Problem solving: kinematics (II)

Physics 211 Syracuse University, Physics 211 Spring 2015 Walter Freeman

February 10, 2022

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

- The exam covers kinematics in one and two dimensions
- Kinematics: how are an object's position, velocity, and acceleration related?

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- Kinematics: how are an object's position, velocity, and acceleration related?
- 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

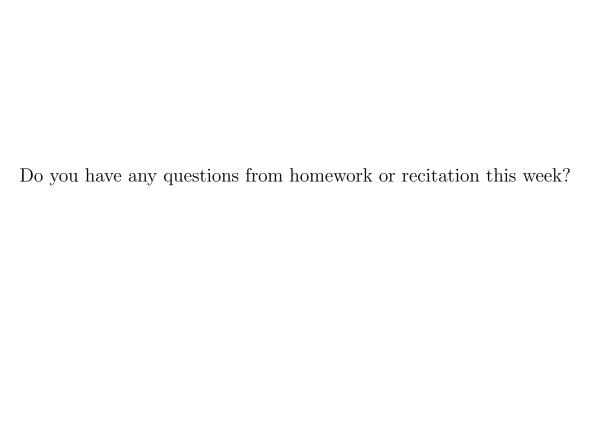
- You will have assigned seats; we will post a seating chart before the exam
- Some seats are left-handed; we'll ask you which hand you write with on Friday's checkin
- You are allowed to bring one page of notes that you handwrite yourself
 - No typed notes unless you have a disability that prevents 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. If you have vectors in the "angle and magnitude" form $(\vec{a}, \vec{v}, \vec{s})$, convert them to components
- \bullet 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. Understand what instant in time you want to know about: ask the right question
- 4. Put in what you know; solve for what you don't (using substitution, if necessary)
- 5. Think about the physical meaning of your solution

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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

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

A: 0

B: 9.8 m/s

What is a_x here?

A: 0

B: -g

C: +g

What is a_y here?

A: 0

B: -g

C: +g

What is x_0 here?

A: 0

B: h

C: d

What is y_0 here?

A: 0

B: h

C: d

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_r at the time when y=0?
- C: What is v_n 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?

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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?