Problem solving: kinematics (II)

Physics 211
Syracuse University, Physics 211 Spring 2015
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Announcements

- Homework 2 due date is **tomorrow**
- Exam 1 is next Tuesday
  - No homework due next week
  - HW2 problems are similar to those on Exam 1
  - Recitation Friday is your group practice exam
  - If you must miss Friday, notify your TA in advance and explain to them why you will be absent; be prepared to provide documentation
  - If your absence is for a justified reason (see the syllabus), we will give you your grade on Exam 1 as a replacement for Group Exam 1
    - Saturday: Exam review in Stolkin, 5-8 PM

Exam 1

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- The exam will be somewhat easier than the homework.
- There will be one problem where you need the quadratic formula
    - ... this means interpreting the two values it spits out
- There will be at least one instance where you need to interpret or sketch position, velocity, and acceleration graphs
- You will *not* need to compute derivatives or integrals algebraically
- The exam will be four or five problems

Exam 1, protocol

- You will have assigned seats; we will post a seating chart before the exam
- Some seats are left-handed; we'll ask you which hand you write with on Friday's checkin
- You are allowed to bring one page of notes that *you handwrite yourself*
  - No typed notes unless you have a disability that prevents you from writing
  - Your friend can't write it
  - You can't photocopy stuff from the book
  - It won't help you as much anyway

Problem solving: 2D kinematics, constant acceleration

1. 1. If you have vectors in the "angle and magnitude" form $(\vec{a}, \vec{v}, \vec{s})$, convert them to components
2. 2. Write down the kinematics relations, separately for x and y
   - Many terms will usually be zero
   - Freefall: $a_x = 0$, $a_y = -g$ (with conventional choice of axes)
3. 3. Understand what instant in time you want to know about: ask the right question
4. 4. Put in what you know; solve for what you don't (using substitution, if necessary)
5. 5. Think about the physical meaning of your solution

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Do you have any questions from homework or recitation this week?

Throwing a rock off a cliff

A hiker throws a rock horizontally off of a $h = 100$ m tall cliff. If the rock strikes the ground $d = 30$ m away, how hard did she throw it? How fast was it going when it hit the ground? (Choose the origin at the base of the cliff, up/direction of throw as positive)

What is $v_{0,x}$ here?

A: 0

B: 10/3 m/s

C: You don't know *a priori*

What is $v_{0,y}$ here?

A: 0

B: 9.8 m/s

C: You don't know *a priori*

What is a_x here?

A: 0

B: -g

C: +g

D: You don't know *a priori*

What is a_y here?

A: 0

B: -g

C: +g

D: You don't know *a priori*

What is x_0 here?

A: 0

B: h

C: d

D: You don't know *a priori*

What is y_0 here?

A: 0

B: h

C: d

D: You don't know *a priori*

What question do you ask to find "how hard did she throw it?"

A: What value of $v_{x,0}$ makes it such that $x = d$ when $y = 0$?

B: What value of $v_{y,0}$ makes it such that $x = d$ when $y = h$?

C: What is the value of v_x when $y = 0$?

D: What is the magnitude of $\vec{v}$ when $y = 0$?

E: What is the magnitude of $\vec{v}_x$ when $y = h$?

What question do you ask to find “how fast is it going when it hits the ground?”

A: What is v_x at the time when $v_y = 0$?
B: What is v_x at the time when $y = 0$?
C: What is v_y at the time when $y = h$?
D: What is the magnitude of $\vec{v}$ when $y = 0$?
E: What is the magnitude of $\vec{v}$ when $y = h$?

What's the magnitude of $\vec{v}$?

A: $v\cos\theta$

B: $v\sin\theta$

C: $\tan^{-1}\frac{v_x}{v_y}$

A: $\sqrt{v_x^2+v_y^2}$

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Will the monkey dodge the coconut by doing this, or will the coconut return to monke?

Kicking a football from a cliff

We return to our example football player from last class. They kick a football from the top of a 10-meter-tall cliff at 20 m/s at an angle 30° above the horizontal. Where does it land?

A rocket

A rocket is launched from rest on level ground. While its motor burns, it accelerates at 10 m/s at an angle 30 degrees below the vertical. After $\tau = 10$ s its motor burns out and it follows a ballistic trajectory until it hits the ground.

How far does it go?