Announcements – 9/10/13

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

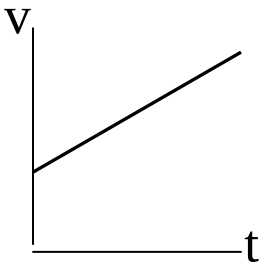
2. **Second homework assignment** is due tonight at 11:59 pm.
   a. If you missed the first one, you do get four free late assignments (all other late work is counted 50%).
   b. Note: It's better to turn it in late, than turn it in incorrect.

3. **Exam 1 starts Thursday! Yikes!**
   a. We'll finish up discussing some 2D problems the first half of Thursday lecture, then do exam review for the second half.
      → Warmup: Vote for problems
   b. Exam ends on Wednesday, 2 pm. Late fee after Tuesday, 2 pm.
   c. Exam covers through HW 4. HW 4 isn't technically due until next Tuesday night… so you might want to do it early!
   d. Probably only 60% pts of regular exam

4. **TA-led exam review** – Thurs 6:30 – 8 pm. Room TBD.

Review Equations

For **constant acceleration**…



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

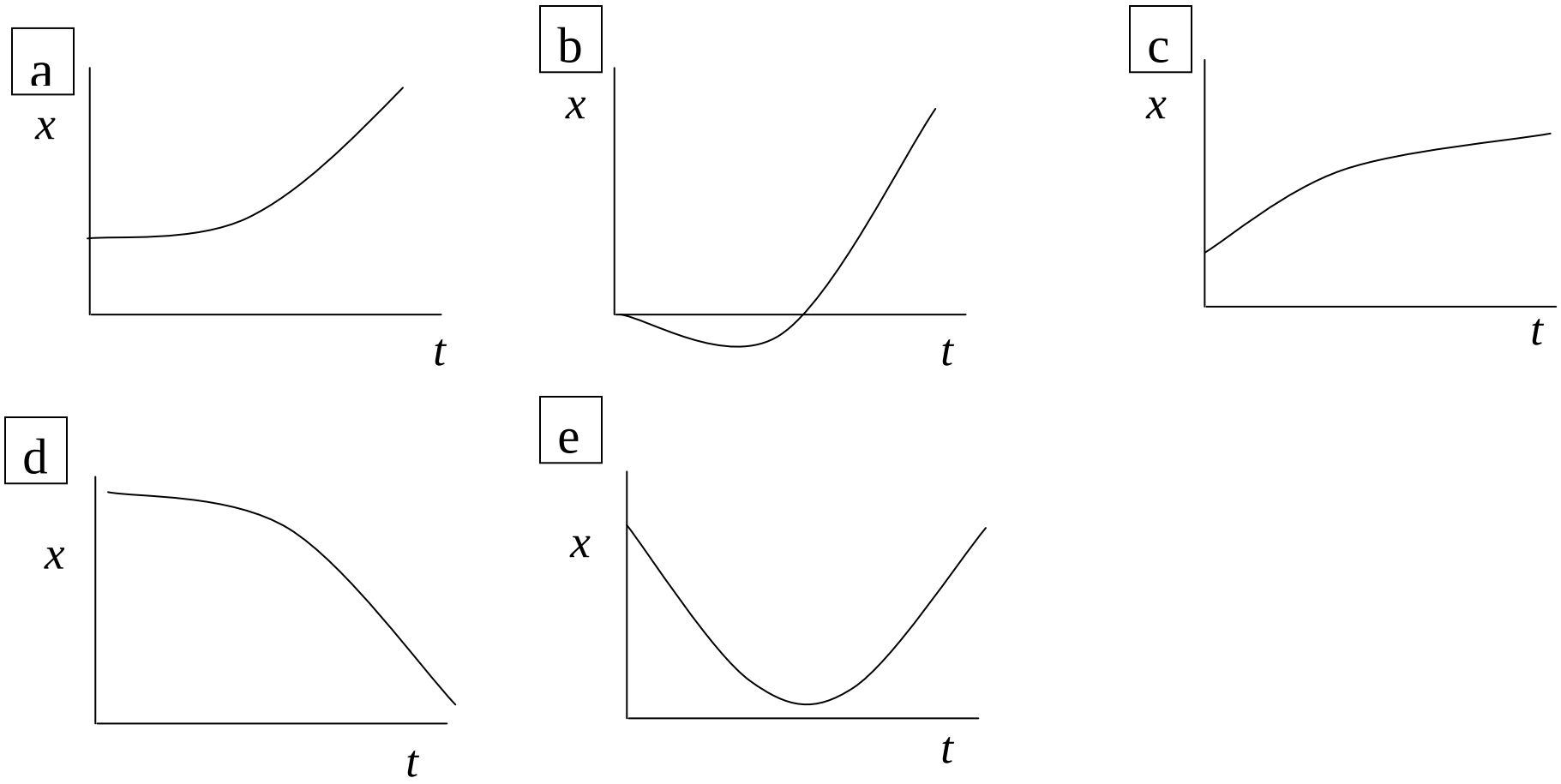
"Three basic kinematic equations"

