Announcements – 9 Sep 2014

1. Prayer

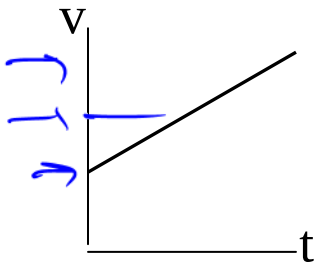
2. Course homepage via: **physics.byu.edu → Class web pages → Physics 105 (Colton J)**

3. Inauguration today at 11 am!

“Which of the problems from last night's HW assignment would you most like me to discuss in class today?”

Review Equations

For **constant acceleration**…



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

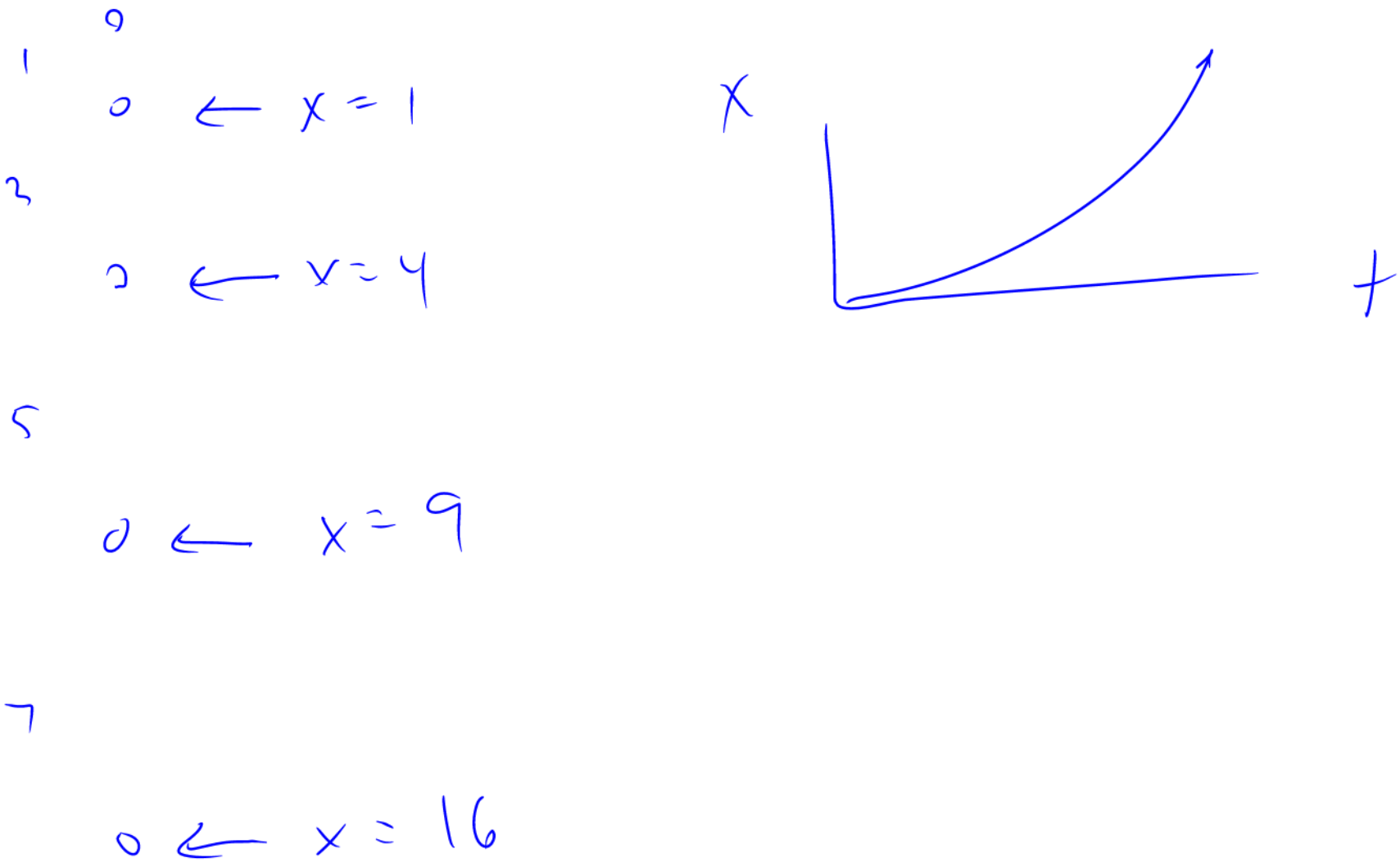
"Three basic kinematic equations"

