Name ___________________
Mr. Dove

Honors Physics
Based on Chapter 1, 2, and 6 in the textbook

Unit 1: Intro. to Physics

Objectives:

1. Understand selected metric units and prefixes
2. Be able to set up and calculate simple conversions
3. Identify, measure, and calculate with significant figures
4. Be able to manipulate an equation to solve for a variable
5. Perform calculations using trigonometry
6. Graph and identify linear and power functions
7. Draw scaled diagrams using vectors to find the resultant

I. Units:

- Base Units – these units are used along with various laws to define additional units for other important physical quantities
- For this course we will be using the metric system.

SI (International System of Units)Base Units

Quantity	Unit	Symbol
Length	meter	m
Mass	kilogram	kg
Temperature	kelvin	K
Time	second	s
Amount of Substance	mole	mol
Electric Current	ampere	A
Luminous Intensity	candela	cd

- **Remember**: We will only be using the metric system in this course, so here are some useful ways of relating the English System (US's measurement) to the rest of the world

1 kg = 2.20 lb = approximate mass of a textbook (175 lb person = 79 kg)
1 m = 3.28 ft = approximate height of a doorknob (a basketball hoop (10ft) = 3.05 m)

- **Derived units**: ____

Examples: *velocity/speed:* _________, *acceleration:*________________, *force:* ____________

- The SI system is a decimal system, meaning prefixes are used to change SI units by a power of 10
- Common prefixes we will use are:

Prefix	Symbol	Notation
•	• *k*	•
• *Centi-*	•	•
•	•	• 10^{-3}
• *Micro-*	•	•

- Find common prefixes on the Physics Reference Tables (front page – bottom left)
- Convert the following:

1) 25 centimeters to meters:

2) 0.25 grams to milligrams (mg):

3) 3.56×10^{-4} kilograms (kg)to grams:

4) 500,000 micrometers (μm) to meters

5) 5.7×10^{5} meters to gigameters (Gm)

6) 4.5×10^{-7} megagrams (Mg) to grams

II. Scientific Notation

- For very small and very large numbers we use scientific notation
- Express decimals places as powers of ten

A. Converting standard numbers to scientific notation:

1.) 25 students

2.) 2008 year

3.) 100,000,000,000 stars

B. Converting scientific notation to standard numbers:

1.) 9.6×10^{-5} mL

2.) 8.3×10^{-2} s

3.) 5.6×10^{0} m

III. Conversion of Units

- Any quantity can be measured in several different units, therefore it is important to know how to convert from one unit to another.
- Conversion scales are used to convert one unit to another

Necessary conversion scales:

1 mile = 5280 ft

1 hr = 3600 s

1 gallon = 3.79 L

1 mile = 1609 meters

1 whatchamacallits = 320 thingamajigs

1. How many miles are in 28,465 ft?

2. How many gallons are in 5 L?

3. How many meters in 1,075 nanometers?

4. How many thingamajigs are in 5.5×10^4 whatchamacallits?

5. How many miles/hour is 40 m/s? (double conversion)

IV. <u>Significant Figures</u>

- They are the valid digits in a measurement
- **Rules for Sig. Figs.:**

1. Nonzero digits are always significant	Ex) 235 => ________ 0.45 => _______
2. All final zeros after the decimal point are significant	Ex) 2.3400 => ______
3. Zeros between two other significant digits are always significant	Ex) 2008 => ______ 0.203 => ______
4. Zeros used solely as placeholders are not significant	Ex) 300,000 => ______ 0.0030500 => ________

Examples: How many significant figures does each of these measurements have?

1) 3.1 m ______ 2) 3.0001 kg _____ 3) 1.20×10^{-4} km ______ 4)0.007060 cm _____

- For this course, just round answers to three significant figures.
- IMPORTANT: When using your calculator to perform scientific calculations ALWAYS use the EE (EXP) button. **<u>Example</u>**: 3×10^3 would be entered as: 3 EE 3

- Round the answers to three significant figures and in scientific notation:

1) 3580 * 256 =

2) $\frac{45.45}{23.0} =$

3) (?Ç????? ÆÇ?????? ? / ???Ç

4) $\frac{(2.11x10^{-34})(5.55x10^{18})}{(3.00x10^{-7})(6.86x10^{-9})} =$

5) $\frac{(6.67x10^{-11})(1.67x10^{-27})(9.11x10^{-31})}{(1.23x10^{-22})^2} =$

V. Equation Manipulation

- In physics we will be using a lot of equations. To solve for specific variables in the equations we want to first manipulate the variables around to solve for what we are looking for.

