Announcements

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

   physics.byu.edu → Class Web Pages → Physics 105
   - Look at the lecture notes for the first lecture (available on course website)
     - Especially last viewgraph, "Summary: what you need to do ASAP"
   - Read the syllabus

2. First HW due tomorrow (Fri) at 11:59 pm

3. Tutorial Lab: Some of the tutors will have "Physics 105 labels". Try to use those ones.

4. You can come to either of my Physics 105 classes.

5. We'll discuss the online homework system today.

The Computerized 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] ______ 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] ______ km/h, what minimum average speed must it have in the second half of the event to qualify? Warning: The average speed is defined to be the total distance traveled divided by the total time elapsed. This is not the same as the average of the two speeds.

Get your missing numbers ("data") online

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

```
set 1. [01] 3.43 [02] 8.20 [03] 22.
[04] 30.2 [05] 39.8 [06] 4.0
```
etc.

Syllabus packet contains answer range:

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 units, range and precision of answer

More HW details

- **Due-dates**: 11:59 pm on date marked on schedule (Wed/Fri)
- **Answers**
  - Submitted over internet
  - Course website → Online Homework → Assignment number
- **Answer formats**:
  - Do not put units on your answer
  - For scientific notation, use e.g. "3.00e8" not "3.00x10^8"
  - No spaces! No "x"s! No commas!
  - Yes negative signs! (where appropriate)
  - Don't round until the final answer
- **To see your score the next day**:
  - Course website → Online Homework → Homework status
  - Correct answers given
- **Advantages**
  - Used textbooks OK
  - Fast feedback re: right/wrong
  - Less graders/More Tutorial Lab TAs
  - Less copying off other students
- **Partial credit**: given through "retries"
  - Up to 4 retries per problem (lose a point each time)
  - Use new set of data for each retry
  - All retries due at same time as next HW assignment, or else counted late

- **Late**: three free late assignments; after that late work = half credit
  - "Free" ones chosen to maximize your points
- **Special types of problems**:
  - Multiple-choice: 2 points each, use drop-down box. No retries.
  - Hardcopy diagrams: 2 points each, graded by TAs. No free lates, no retries. Turn in via boxes by room N357 ESC.
- **Amount of time**: last year average student spent 5-6 hours/week

Velocity, cont from last time

On the Tour de Utah, bicyclists ride straight south for 3 hours at 8 km/hr, rest for 2 hours, then continue their ride south down a mountain for 1 hour at 20 km/hr. What is their average velocity for the morning?

→ From "Problem Solving" section of syllabus:
"<u>P</u>hysicists <u>Think</u> <u>Equations</u> <u>A</u>re <u>C</u>ool, but <u>Think</u> <u>again</u>."

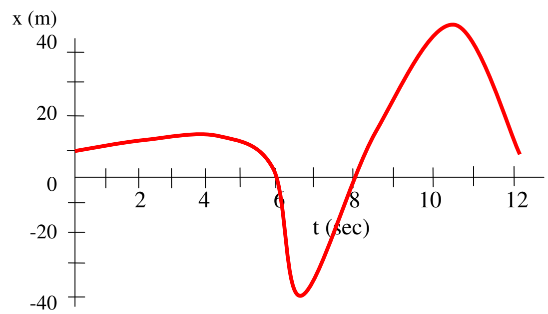
Picture
Think
Equations
Algebra
Calculator
Think again

Instantaneous Velocity

(…at a particular time)

The instantaneous velocity at a time t_a, $v(t = t_a)$ is the average velocity over a very small time interval around t_a

= slope of tangent line of the $x(t)$ graph at t_a

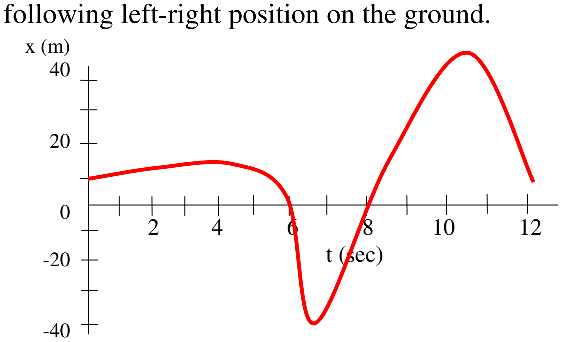


Positive slope means:

Negative slope means:

Zero slope means:

Problem: The shadow of a roller coaster car has the following left-right position on the ground.