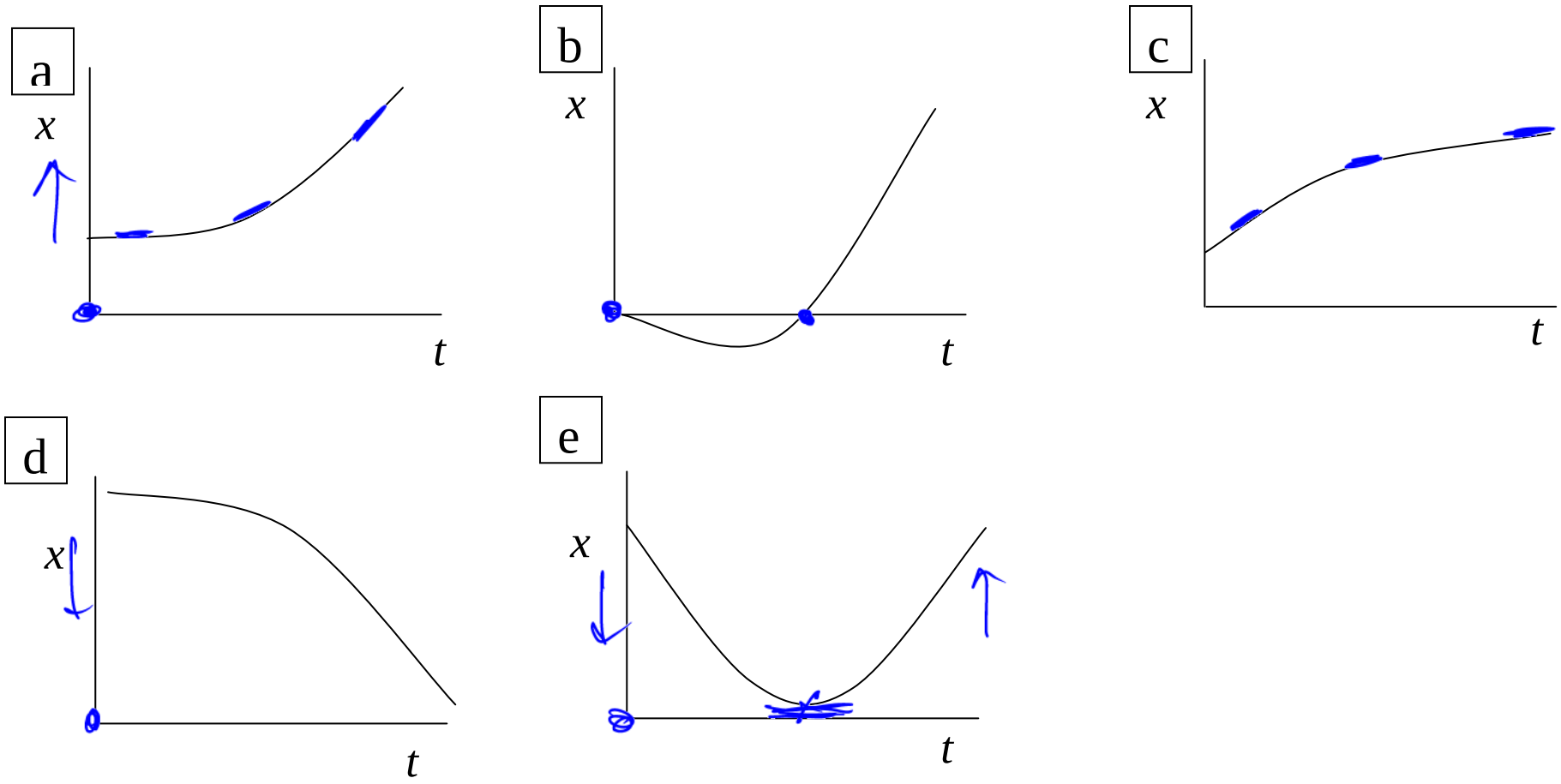
velocity-time: $\boxed{v = v_0 + at}$ (*v* vs. *t* = straight line)

