Announcements – 9/3/09

1. If you weren't here last time:
   - ○ Go to the course website!

   physics.byu.edu → Class Web Pages → Physics 105
   - ○ Read the "How to get started" section <u>immediately</u>; there are about 10 things you need to do ASAP
   - ○ Read the syllabus
   - ○ Look over the posted class notes from Tuesday

2. First HW due Sat at 11:59 pm

3. Use the class Google group for homework hints/discussion

Review: The HW System

Syllabus packet contains problems:

1-1. Two boats start together and race across a 60-km-wide lake and back. Boat A goes across at [01] 3.43 km/h and returns at the same speed. Boat B goes across at 30 km/h and its crew, realizing how far behind it is getting, returns at 90 km/h. Turnaround times are negligible, and the boat that completes the round trip first wins. (a) Which boat wins and (b) by how much time?

1-2. In order to qualify for the finals in a racing event, a race car must achieve an average speed of 250 km/h on a track with a total length of 1600 m. If a particular car covers the first half of the track at an average speed of [02] 8.20 km/h, what minimum

Get your missing numbers ("data") from class website

→ *Put in the [xx]______ spaces before you work the problem*

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set 1. [01] 3.43 [02] 8.20 [03] 22.2 [04]
30.2 [05] 39.8 [06] 4.0
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etc.

Answer range at end of list of problems:

1-1b. 15.0, 60.0 min
1-2. 300, 800 km/h
1-3a. 150, 210 km
1-3b. 60.0, 70.0 km/h

Indicates <u>units</u>, <u>range</u> and <u>decimal places</u> of answer

Type into website form: 63.8

Submit all answers at once

Partial credit, aka "retries"

- Points for each successive try: 5, 5, 4, 3, 0
- If you miss, correct answer is given to you
- Use new data each time

Late submissions:

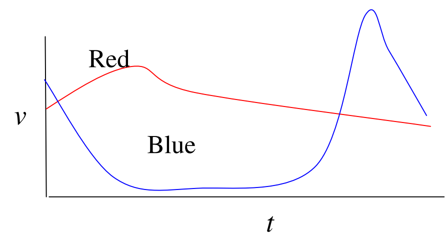
- Three free late submissions, chosen to give you most points
- All other late submissions only worth 50%

Special cases:

- Multiple choice problems are graded differently: 2 pts each part, no retries
- Sometimes diagrams are required (forms at back of packet): no free late, no retries
- Some problems are extra credit. They require you to measure something at home and use that as "data" for the problem.

Everything's explained in syllabus! You are responsible!

Clicker quiz: The following are $v(t)$ curves for two airplanes.



Which airplane flew the farthest?

a. red
b. blue

Hint: estimate each one's <u>average</u> velocity

Train problems…

A train leaves Provo for SLC at 8:00 am, going 10 mph. A second express train leaves Provo for SLC at 9 am, going 15 mph. It is 40 miles to SLC. Will the 2nd train catch up before SLC? If so, where?

Hint: think about *relative* velocities.
→ how fast does the gap close?

Steps:

- What is the initial gap? (How much of a head start does the first train have?)
- How fast does the gap close?
- How long does it take the gap to close?
- Where are both trains after this amount of time?

Review

Position: where the object is.
Displacement: change in position.
Velocity: rate of change of position

- **average** velocity: rate of change of position over some time interval, slope between two points of x vs t graph
- **instantaneous** velocity: rate of change at specific time, slope of tangent line at one point of x *vs.* t graph.

Acceleration

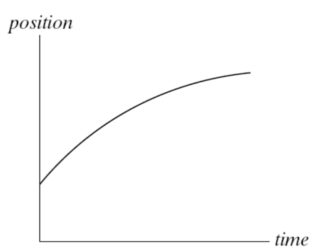
is **rate of change of velocity**: slope of v vs t graph

average acceleration $\langle a \rangle = \frac{\Delta v}{\Delta t} =$
instantaneous acceleration

Acceleration has the same relationship to velocity…
as velocity does to position

a is to v as v is to x

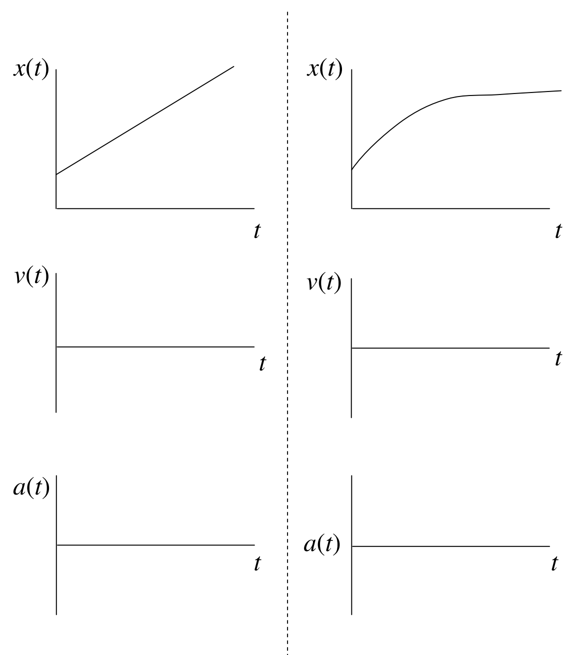
Clicker quiz: A train car moves along a long straight track. The graph shows the position as a function of time for this train. The graph shows that the train:



a. speeds up all the time.
b. slows down all the time.
c. speeds up part of the time and slows down part of the time.
d. moves at a constant velocity.

