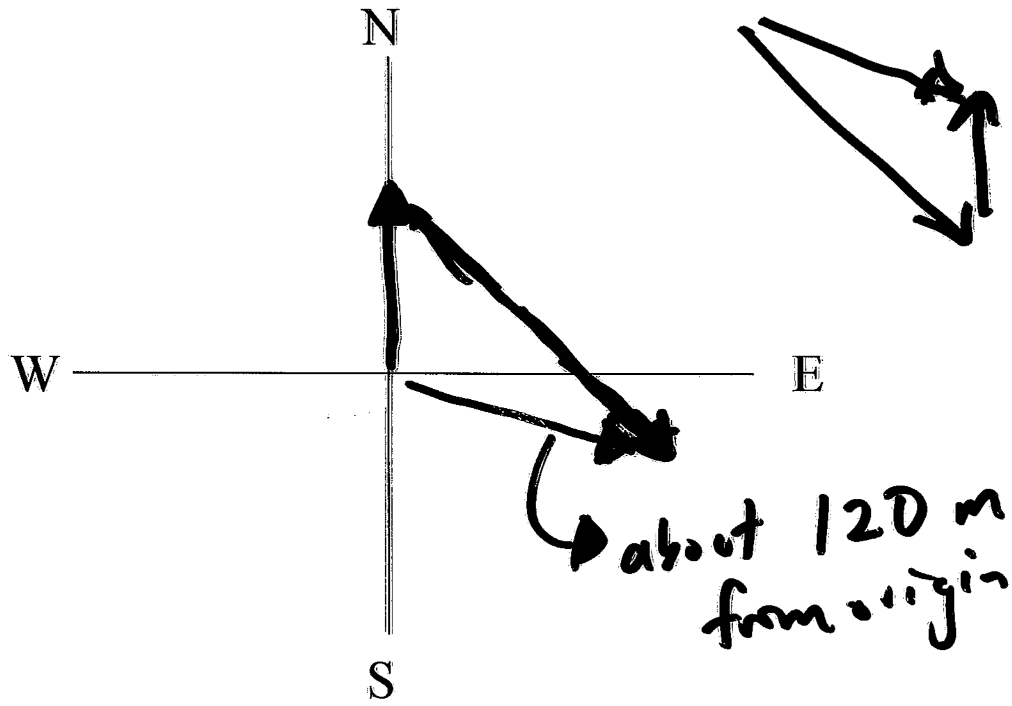


$\vec{A}-\vec{B} = \vec{A} + (-\vec{B})$

Guidance:

- A **negative vector** points in the opposite direction.
- Be sure all vectors are drawn to scale

Worked Problem: A student walks 100 m north then 200 m south-east. Find her final displacement vector relative to the origin, graphically.



From warmup: It doesn't matter which order you add two vectors together, you will get the same sum either way.

a. true
b. false

Relative velocities

From warmup: A man on a treadmill is walking at 1.5 m/s to the left. The treadmill is going at 2 m/s to the right. If you are standing still, it looks like the man is moving:

a. 0.5 m/s left
b. 3.5 m/s left
c. stationary
d. 0.5 m/s right
e. 3.5 m/s right

← left 1.5
→ right 2.0
→ right .5 m/s

Colton's "one size fits all" relative velocity equation

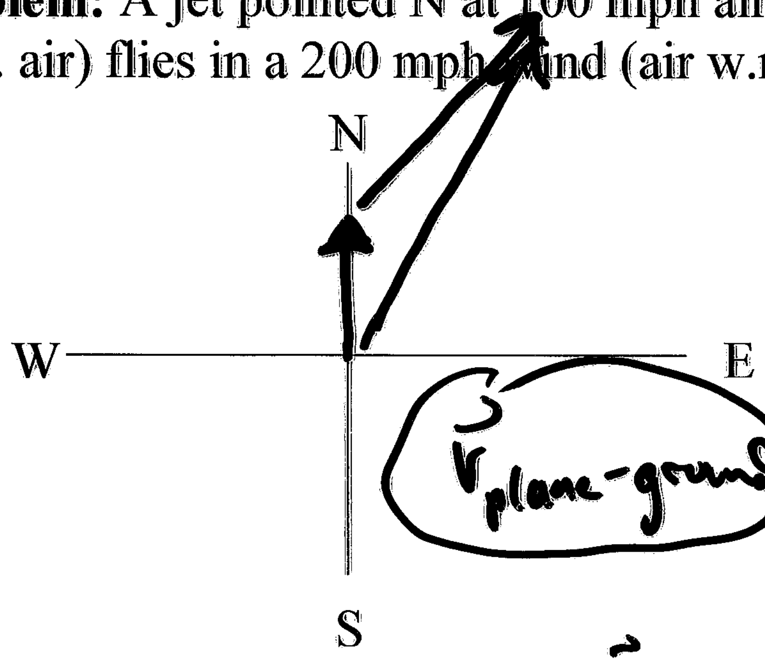
$$\vec{v}_{a\text{-}c} = \vec{v}_{a\text{-}b} + \vec{v}_{b\text{-}c}$$

- Read $v_{a\text{-}c}$ as "velocity of object *a* with respect to object *c*"
- These are vectors!

