Today’s class

Go through the webpage/syllabus
- policies
- grading scheme
- what’s (still relatively) new with 218
- general strategies

“Chapter 0” – math review
- scientific notation
- algebra
- simultaneous equations
- quadratic equation
- trigonometry
- calculus
Course objectives, outline, logistics, …

You should be able to find an answer to almost any question related to this course on the PHYS 218 common webpage:

http://physics218.physics.tamu.edu/

(if not, please let me know!!)

Required materials:
- Textbook: *University Physics*, 14th ed, vol 1, with modified MasteringPhysics
- Homework: modified MasteringPhysics; through eCampus (at least initially)
- Pre-lectures: FlipItPhysics (was smartPhysics)
- Labs: WebAssign
- Participation: i>Clickers
# Course evaluation

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common midterm exams</td>
<td>75%</td>
</tr>
<tr>
<td>Comprehensive exam</td>
<td></td>
</tr>
<tr>
<td>Laboratories</td>
<td>9%</td>
</tr>
<tr>
<td>Mastering homework</td>
<td>4%</td>
</tr>
<tr>
<td>Recitations</td>
<td>4%</td>
</tr>
<tr>
<td>FlipItPhysics pre-lectures and checkpoints</td>
<td>4%</td>
</tr>
<tr>
<td>i&gt;Clicker participation</td>
<td>4%</td>
</tr>
</tbody>
</table>
We have implemented a new grading scheme for the midterm and comprehensive exams, one based on how many learning objectives you have achieved (rather than a numerical grade)

The list of objectives for this course may be viewed at http://physics218.physics.tamu.edu/los.html

Your final exam grade (75% of your course grade) will be based on the fraction of those achieved to those tested over the whole semester

You need to achieve > 50% (not \( \geq 50\% \)) in order to achieve an objective

If you did not achieve an objective on the midterm(s), but it is tested in the comprehensive and you got it, then the correct answer trumps any previous ones and you will be considered as having mastered it

Best way to explain, probably, is by example…
Example problem from an old exam

Prob 1 You are playing Angry Birds and want to hit the pig on the upper shelf that is $h = 0.20$ m above the slingshot as indicated in the figure below. You aim your shot $36^\circ$ above the horizontal and send the bird off with $v_0 = 8.00$ m/s. Assuming you hit the pig:

a) Find the time that it took for the bird to reach the pig.

<table>
<thead>
<tr>
<th>Learning Objective</th>
<th>Mastered?</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.1</td>
<td>No</td>
</tr>
<tr>
<td>2.3</td>
<td>No</td>
</tr>
<tr>
<td>3.1</td>
<td>No</td>
</tr>
<tr>
<td>24.2</td>
<td>No</td>
</tr>
</tbody>
</table>

LO 14 is understanding the equations of motion. The “.1” means it is the first time it is tested on this exam.

LO 2.3 corresponds to the 3rd time you were tested on the ability to compute vector quantities. This (rather basic) objective would likely appear again in later exams.

You may have chances to improve (or lower) your standing with some LOs that are tested multiple times. Remember, the course builds on earlier material!
1. You go on-line and view the pre-lectures on FlipItPhysics before we meet
2. You usually do short “check-point” quizzes to test your understanding of the concepts
3. Hopefully you provide feedback so I know what to concentrate on in class ("just-in-time teaching")
4. Hopefully we have a more interactive lecture-session: clickers and problem-solving strategies
5. Follow up with resources available to you and doing problem after problem in the homework

Make sure you understand things as we go through them; it’s very easy to fall behind in this course, and nearly impossible to catch back up!
Grounded in research

The flipItPhysics approach is grounded in physics education research and principles of cognitive psychology. The system was developed over ten years at the University of Illinois, Urbana-Champaign, and tested by thousands of students and instructors at dozens of institutions across North America.

What's more, flipItPhysics works. Supported by grants from the National Science Foundation, our research demonstrates that students learn more when using flipItPhysics, and have a more positive outlook on their learning experience.
View pre-lectures and answer checkpoint questions
If you already got WebAssign access for math, you’ll still need to purchase a separate access code for this course.

Sign up with your TAMU NetID at www.webassign.net/tamu/login.html.

Once you successfully log in, you will be directed to the section you’re registered for and you can join the course.
Gaining access the first time

Note: The following message is shown to your students. As WebAssign faculty, you are not required to enter an access code.

⚠️ According to our records you have not yet redeemed an access code for this class or purchased access online.

