Announcements

• Having trouble getting started on WebCT? Try:
  – ITS Help sessions
  – Open access lab/student computing.
  – Instructions on faculty.physics.tamu.edu/toback/WebCT
  – email to webct@tamu.edu

• Check your neo email account for announcements. Two of you had your email bounce

• Any Volume 1 of the 11th edition of Young & Freedman will be fine. You will need Volume 2 for Phys208 and Volume 3 for beyond that. The maroon “University Edition” is also fine.
Procedure for Each Week

• Week 1 (This week):
  – Lecture: Chapter 1 (Reading, but nothing due)
  – Recitation: Calculus and Lab Techniques
  – Homework due: None

• Week 2 (Next week):
  – Homework due (Monday): Math quizzes
  – Lecture: Chapter 2 (Reading and Lecture Assignment due)
  – Recitation: Chapter 1 (and Lab 1)

• Week 3 (The week after that):
  – Homework due (Monday): Chapter 1
  – Lecture: Chapter 3 (Reading and Lecture Assignment due)
  – Recitation: Chapter 2 (no lab, but lab 1 is due)

• Etc..
Chapter 1: Math n’ Stuff

Won’t cover the entire chapter:

• **Problem Solving**
  – Tricks
  – Methods

• **Vectors**
  – Components (Unit vectors)
  – Addition
  – Multiplication (dot and cross products)
Problem Solving Overview

• There are good general problem solving TRICKS
  – Units checking
  – Special case checking
  – Etc.

• There are good METHODS of problem solving that prepare you for the exams

We’ll use both to solve problems in lecture
First Things First!

What’s the first thing you should do when you’re given a problem?

- **Draw a diagram!!!**
  - Usually good for some partial credit

- **List givens and wants as variables**
  - Also a good bet for partial credit

Then use reasonable equations and solve with your variables
Trick #2: Units

• The speed of your car isn’t measured in seconds, it’s measured in meters/second (or miles/hour etc.)

• Paying attention to the units will help you catch LOTS of mistakes on exams, quizzes and homework!!

  – If we ask what the mass of your car is, make sure your answer is in kg (or lbs etc.)

**Trick #2: Every time you finish a problem ALWAYS check the units of your answer!!**
Tricks #3 and #4

Check *Reasonableness*:

- Can you find another way to do the same problem that gives the same answer? *Trick #3*
- Simple numbers give expected numerical answers? Example: Zero, or infinity *Trick #4*
How to use the Tricks and Methods

• Next we’ll do an example problem like one of the homework problems in the text book

• Solve this problem using the right method
  – Draw a diagram
  – Convert the numbers to variables
  – Solve to get a formula
  – Plug in the numbers at the end
  – Check
    • Reasonable numbers?
    • Silly numbers?
    • Another way to do the same problem?
Example Problem

You want to measure the height of a building. You stand 2m away from a 3m pole and see that it’s “in line” with the top of the building. You measure 16 m from the pole to the building.

What is the height of the building?
Vectors

Vectors:
- Why we care about them
- Addition & Subtraction
- Unit Vectors
- Multiplication
Why do we care about Vectors?

As you may have noticed, 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

- Vectors have a magnitude AND a direction
  - I’m driving 70 miles/hr SouthEast to Houston
- Scalars are just a number
  - My speedometer says 70 m/hr
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:
1) Travel 11.2 km at an angle of 26.5 degrees
2) Travel 10 km East then 5 km North

My single vector in some funny 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

Adding vectors is a skill
Use this in far more than just physics
More on this later…
Re-write my location

• Describe my location in terms of the sum of two vectors

\[ \vec{V} = \vec{V}_X + \vec{V}_Y \]

\[ |V_X| = |V| \cos \Theta \]

\[ |V_Y| = |V| \sin \Theta \]

• 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
  – \( \tan \theta = \frac{v_y}{v_x} \)

Either method is fine, but you should pick which is easiest, and be able to use both

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

This is how the pros write things!

\( \hat{i} \) means 1 in the x direction

\( \hat{j} \) means 1 in the y direction

\( \hat{k} \) means 1 in the z direction

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

The pros also use:

\( \hat{x} \) 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 \( \hat{i} \)-hats, \( \hat{j} \)-hats and \( \hat{k} \)-hats

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

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

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

\[
\Rightarrow \vec{D}_R = 10 \text{ km} \hat{i} + 5 \text{ km} \hat{j} + 0 \text{ km} \hat{k}
\]
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 $A \cdot B$

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

\[ \hat{i} \times \hat{i} = 0 \ (\sin \theta = 0) \]
\[ \hat{i} \times \hat{j} = \hat{k} \ (\sin \theta = 1) \]
\[ \hat{i} \times \hat{k} = -\hat{j} \ (\sin \theta = 1) \]
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?
Results of Math Quizzes

The average of all Math Quizzes taken so far (not the Math Assessment) is about an 8.1 with a standard deviation of just above 1.1.

How to evaluate where you stand. If the average of the scores of all the quizzes you have taken is:

- 95% or above: Well prepared
- 85% - 90%: Good, but needs to be better
- 80% – 85%: Ok, but really needs some work
- 75% - 80%: Hmmm...maybe get some help
- 75% or below: Careful...Definitely get help! Maybe drop...
For Next Week

• **Before Lecture:**
  – Read Chapter 2
  – Math Quizzes due Monday
  – Lecture Assignment: Q2.8 and Q2.20 (These are the “Discussion Questions”)

• **In Lecture**
  – Cover Chapter 2
  – Turn in Lecture Assignment at the beginning

• **Recitation, Lab and Homework:**
  – Start HW1 on WebCT before recitation
  – All Ch. 1 problems due Monday after recitation
  – Read your lab materials before lab