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

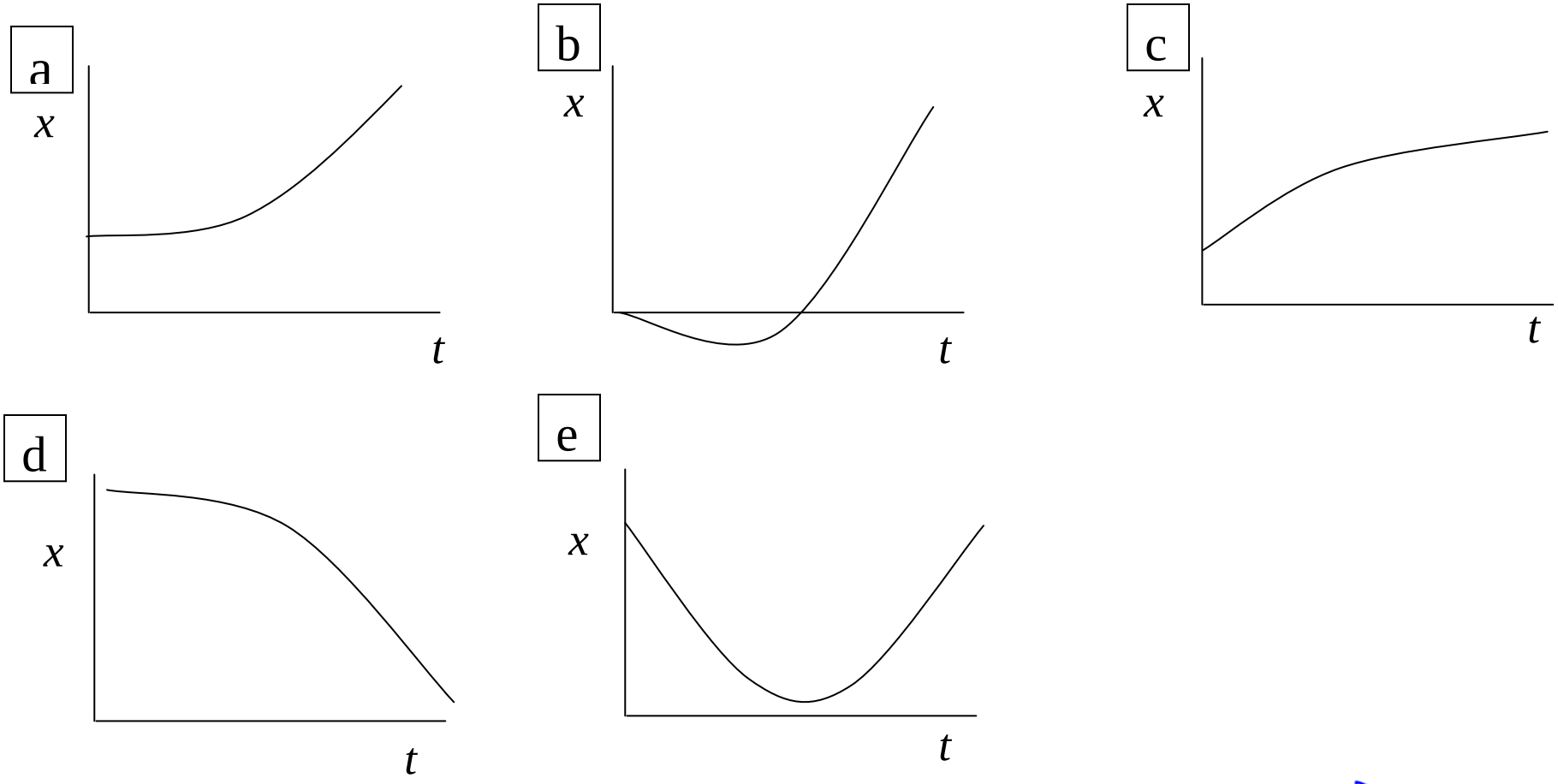




Clicker quizzes: There is a lamppost at $x = 0$. Which curve describes:

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 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. first left, then right
D. first right, then left
E. zero

before

$v_0 = -10\ m/s$

$v_f = +10\ m/s$

$\Delta v = +20\ m/s$

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

$v_f = v_0 - gt$

$y_f = y_0 + v_0 t - \frac{1}{2} g t^2$

$v_f^2 = v_0^2 - 2g\Delta y$ ★