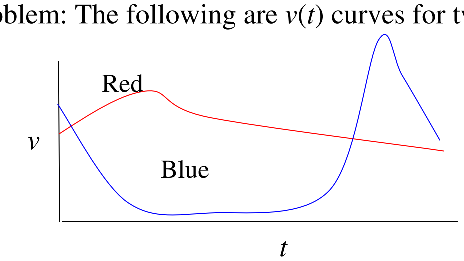
What is v_x at 6 seconds?

How many times does the roller coaster stop and turns around?

When does it have the fastest horizontal speed?

What direction is it moving at t = 8 sec?

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



Which airplane flew the farthest? _______

Hint: judge the average 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?

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

- average velocity is slope between two points of x vs t graph
- instantaneous velocity is slope of tangent line at one point of $x(t)$ graph.

Acceleration

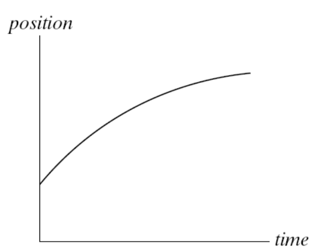
is rate of change of velocity: slope of v vs t graph

average acceleration $< a >= \frac{\Delta v}{\Delta t} =$
instantaneous acceleration

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

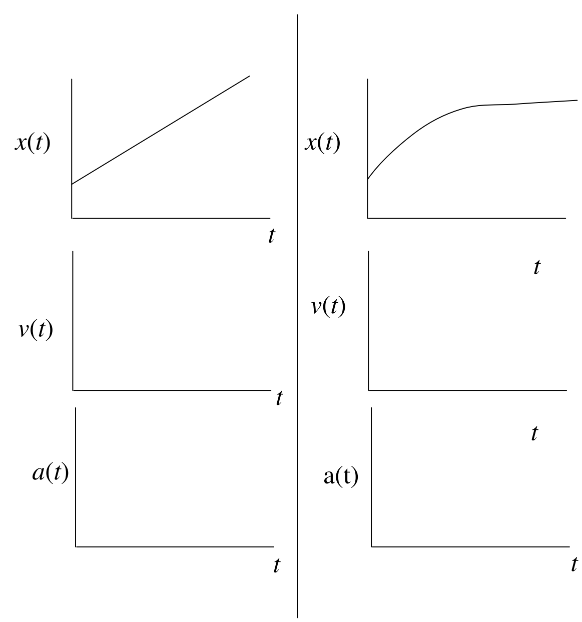
a is to v as v is to x

Q1. 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:

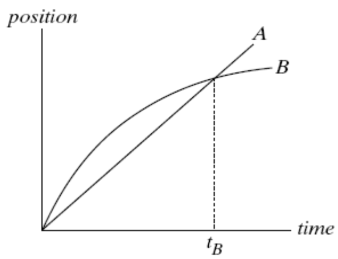


a. speeds up all the time.
b. slows down all the time.
c. speeds up part of the time and slows down part of the time.
d. moves at a constant velocity.

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.

