Announcements – 9/8/09

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.

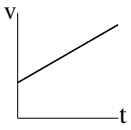
3. **Second homework assignment** is due tonight at 11:59 pm.
   a. If you missed the first one, you do get three free late assignments (all other late work is counted 50%).
   b. HW 3 is due Thursday night.

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

Review Equations

For **constant acceleration**…



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

"Three basic kinematic equations"

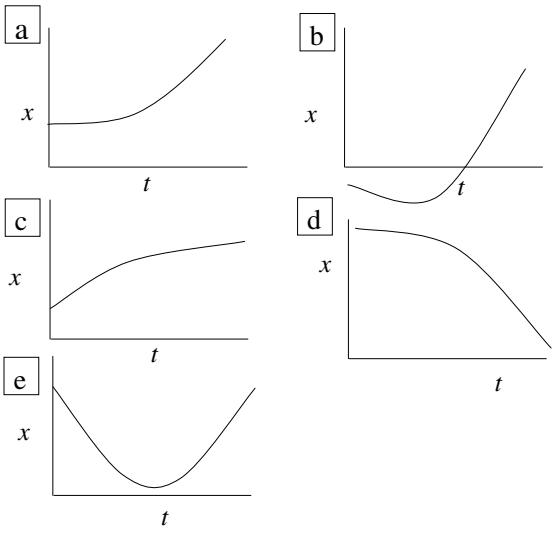
velocity-time: $\boxed{v = v_0 + at}$ (v vs. t = straight line)

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

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

Vectors: Magnitude + Direction

Examples:

Velocity
Acceleration

Displacement?
Position?

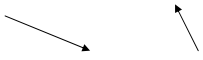
(later) Forces
(in Physics 106) Electric field, magnetic fields

More obscure:
Wind speed
Heat flow
Etc.

Represented by Arrows

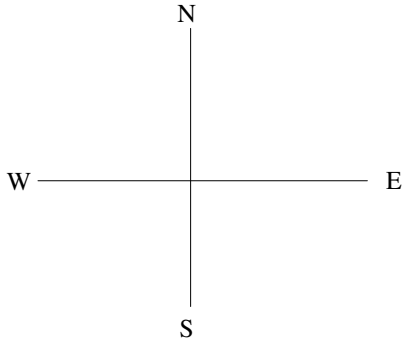
Adding Vectors Graphically: "Tip to Tail"

- 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 

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

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

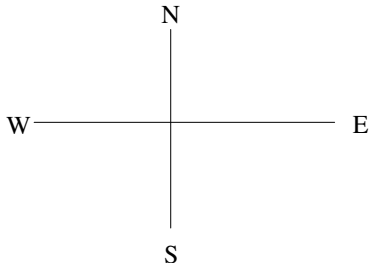
$$\boldsymbol{v_{a\text{-}c} = v_{a\text{-}b} + v_{b\text{-}c}}$$

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

In this case

$$v_{man\text{-}ground} = v_{man\text{-}treadmill} + v_{treadmill\text{-}ground}$$

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.



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:

Colton's advice: think of shadows

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

Getting components from vector:

Getting vector from components:

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

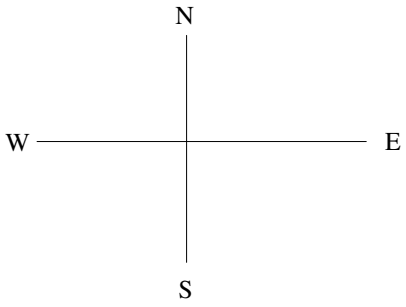
Worked Problem: A boy scout carefully walks north for 300 m, then 20° west of north for 200 m, then 40° west of north for 400 m. How far from his starting point is he? What the angle of his displacement?

Problem: A captain wants her boat to sail exactly **E** on a map, with a speed relative to the *earth* of 10 mph. What direction should she point her boat if there is a 5 mph current to the **N**?

a. a little bit north of east
b. a little bit east of north
c. a little bit south of east
d. a little bit east of south

Hint: Start with an approximate picture

$\mathbf{v}_{\text{boat-earth}} = \mathbf{v}_{\text{boat-water}} + \mathbf{v}_{\text{water-earth}}$



How fast will the boat have to go?

2D Motion: Basic Concept

Motions in perpendicular directions are **independent**

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

$$v_y = v_{0y} + a_y t$$
$$y = y_0 + v_{0y} t + \tfrac{1}{2} a_y t^2$$
$$v_{fy}^{\ 2} = v_{0y}^{\ 2} + 2 a_y \Delta y$$

2-D Projectile motion: $\boxed{a_x = 0}$ $\boxed{a_y = -g}$ (= –9.8 m/s^2)

projectile: an object in free fall

Demo: Cart & ball

Clicker quiz: What will happen?
A. Ball will land in front of cart
B. Ball will land in back of cart
C. Ball will land in cart

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

Clicker quiz: What will happen?
A. Dropped ball will land first
B. Shot ball will first
C. Two balls will land at same time

Flash animation: baseball velocity components
http://stokes.byu.edu/baseball_flash.html

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

Clicker quiz: Which spends the longest time falling?
a. Sally's
b. Bob's
c. same

Clicker quiz: Which rock is going fastest (vector magnitude) just before it hits the ground?
a. Sally's
b. Bob's
c. same

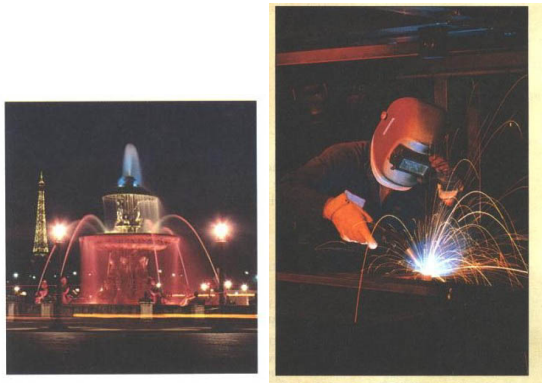
Sally throws a rock horizontally from a cliff. Bob throws his at an angle above horizontal. They throw at the same speed.

Clicker quiz: Which hits first?
a. Sally's
b. Bob's
c. same

From warmup (if we have time): Which geometrical shape does a 2D projectile follow?

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

Why is that?



Video: Motorcycle jumping over airplane
http://www.youtube.com/watch?v=0p8xRNAga80