$a = -g$

$t = \frac{v_0 - v_f}{g} = \frac{20\ m/s - 0}{9.8\ m/s^2} = 2.04\ s$

$v_f = \sqrt{(20)^2 - 2(9.8)(-30)} = 31.43\ m/s$ ← speed

$t = \frac{v_0 - v_f}{g} = \frac{20 - (-31.43)}{9.8} = 5.25\ s$

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

Vectors: Magnitude + Direction

Examples:

Position (compare vs. "distance")
Displacement
Velocity (compare vs. "speed")
Acceleration

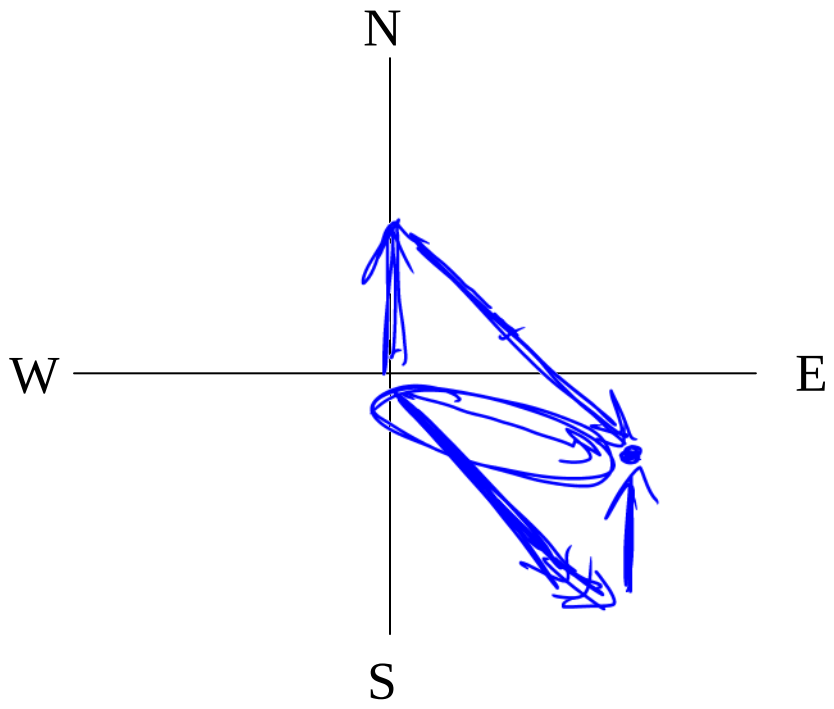
(later) Force, momentum
(in Physics 106) Electric field, magnetic field

More obscure:
Wind speed
Heat flow
Etc.

