Announcements

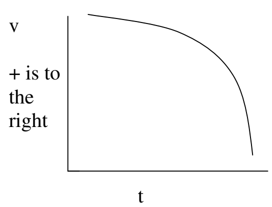
1. No homework due tomorrow!
   a. Would be an excellent evening to study for and/or take the exam…

2. **Exam 1 starts today!**
   a. Available in Testing Center from Tues, Sept. 16 10:15 am, up to Monday, Sep 22, closing time
      i. If you pick up your exam after 5 pm, you'll have a late fee.
   b. **Covers Ch. 2,3** (homeworks 1-3)
   c. There's a **3 hour time limit**
      i. Last year's Exam 1:
         1. Students took an average of 1.5 hours
         2. Some took less than 1 hour
         3. Some took the full 3 hours
      ii. This year's Exam 1 will be a little harder
   d. **Advice**:
      i. Take time and space to draw diagrams.
      ii. Show all your work on the exam papers
      iii. Write your numerical answers in the blanks
      iv. Circle the correct choice
      v. Then transfer your answers onto your bubble sheet.

   e. **Note card:**
      i. I will not give you any formulas on the exam
      ii. I *will* give any constants (like g = 9.8 m/s^2) or conversion factors that you need.
      iii. Write anything else you want on a 3×5 note card, front & back. Handwritten only!
   f. **Calculators:**
      i. They are allowed, any type.
      ii. Be sure your calculator has at least basic scientific functions such as trig, exponents, etc.
   g. **Last year's Exam 1** is posted on the web site, along with solutions.
      i. Don't look at the solutions until you've *worked* the exam...or you won't find out where you are weak.
         → It's easy to fool yourself!
   h. **Things to study**
      i. HW problems
      ii. In-class problems (clicker quizzes & problems)
      iii. Last year's exam
      iv. Concepts from lectures & demos
      v. Other problems! (textbook, other books, etc)

Exam format

The following graph is of velocity vs time v(t) of a car moving along a road, and right is positive. The graph shows that the car is [1?] ____ a) speeding up b) slowing down c) staying at constant speed, and moving to the [2?] ____ a) right b) left, with acceleration to the [3?] ____ a) right b) left, and the acceleration is [4?] ____ a) increasing in magnitude b) decreasing in magnitude c) constant.



A jet plane lands with a speed of 50 m/s and can decelerate (slow down) at a maximum acceleration magnitude of 7 m/s^2 as it comes to rest. From the instant the plane touches the runway, what is the minimum time needed before it can come to rest? [11?] ______ a) less than 7.0 s b) between 7.0 and 7.1 s c) between 7.1 and 7.2 s d) between 7.2 and 7.3 s e) between 7.3 and 7.4 s f) between 7.4 and 7.5 s g) between 7.5 and 7.6 s h) more than 7.6 s

→ These bubble sheets have 10 bubbles per question.

Formulas Review

Definitions
Final exam: you will be expected to know these

$$v_{ave} = \langle v \rangle = \frac{\Delta x}{\Delta t}$$

v (instantan.) = slope of tangent line of x vs t graph

$$a_{ave} = \langle a \rangle = \frac{\Delta v}{\Delta t}$$

a (instantan.) = slope of tangent line of v vs t graph

Trigonometry definitions
Final exam: you will be expected to know these

$$\sin\theta = \frac{opposite}{hypotenuse}$$

$$\cos\theta = \frac{adjacent}{hypotenuse}$$

$$\tan\theta = \frac{opposite}{adjacent}$$

Quadratic formula
Final exam: I will give you this

$$\text{If } ax^2 + bx + c = 0, \quad x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Kinematic formulas for constant *a*

Final exam: I will give you these

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

$$v = v_o + at$$

$$x = x_o + v_o t + \frac{1}{2}at^2$$

$$v_f^{\,2} = v_o^{\,2} + 2a\Delta x$$

Kinematic formulas, applied to projectiles

Final exam: I will *not* give you these; just plug in $a_x = 0$ and $a_y = -g$ to the regular kinematic formulas which I will give you

x-direction

$$v_x = v_{ox}$$

$$x = x_o + v_{ox}t$$

y-direction

$$v_y = v_{oy} - gt$$

$$y = y_o + v_{oy}t - \frac{1}{2}gt^2$$

$$v_y^{\,2} = v_{oy}^{\,2} - 2g\Delta y$$

Concepts Review

1. Trig: need to know how sin, cos, and tan work

2. Motion:
   a. Displacement
   b. Velocity and speed
   c. Acceleration (always in direction of force)
   d. How to interpret $x(t)$, $v(t)$ and $a(t)$ graphs:
      i. slopes connect them
   e. Average vs. Instantaneous

3. Kinematic equations
   a. Take your time:
      i. Draw pictures, choose + direction
         1. Write given info on picture, properly labeled (example: $v_f = 10$ m/s)
         2. Write missing info on picture, also labeled (example: $\Delta x = ?$)
      ii. Think about which equations describe the motion
      iii. Write down the most relevant equations symbolically
      iv. Plug numbers into your equations, see what they tell you

      v. Do algebra, carefully
      vi. Plug numbers into calculator—twice!
   b. Problems can be done more than one way—it doesn't hurt to check your work with other eqns

4. Adding Vectors
   a. Graphically—always do!
   b. With components
      i. Use cos, sin to get *x*-and *y*- "shadows"
      ii. Add *x*- and *y*-components separately to get components of final vector
      iii. Magnitude of final vector: Pythagorean thm
      iv. Angle of final vector: tangent

5. Free-fall/projectiles
   a. Two sets of kinematic equations (*x* and *y*)
      i. $a_x = 0$
      ii. If up = positive, then $a_y = -g = -9.8$ m/s^2
   b. If initial velocity at an angle: divide v_0 into *x*- and *y*-components
   c. If "range"-type problem: think about which coordinate sets the time.
      i. Solve for time
      ii. Plug into other coordinate's equation(s)

6. Relative motion:
   a. One-dimension: it's easy to figure out, just add or subtract speeds
   b. 2-dimensions: draw **vectors**, and write the vector equation: $\mathbf{v}_{ac} = \mathbf{v}_{ab} + \mathbf{v}_{bc}$ with "a", "b", and "c" being objects from the problem. Then be sure your work (components) agrees with it.