In this case

$$\vec{v}_{man\text{-}ground} = \vec{v}_{man\text{-}treadmill} + \vec{v}_{treadmill\text{-}ground}$$

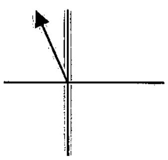
Problem: A jet pointed N at 100 mph airspeed (v of plane w.r.t. air) flies in a 200 mph wind (air w.r.t. ground) going NE.

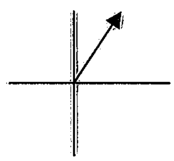


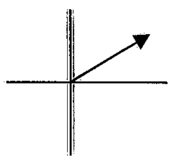
$\vec{v}_{plane-ground} = \vec{v}_{plane-air} + \vec{v}_{air-ground}$

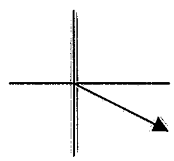
$\vec{v}_{air-ground} = \vec{v}_{p-g} - \vec{v}_{p-a}$

Clicker quiz: What is the jet's true bearing (velocity with respect to the ground)?

a. 

b. 

c. 

d. 

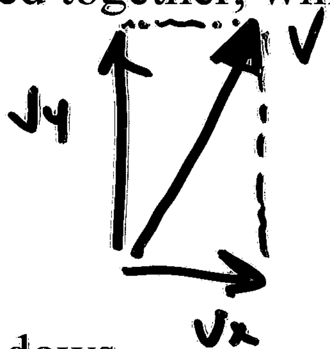
Question: How would you figure out the jet's total velocity (magnitude)?

Vector components

From warmup: Ralph is confused about how his book defined the components of a vector. The book says, "The components of a vector are the projections of the vector along the coordinate axes". What can you tell Ralph to help him understand what the word "projections" means in this context?

Answer from the class:
065--------------------------
Projections refers to the arrows that extend along the coordinate axes, which if added together, will add up to equal the vector.

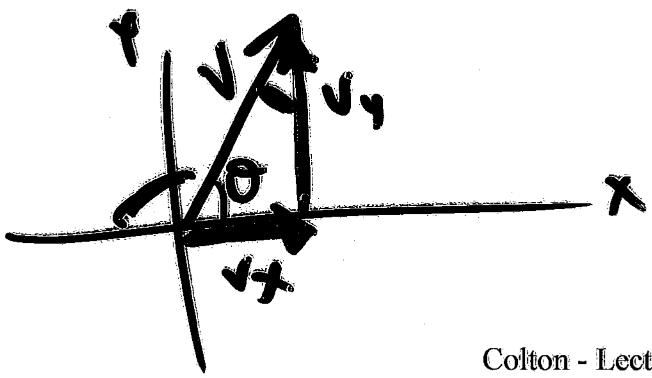
$V_x + V_y \neq V$



Colton's advice: think of shadows

Vector web demo: http://phet.colorado.edu/sims/vector-addition/vector-addition_en.html

Getting components from vector: $\cos\theta = V_x / V$

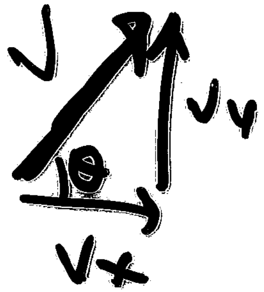


$V_x = V\cos\theta$

$\sin\theta = \frac{V_y}{V}$

$V_y = V\sin\theta$

Getting vector from components:



$$v = \sqrt{v_x^2 + v_y^2}$$

$$\tan\theta = \frac{v_y}{v_x} \rightarrow \theta = \tan^{-1}\frac{v_y}{v_x}$$

if you're careful!

When adding vectors, never forget this:
You can add components but you can't add magnitudes

Worked Problem: A boy scout carefully walks north for 300 m, then 20° west of north for 200 m, then 40° west of north for 400 m. How far from his starting point is he? What the angle of his displacement?