→ **Represented by Arrows**

Worked Problem

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

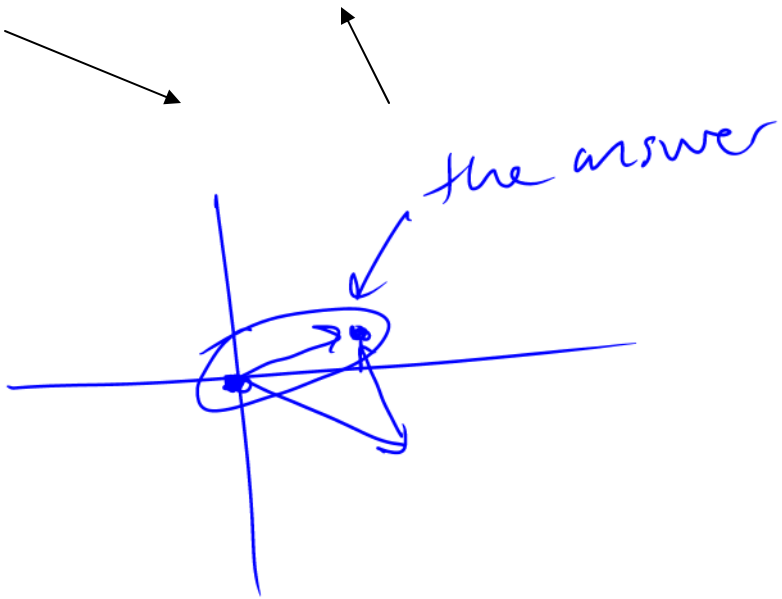


Answer: 147.4 m, 16.3° south of E

Adding Vectors Graphically: “Tip to Tail”

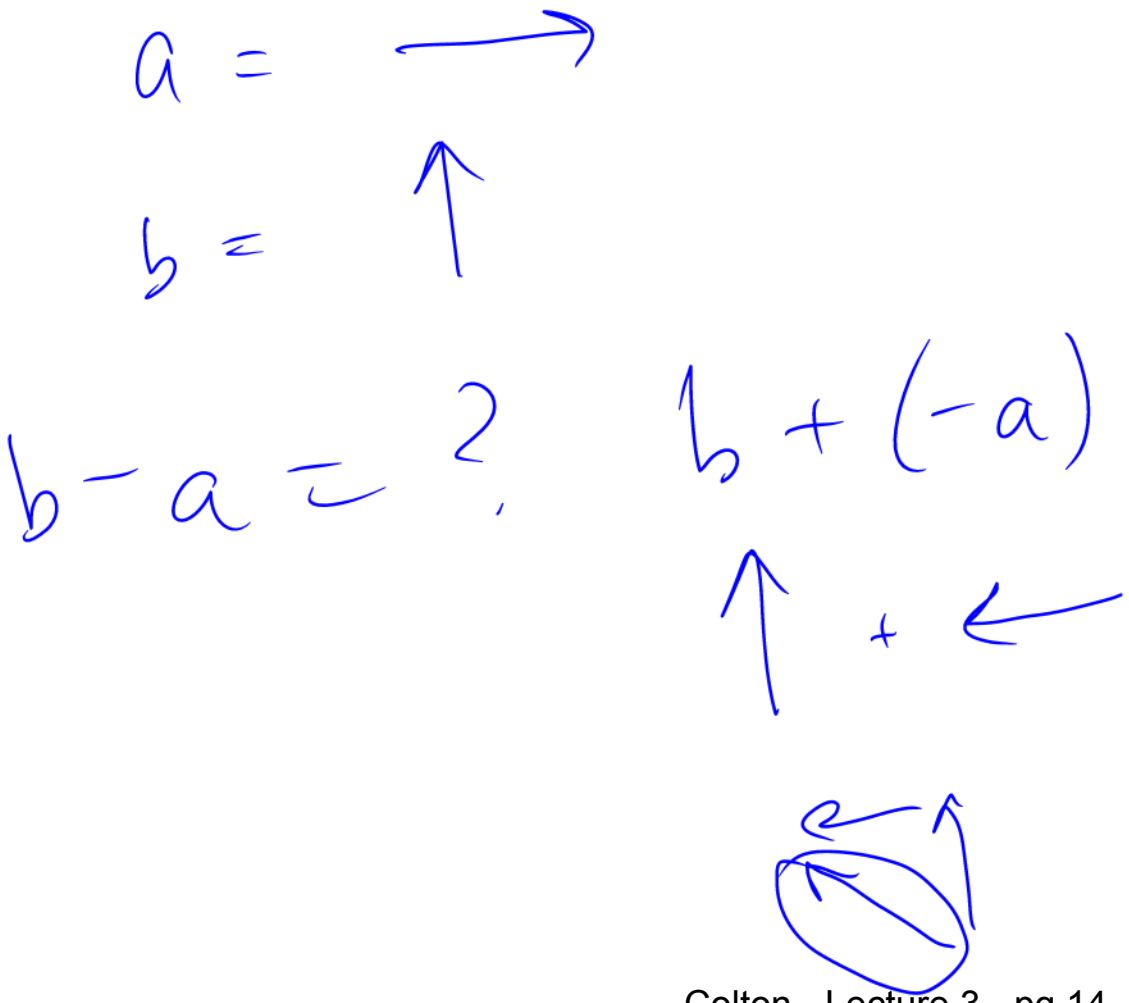
- Draw the first arrow starting from the origin
- **Begin the next vector starting with its tail where the tip of the previous vector leaves off:** “tip-to-tail”
- Connect up more arrows the same way, if you have additional vectors to add.
- The sum is an arrow from the start of the first vector to the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