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

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

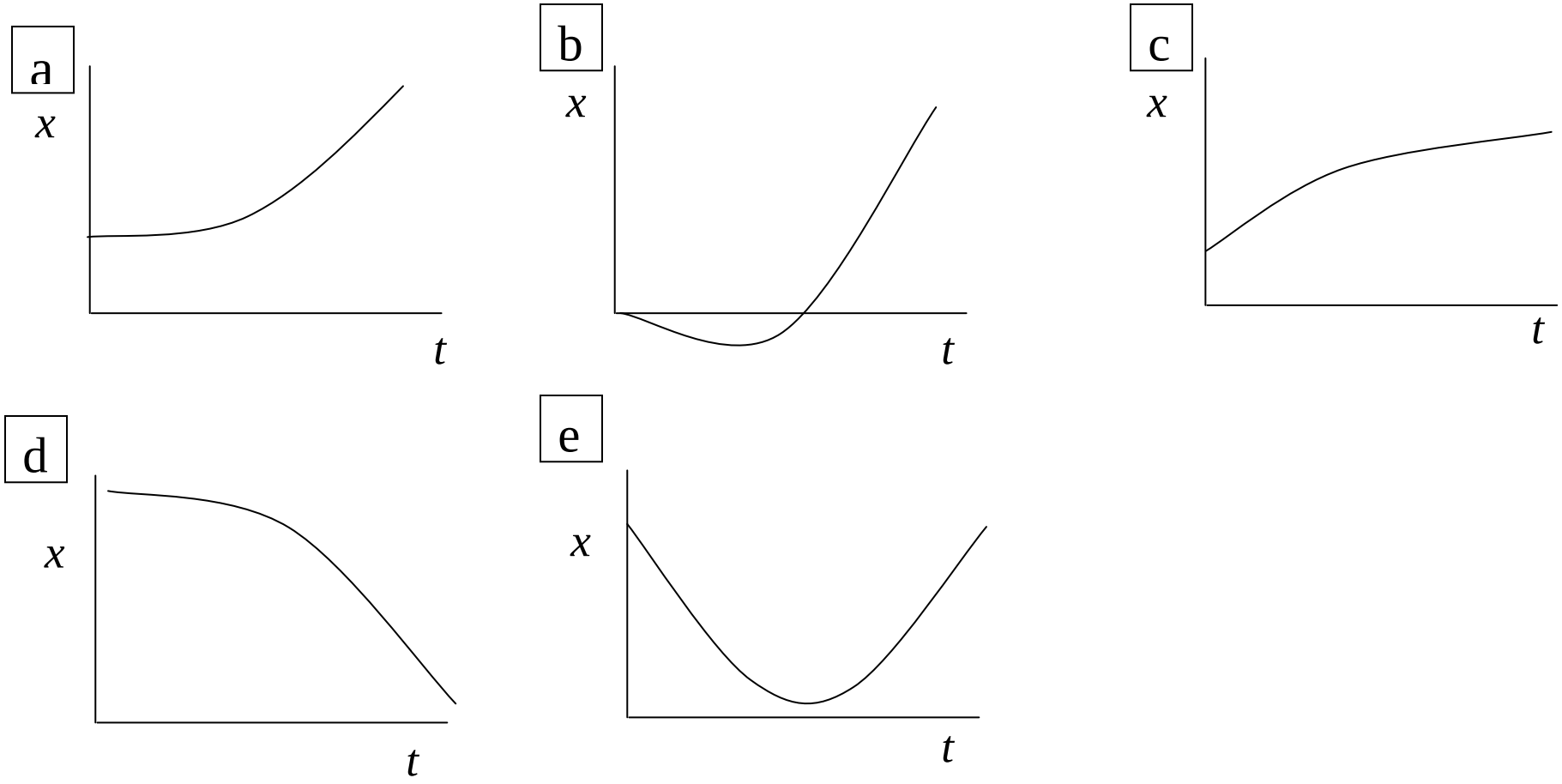
velocity-position: $\boxed{v_f{}^2 = v_0{}^2 + 2a\Delta x}$