The grace period will end Sunday, January 31, 2021 at 12:00 AM CST. After that date you will no longer be able to see your WebAssign assignments or grades, until you enter an access code or purchase access online.

I would like try:
- purchase access online
- enter an access code (purchased with textbook or from a bookstore)
- continue my trial period (12 days remaining)

Continue
Your homepage should look like this:
What to expect in this course

- Expect to work and put a lot of time into this course
- Expect to truly learn the material. Memorization *won’t* get you a good grade; there are no short cuts.
- Expect a fast pace: ~1 chapter/week!
- Expect to get frustrated
- Expect to get confused
- Expect to get mad

- Expect to learn to think more critically
- Expect to understand most of the physical phenomena you experience in everyday life
- Expect to develop good study habits and a strong work ethic which will serve you well in other courses and future careers!
Strategies

The obvious: come to class, go to recitations, do the work *yourself*, study and practice problems

The not as obvious:

― “It makes sense in class, but then I’m lost when I get back home and try to homework”

― Student:
  ● “I come to class and have done well on the homework; so why did I bomb your test???”

― Me:
  ● “Did you do the homework on your own?”
  ● “Did you copy a similar example as worked out in the solution manual or on the web?”
  ● “Did you use the book as you did it?”
  ● “Did you only use the formula sheet as you worked problems?”

http://physics218.physics.tamu.edu/index.shtml#resources
Chapter 1

Units, Physical Quantities, and Vectors

PowerPoint® Lectures for
University Physics, Twelfth Edition
– Hugh D. Young and Roger A. Freedman

Lectures by James Pazun

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Standards and units

Base units are set for length (meter or m), time (seconds or s), and mass (Kilogram or Kg).
Unit prefixes size the unit to fit the situation.

Kilo=k=10³
Centi=c=10⁻²
Mili=m=10⁻³
Nano=n=10⁻⁹
You are traveling in Europe in your Audi rental car and a policeman stops you and tells you. “Sir, you were going 160 km/h, what is the rush for?” How fast were you going in miles per hour?

Unit conversions is all about multiplying by 1, but a very particular one

\[
160 \frac{km}{h} \times \frac{1000m}{1km} \times \frac{39.37in}{1m} \times \frac{1ft}{12in} \times \frac{1mile}{5280 ft} = 99.4 mph
\]
Q&A Since Last Class

1. Assignment due dates?
2. If I am retaking the class, do I need to sign up for MP, SP, Web Assign?
3. How can I transfer my lab grades, if I had passed the lab from last time?
4. Can you extend my deadline? I somehow missed it!
5. Anything else I missed?
Vectors

Why we care about them
Addition & Subtraction
Unit Vectors
Multiplication

Bag of gold?
20 m - which way??
Why do we care about Vectors?
The world is not one-dimensional!

Three dimensions: X, Y and Z. Example:

1. Up from us
2. Straight in front of us
3. To the side from us
   – All at 90 degrees from each other. Three dimensional axis.

Need a way of saying how much in each direction

For this we use VECTORS
Vector and Scalar
Vector has a magnitude **AND** a direction
10 miles in the south direction
Scalar is just number
Mass of your car
Earth radius
Where am I?

Let’s say I’m here

You’re here (origin)

I call you on the cell phone.

How do I tell you how to get to me?

2 equivalent ways:

• Travel 11.2 km at an angle of 26.5 degrees

• Travel 10 km East then 5 km North

A single vector in arbitrary direction can be thought of as two vectors in nice simple directions (like $X$ and $Y$). This can make things much easier.
Vector Addition

To specify where I am, often doing the two vector version is easier

Represent Graphically:

Lay down first vector
Lay down second vector
Put the tail at the head of the first vector
The “Sum” is where I am
Re-write my location

Describe my location in terms of the sum of two vectors

\[ \vec{R} = \vec{R}_x + \vec{R}_y \]

\[ |R_x| = |R| \cos \Theta \]

\[ |R_y| = |R| \sin \Theta \]

Careful when using the sin and cos
Specifying a Vector

Two equivalent ways:

- Components $V_x$ and $V_y$
- Magnitude $V$ and angle $\theta$

Switch back and forth

- Magnitude of $V$
  \[ |V| = (v_x^2 + v_y^2)^{\frac{1}{2}} \]
  Pythagorean Theorem
- $\tan \theta = v_y / v_x$

Either method is fine, pick one that is easiest for you, but be able to use both.