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

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

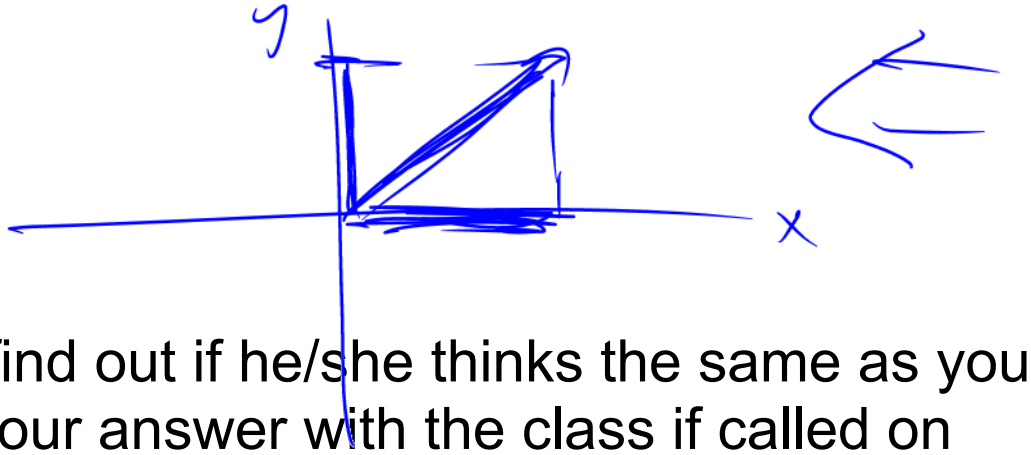
a. true
b. false

Web demo

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

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?