- In the following examples solve the given variable:

1) $a = \frac{F}{m}$, solve for m

2) $v_f = v_i + at$, solve for a

3) $PE = \frac{1}{2}kx^2$, solve for x

4) $v_f^2 = v_i^2 + 2ad$, solve for v_i

5) $a = \frac{\Delta v}{t}$, solve for t

6) $d = v_i t + \frac{1}{2}at^2$, solve for a

7) $P = \frac{V^2}{R}$, solve for V

8) $F = \frac{Gm_1 m_2}{r^2}$, solve for r

9) $v_f^2 = v_i^2 + 2ad$, solve for a

10) $F = \frac{Gm_1 m_2}{r^2}$, solve for m_1

VI. Dimensional Analysis

- Dimensional analysis is used to check mathematical relations for the consistency of their dimensions
- Meaning, the dimension (i.e. – length) on the right side of the equation, has to match the dimension on the left side of the equation

Example:

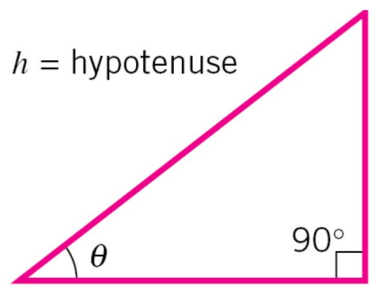
Variable	Units
x	meters (m)
v	meters per second (m/s)
t	seconds (s)
a	meters per second squared (m/s^2)

In which of the following equations do the units on the right side equal the units on the left side.

1. $x = vt + \frac{1}{2}at^2$
2. $v = at$
3. $v = at + \frac{1}{2}at^3$
4. $t = \sqrt{\frac{2x}{a}}$

VII. Trigonometry (see ref. tabs.)

- In physics we use trig. to find the dimensions of buildings and objects and to find the x and y components of vectors (i.e. – velocity, force, displacement)



- NOTE:*the choice of which side the triangle to label opposite and adjacent is made after the angle is identified*

- Example:

A tall building casts a shadow of 70.0 m long. The angle between the sun's rays and the ground is 50.0 degrees. Determine the height of the building.

Inverse Trigonometric Functions:

- When values of two sides of a right triangle are given, the angle can be calculated by using the inverse trig. Functions (see Reference Tables)

$$\sin\theta = \frac{opp}{hyp} \Rightarrow \theta = \sin^{-1}\left(\frac{opp}{hyp}\right)$$

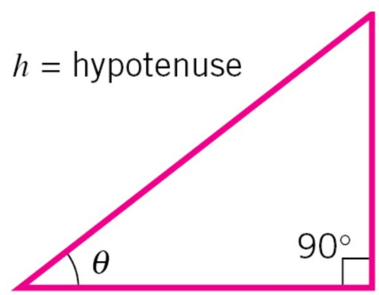
$$\cos\theta = \frac{adj}{hyp} \Rightarrow \theta = \cos^{-1}\left(\frac{adj}{hyp}\right)$$

$$\tan\theta = \frac{opp}{adj} \Rightarrow \theta = \tan^{-1}\left(\frac{opp}{adj}\right)$$

Example: A lakefront drops off at a certain angle. At a distance 15.0 m from the shore, the water is 2.25 m. What is the angle the lakefront drops off at?

VIII. Pythagorean Theorem

Square of the length of the hypotenuse of a right triangle is equal to the sum of the square of the length of the other two sides:



Example:
A highway is to be built between two towns, one of which lies 35.0 km S and 72.0 km W of the other. What is the shortest length of the highway that can be built between the two towns, and at what angle would this highway be directed?

IX. Graphing/Mathematical Models

- To describe how nature works, we collect data and look for patterns in that data
- We often try to map these patterns to mathematical models in the form of equations. These models are most important in physics because they not only describe the specific experiments we performed, but give you insights beyond our data set to help us understand the universe.