Demo: milk drop acceleration of gravity



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

Q1. a car **slows 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 **speeds 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. first left, then right
D. first right, then left
E. zero

Clicker quiz: What is the direction of acceleration of the ball <u>after</u> the hit? (take into account air resistance)

A. right
B. left
C. first left, then right
D. first right, then left
E. zero

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?

A. right
B. left
C. first left, then right
D. first right, then left
E. zero

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 speed just before it hits the ground (30 m below the cliff)?
c) How long does it take to hit the ground?

➢Remember PEANuT

Answers: (a) 2.04 s, (b) 31.43 m/s, (c) 5.25 s

Vectors: Magnitude + Direction

Examples:

Velocity
Acceleration

Displacement?
Position?

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

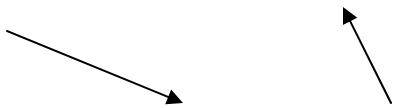
More obscure:
Wind speed
Heat flow
Etc.

→ **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

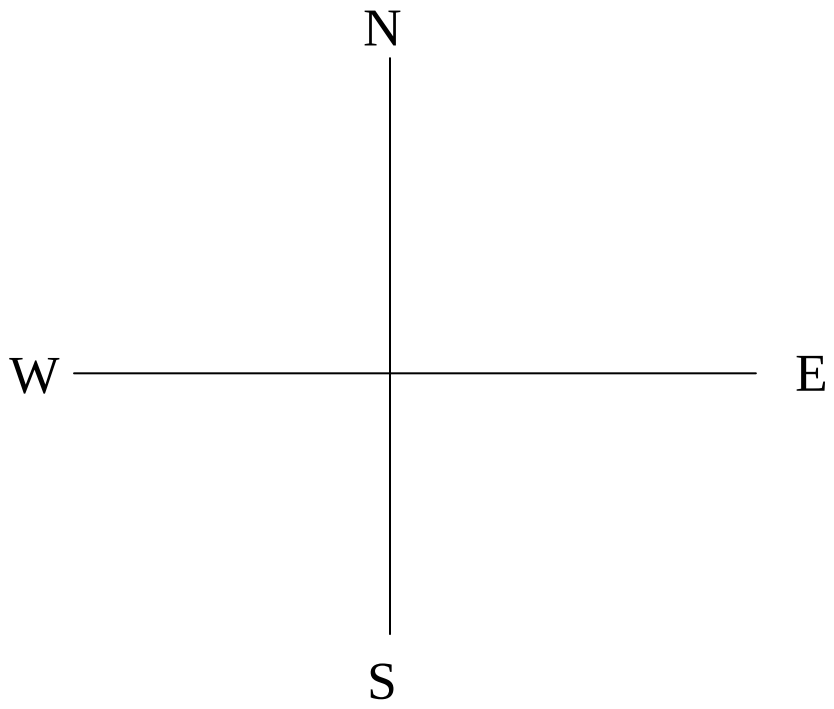


Additional Guidance

- 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.



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

Remember these guys?