"Think-pair-share"

- Think about it for a bit
- Talk to your neighbor, find out if he/she thinks the same as you
- Be prepared to share your answer with the class if called on

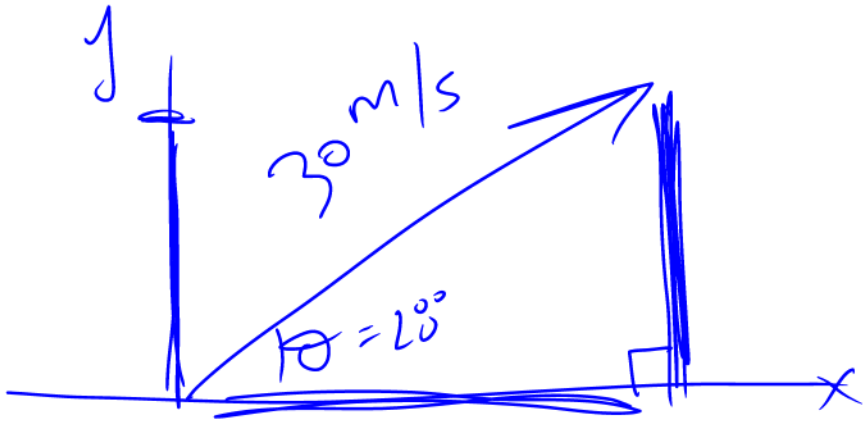
Clicker: I am now ready to share my answer if randomly selected.

a. Yes

Note: you are allowed to "pass" if you would really not answer.

Colton's advice: think of shadows

Getting components from vector:



$$\cos = \frac{adj}{hyp}$$

$$\sin = \frac{opp}{hyp}$$

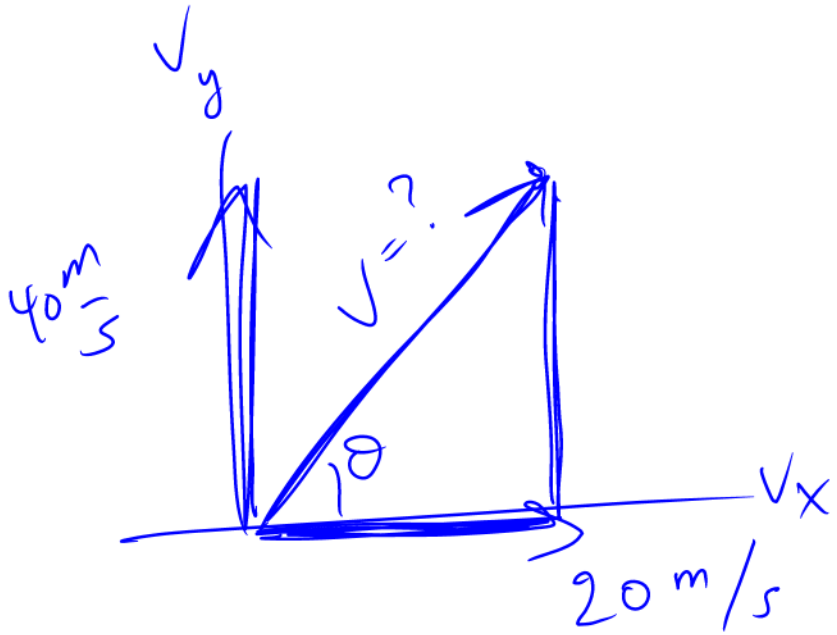
$$V_x = adj = hyp \times \cos\theta$$

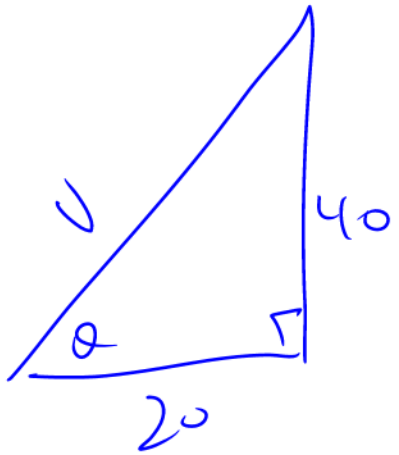
$$= (30\ m/s)(\cos 28^\circ)$$

$$V_y = opp = hyp \times \sin\theta$$

$$= (30\ \tfrac{m}{s})(\sin 28^\circ)$$

Getting vector from components:





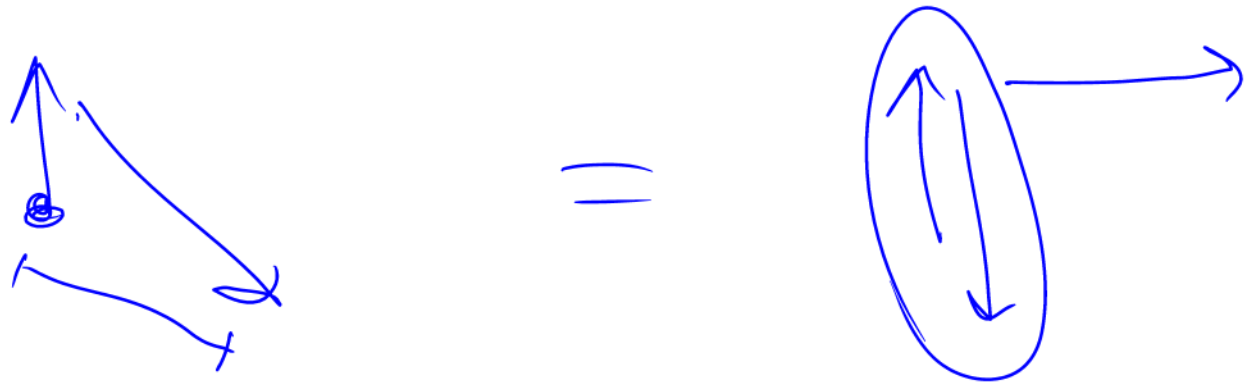
$$V = \sqrt{20^2 + 40^2}$$

$$\tan\theta = \frac{opp}{adj} = \frac{40}{20}$$

$$\theta = \tan^{-1}(2)$$

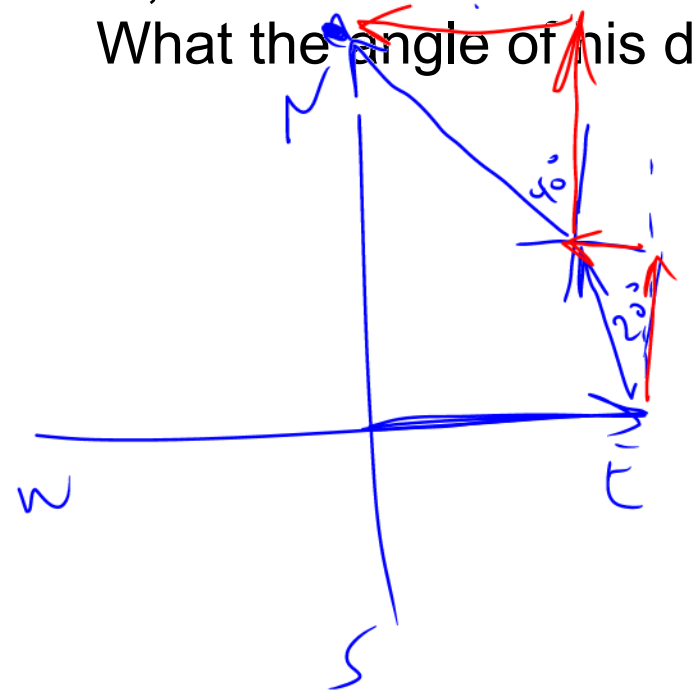
When adding vectors, never forget this:

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?



	x	y
V_1	300	0
V_2	$-200 \sin 20°$	$+200 \cos 20°$
V_3	$-400 \sin 40°$	$+400 \cos 40°$
	-25.5	494.4

$\sin = \frac{opp}{hyp}$

$opp = hyp \cdot \sin\theta$

tot

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