Some concepts from last lecture

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 the same speed.

Clicker quiz: Which hits first?

a. Sally's
b. Bob's
c. same

Maximum range

Warmup: Neglecting air resistance, at what angle should you throw a ball on a flat field in order to get the maximum range?

a. 30°
b. 45°
c. 60°
d. It depends on the initial speed

We're also neglecting height of person…that could have a slight effect.

What if you do worry about **air resistance**?

Simulation:
http://phet.colorado.edu/new/simulations/sims.php?sim=Projectile_Motion

Some HW problems (missed by many):

HW 2, Problem 3

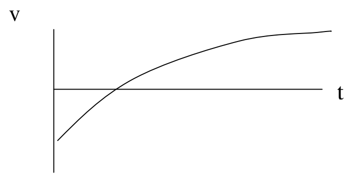
Using a rocket pack with full throttle, a lunar astronaut accelerates upward from the Moon's surface with a constant acceleration of 2.03 m/s2. At a height of 9.76 m, a bolt comes loose. (The free-fall acceleration on the Moon's surface is about 1.67 m/s2.) (a) How fast is the astronaut moving at that time? (b) How long after the bolt comes loose will it hit the Moon's surface? (c) How fast will it be moving then? (d) How high will the astronaut be when the bolt hits? (e) How fast will the astronaut be traveling then?

HW 3, Problem 3

A home run is hit in such a way that the baseball just clears a wall 21 m high, located 130 m from home plate. The ball is hit at an angle of 32.6° to the horizontal, and air resistance is negligible. Find (a) the initial speed of the ball, (b) the time it takes the ball to reach the wall, and (c) the speed of the ball when it reaches the wall. (Assume the ball is hit at a height of 1.0 m above the ground.)

More conceptual quizzes

The curve is velocity vs time for an object, positive means to the right.



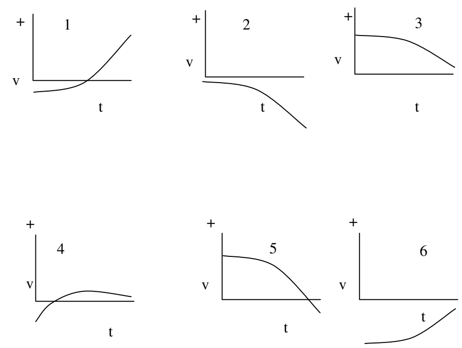
Clicker quiz: The curve represents an object:

a. moving right
b. moving left
c. moving right then moving left
d. moving left then moving right
e. not moving

Clicker quiz: The *acceleration* of this object is:

a. to the right
b. to the left
c. to the right then to the left
d. to the left then to the right
e. zero

For the x(t) curve A shown to the right, the closest v(t) curve that describes its velocity is closest to curve _____ (choose 1-6 from curves below). For the x(t) curve B shown to the right, the closest v(t) curve that describes its velocity is closest to _____ (choose 1-6 from curves below). For curve 1 in the v(t) graphs below, the acceleration is _______ 1) always positive 2) always negative 3) positive then negative 4) negative then positive.



Clicker quiz: If $\vec{A}$ and $\vec{B}$ are vectors, which is true for $\vec{A}-\vec{B}$ and $\vec{B}-\vec{A}$?

a. they point in the same direction
b. they have the same components
c. they point in opposite directions
d. they look the same when drawn

Clicker quiz: The horizontal (x) component of the velocity of a football while in the air is: (neglect air resistance)

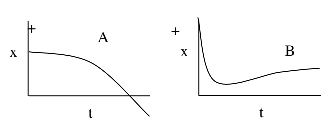
b. increasing
c. decreasing
d. staying the same
e. speeding up then slowing down
f. none of the above

More worked problems

A motorist drives **north** for 30 **minutes** at 85 km/h and then stops for 15 minutes. He then turns **south**, traveling 130 km in 50 min. His average **velocity** was ______ km/hr in the direction _____ 1) north 2) south

A baseball hit straight up takes 5 seconds to reach its maximum height. The initial velocity of the ball was_____ m/s. The maximum height the ball reached was_______ m.

Cliff divers at Acapulco jump into the sea from a cliff 40 m high. At the level of the sea, a rock sticks out a horizontal distance of 5.5 m. If the divers jump off horizontally, they must have a horizontal initial velocity greater than _____ m/s to just miss the very edge of the rock (if they use the velocity you calculate they would just hit the edge of the rock). The divers are in the air for how long? _____ s



A place kicker kicks a football from a point 50 m from the goalposts, from the ground. When kicked, the ball leaves the ground with a speed of 35 m/s at an angle of 25^o above the horizontal. When it crosses the plane of the goalpost it is ________ m above the ground. The initial horizontal component of the velocity is _________ m/s.