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

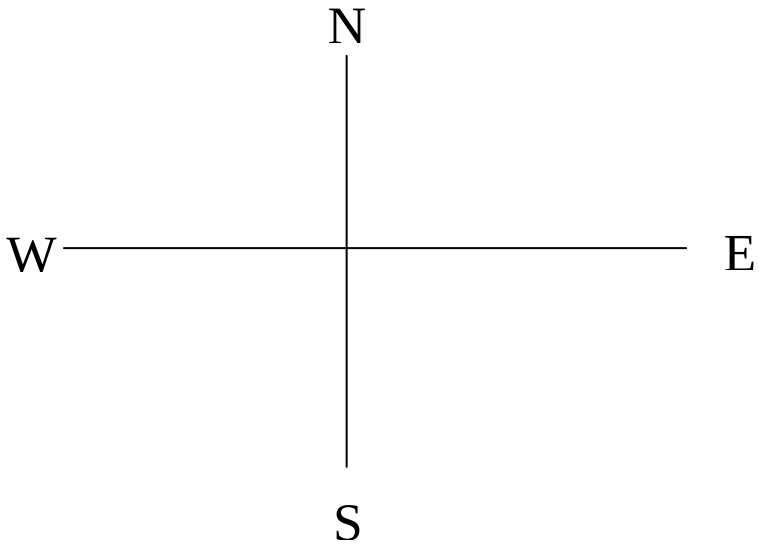
$$\boxed{\vec{\mathbf{v}}_{13} = \vec{\mathbf{v}}_{12} + \vec{\mathbf{v}}_{23}}$$

- Read v_{13} as "velocity of object 1 relative to object 3"
- These are vectors!

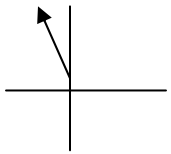
In this case

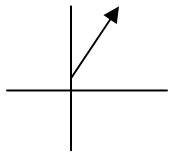
$$\vec{\mathbf{v}}_{man-ground} = \vec{\mathbf{v}}_{man-treadmill} + \vec{\mathbf{v}}_{treadmill-ground}$$

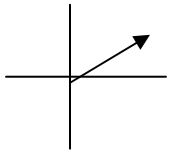
A jet pointed N at 100 mph airspeed (*v* of plane w.r.t. air) flies in a 200 mph wind (air w.r.t. ground) going NE.

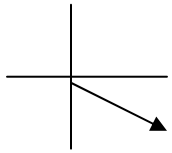


Clicker quiz: What is the jet's true bearing (velocity with respect to the ground)?

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?

“Pair share”–I am now ready to share my neighbor’s answer if called on.

a. Yes

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 (normally) add magnitudes

Worked Problem

A boy scout carefully walks east 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?

Answer: components are -25.519 m, 494.356 m; magnitude = 495.01 m; direction = 2.96° east of north

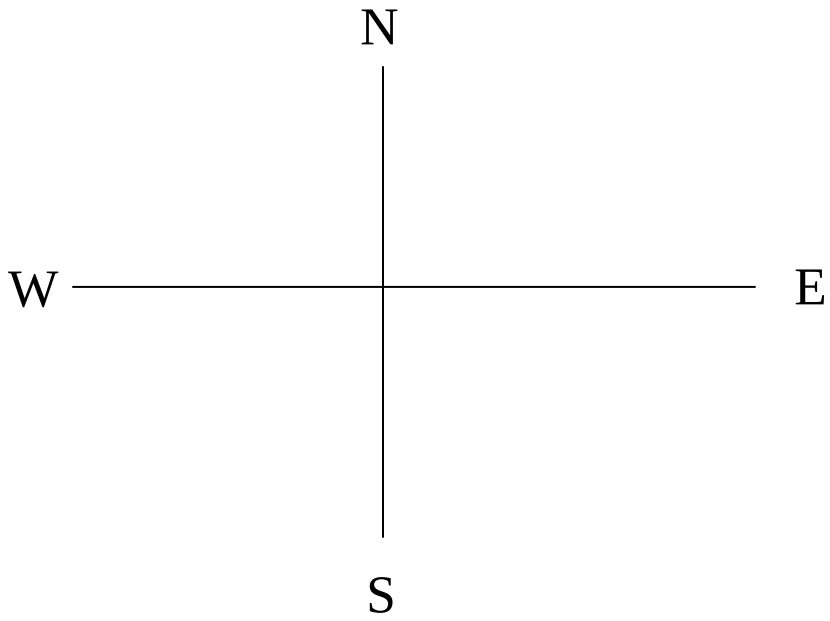
Clicker quiz

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

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



Worked Problem

How fast will the boat have to go, and what's the exact heading?

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

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

2D Motion: Basic Concept

Motions in perpendicular directions are **independent**

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

From 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