\[ \sin \theta = \frac{v_y}{V} \]
\[ \cos \theta = \frac{v_x}{V} \]
\[ \tan \theta = \frac{v_y}{v_x} \]
\[ V^2 = V_x^2 + V_y^2 \]
Unit Vectors

Another notation for vectors:

Unit Vectors denoted \( \hat{i}, \hat{j}, \hat{k} \)
Magnitude of 1
Only purpose is to point in space

\[ \hat{i} \text{ means 1 in the } x \text{ direction} \]
\[ \hat{j} \text{ means 1 in the } y \text{ direction} \]
\[ \hat{k} \text{ means 1 in the } z \text{ direction} \]

\[ \vec{V} = V_x \hat{i} + V_y \hat{j} + V_z \hat{k} \]
Unit Vectors

Similar notations, but with $x, y, z$

$\hat{x}$ is the same as $\hat{i}$
$\hat{y}$ is the same as $\hat{j}$
$\hat{z}$ is the same as $\hat{k}$

$$\vec{V} = V_x \hat{x} + V_y \hat{y} + V_z \hat{z}$$
Vector in Unit Vector Notation

\[ |V_x| = |V| \cos \Theta \]
\[ |V_y| = |V| \sin \Theta \]
\[ \vec{V} = \vec{V}_x + \vec{V}_y \]
\[ \vec{V} = V_x \hat{i} + V_y \hat{j} \]
\[ \vec{V} = |V| \cos \Theta \hat{i} + |V| \sin \Theta \hat{j} \]
General Addition Example

Add two vectors using the \( i \)-hats, \( j \)-hats and \( k \)-hats

\[
\vec{D}_R = \vec{D}_1 + \vec{D}_2
\]

\[
\vec{D}_1 = 10 \text{ km } \hat{i} + 0 \text{ km } \hat{j} + 0 \text{ km } \hat{k}
\]

\[
\vec{D}_2 = 0 \text{ km } \hat{i} + 5 \text{ km } \hat{j} + 0 \text{ km } \hat{k}
\]

\[
\Rightarrow \vec{D}_R = 10 \text{ km } \hat{i} + 5 \text{ km } \hat{j} + 0 \text{ km } \hat{k}
\]
Simple Multiplication

Multiplication of a vector by a scalar

Let’s say I travel 1 km east. What if I had gone 4 times as far in the same direction? → Just stretch it out, multiply the magnitudes

Negatives:

Multiplying by a negative number turns the vector around
Subtraction

Subtraction is same as addition, except the second vector is first made negative and then the two are added together

\[ \mathbf{V}_2 - \mathbf{V}_1 = \mathbf{V}_2 + (-\mathbf{V}_1) \]
How do we Multiply Vectors?

First way: Scalar Product or Dot Product

Why Scalar Product?
Because the result is a scalar (just a number)

Why a Dot Product?
Because we use the notation $A \cdot B$

$$A \cdot B = |A||B|\cos \theta$$
First Question:

\[ \vec{A} \cdot \vec{B} = |A||B| \cos \Theta \]

What is \( \hat{i} \cdot \hat{i} \)?
What is \( \hat{i} \cdot \hat{j} \)?
Harder Example

\[ \vec{A} = A_X \hat{i} + A_Y \hat{j} \]

\[ \vec{B} = B_X \hat{i} + B_Y \hat{j} \]

What is \( \vec{A} \cdot \vec{B} \) using Unit Vector notation?
Vector Cross Product

\[ \vec{C} = \vec{A} \times \vec{B} \]

\[ |C| = |A||B|\sin \Theta \]

This is the last way of multiplying vectors we will see.

Direction from the “right-hand rule”

Swing from A into B!
Vector Cross Product Cont...

Multiply out, but use the Sinθ to give the magnitude, and RHR to give the direction

\[ \vec{C} = \vec{A} \times \vec{B} \]

\[ |C| = |A||B| \sin \Theta \]

\[ \hat{i} \times \hat{i} = 0 \ (\sin \theta = 0) \]
\[ \hat{i} \times \hat{j} = \hat{k} \ (\sin \theta = 1) \]
\[ \hat{i} \times \hat{k} = -\hat{j} \ (\sin \theta = 1) \]
Cross Product Example

\[ \vec{A} = A_x \hat{i} + A_y \hat{j} \]
\[ \vec{B} = B_x \hat{i} + B_y \hat{j} \]

What is \( \vec{A} \times \vec{B} \) using Unit Vector notation?