Hint: What would the velocity vs. time graph look like?

Problem: There two different objects move as plotted.
a. Describe each motion with words.
b. Figure out what the $v(t)$ and $a(t)$ graphs must look like for the two cases.



Some accelerations:

Accel. due to earth's gravity: "*g*"

Altitude (km)[a]	g (m/s^2)
1 000	7.33
2 000	5.68
3 000	4.53
4 000	3.70
5 000	3.08
6 000	2.60
7 000	2.23
8 000	1.93
9 000	1.69
10 000	1.49
50 000	0.13

Near surface $g \approx 9.8$ m/s^2
(ignoring air resistance)

$a_y = -g$

Dr. John Stapp, rocket sled (1951): -45 g's

Fast sports cars: 0.7 – 1.0 *g*

Extreme amusement park rides: 3-5 *g's*

Fighter planes: 5-9 *g's*

Laundry in my washing machine's spin cycle: 100+ *g's*

Keeping track of signs:

Position, displacement, velocity, and acceleration have a <u>direction</u>, sometimes given by a **sign** (+/-) and sometimes by a **description** (left, right, north, south, etc.).

What do we mean by +/- position?
Being on the + or - side of the origin

What do we mean by +/- displacement?
Has *shifted* to the right or left

What do we mean by +/- velocity?
Moving in the + or - direction

What do we mean by +/- acceleration?
The velocity is ________________________

a = +: if v = positive…
if v = negative…

a = –: if v = positive…
if v = negative…

Clicker quiz: You are throwing a ball straight up in the air. At the highest point, the ball's
a. velocity and acceleration are zero.
b. velocity is nonzero but its acceleration is zero.
c. acceleration is nonzero, but its velocity is zero.
d. velocity and acceleration are both nonzero.

Hint: what does $v(t)$ graph look like, starting right after it leaves your hand?

From warmup: A ball tossed vertically upward rises, reaches its highest point, and then falls back to its starting point. During this time, the acceleration of the ball is always
a. in the direction of motion
b. opposite its velocity
c. directed downward
d. directed upward

From warmup: If I throw a ball straight up into the air, we say the ball is an object in "**free fall**"
a. on its way up
b. on its way back down
c. both on its way up and on its way back down.

"Kinematic Equations"

for *constant* acceleration

x_0, v_0 = initial position, velocity
x_f, v_f = position, velocity after some time t (I may leave off the "f")

$$v_f = v_0 + at$$

<u>Derivation:</u>
Use definition of a_{ave}, with $\Delta v = v_f - v_0$ and $\Delta t = t - 0$
Notice that $v(t)$ is a straight line

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

<u>Derivation:</u>
Since $v(t)$ is a straight line, average must be halfway between the beginning and ending velocities

$$x_f = x_0 + v_0 t + \frac{1}{2}at^2$$

<u>Derivation:</u>
$v_{ave} = \frac{x_f - x_0}{t - 0}$, also $v_{ave} = \frac{v_0 + v_f}{2}$
Set equal, plug in $v_f = v_0 + at$
$\frac{x_f - x_0}{t} = \frac{v_0 + (v_0 + at)}{2}$
Solve for x_f

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

<u>Derivation:</u>
Combine two previous boxed eqns to get rid of t, write $x_f - x_0$ as Δx, solve for v_f^2

From warmup quiz: Ralph asked me a question the other day. Consider a car accelerating forward. Its acceleration is 1.8 m/s^2. During the first second, the car accelerates from 0 to 1.8 m/s. Ralph thought that since the velocity at the end of the first second is 1.8 m/s, the car would travel 1.8 m during that first second. But someone told him that the answer is actually 0.9 m. Can you help Ralph understand why? Don't just say, "Because the formula in the book says so."

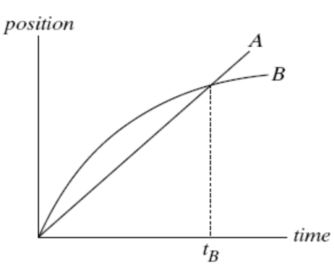
An answer from the class:

Worked Problem: A sprinter runs the 50 m dash starting at rest, with a constant acceleration of 0.5 m/s^2. Find:
a) Her final velocity
b) Her average velocity
c) The time it took

Problem Solving Tip:
Always draw a **diagram**!

Problem Solving Tip:
Look for equations that contain the given information, not the variable you're looking for.

Clicker quiz (if we have time): This graph shows position as a function of time for two trains running on parallel tracks. Which is true:



a. At time t_B, both trains have the same velocity.
b. Both trains speed up all the time.
c. Both trains have the same velocity at some time before t_B.
d. Somewhere on the graph, both trains have the same acceleration.

Things to remember

If you are new:
Go to class website
physics.byu.edu → Course websites → 105 (Colton)

Read "How to get started"

Everyone:

Before Saturday night
- Get individual homework data sheet via class website
- Do first homework
- Submit HW via class website

Optional, but highly recommended
- Register for class Google group
- Read the syllabus for info on things I didn't talk about much: extra credit, etc.

…and of course: do next reading assignment, do next warmup quiz, bring clicker to class, etc.