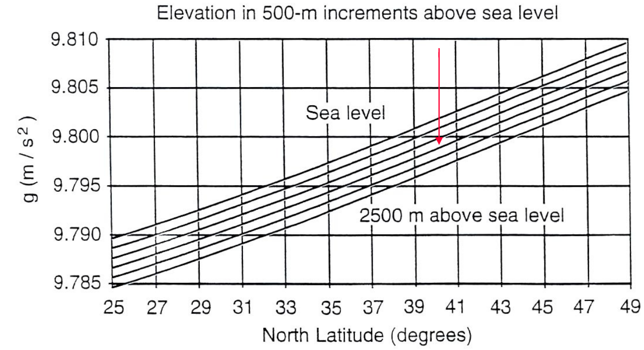


Problem: This graph shows position as a function of time for two trains running on parallel tracks. Which is true:



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.

Some accelerations:



accel. due to gravity near earth: $|a| \approx 9.8$ m/s^2 (one "*g*")

***g* near Provo:** Latitude = 40.24° N
Elevation = 4660ft = 1420m
g = 9.799 m/s^2

Fast sports cars: 0.7 – 1.0 *g*'s

Extreme amusement park rides: 3-6 *g*'s

Fighter pilots: 5-9 *g*'s

Keeping track of signs:

For motion along a line**, position, displacement, velocity, and acceleration have a direction** given by a **sign** (+/-) or a **description** (left, right, north, south)

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

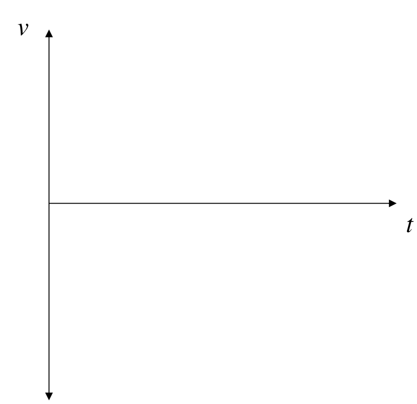
What do we mean by +/- acceleration?
The velocity is becoming more +/-

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

Q2. 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 you throw it?



What is "free-fall"?

“Kinematic Equations”
for *constant* acceleration

x_0: initial position
v_0: initial velocity

$$v = v_0 + at$$

Directly from definition of a_{ave}
($\Delta v = v - v_0$ and $\Delta t = t - 0$)
Notice that $v(t)$ is a straight line

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

Since $v(t)$ is a straight line, the average must be halfway between the beginning and ending velocities

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

Derived in book

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

(combine eqns 1 and 3 to get rid of t)

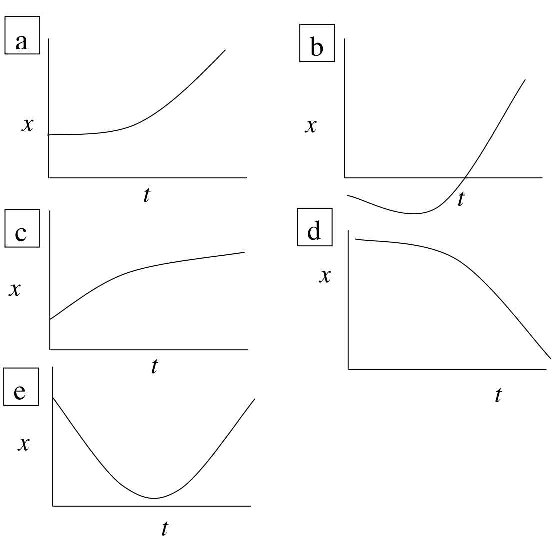
→ These equations work for any direction. I.e., substitute y for x if there’s a constant vertical acceleration.

→ If no acceleration in a direction, just set $a = 0$ for that direction.

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.



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

Q3. a car **slowing down** as it moves **away** from the lamppost
Q4. a car moves **toward** the lamppost, but **slows down** and **turns around** and speeds up
Q5. a car **speeding up** as it moves **toward** the lamppost
Q6. a car that moves away from the lamppost, turns around and **passes** the lamppost

Things to remember

If you’re new,
physics.byu.edu → Course websites → 105 (Colton)
has lots of good info!

Before Friday night, 11:59 pm
- Get individual homework data sheet via website
- Do first HW
- Turn in first HW via website