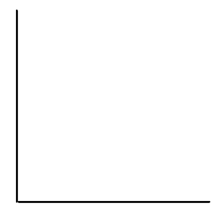
X. Linear Functions

- Linear functions (direct relationships) are the easiest ones to recognize – they are _________

- They all have the general form:

Direct Relationship

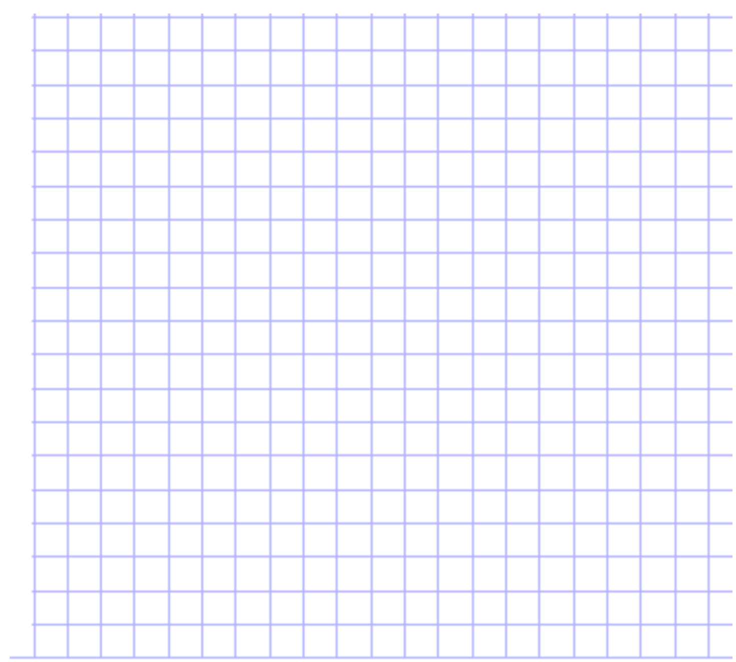
- Exists when both variables are located in the ______________
- Physics Equation Example:



- **Example: Plot the data on the graph paper and analyze it.**
  1) Pick appropriate scales for each axis to maximize the area of the graph
  2) Plot the points carefully
  3) Use a ruler to draw a BEST FIT STRAIGHT LINE through the data. DO NOT PLAY CONNECT-THE-DOTS!!!
  4) Calculate the slope of the line by picking two convenient points ON THE LINE. (NOT DATA POINTS!!!)

Time (s)	Distance (m)
2	4
4	9
6	12
8	16
10	19

Slope Calculation:



XI. Power Functions (Nonlinear Relationships)

- There are a lot of functions that have this form, but the two we will be most concerned about are:

1. Direct Square (Top opening parabola)

- Exists if both variables are located in the ____________

and one variable is ____________

General Equation:

Physics Equation Example:

2. Inverse/Inverse Square

- Exists if one of the variables is located in the _______________ while the

other is in the _____________.

General Equation:

Physics Equation Example:

Example: Plots the points on the graph paper and analyze it

a. Decide what are the independent and dependent variables
b. Pick appropriate scales for each axis to maximize the area of the graph
c. Plot the points carefully
d. Identify what type of relationship it is

radius (m)	Area (m^2)
1	3.14
3	28.3
5	78.5
7	154

Type of Relationship: ____________

Unit 1B: Vectors

I. <u>Vector Introduction</u>

- What is a **scalar quantity**?

____________________ that has only ______________________ (________________)

Examples of scalar quantities:

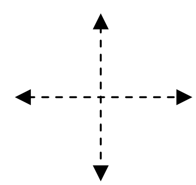
- What is a **vector quantity**?

____________________ that has ______________________ AND _______________________

Examples of vector quantities:

- What is a **vector**?

Scale used to show ________________ AND ___________________

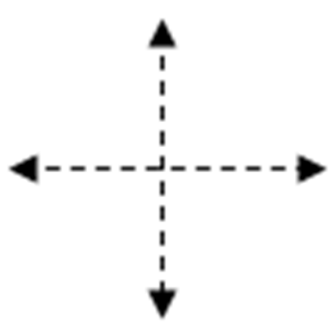


- What do the negative and positive signs mean when dealing with vectors?

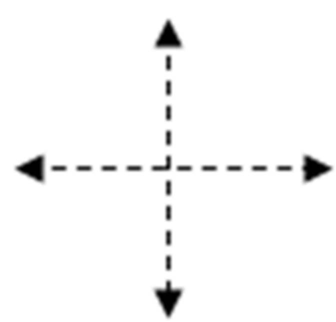
They mean _________________, NOT _____________________

- How do I draw vector?
  - o Coordinate Systems:

Cartesian:



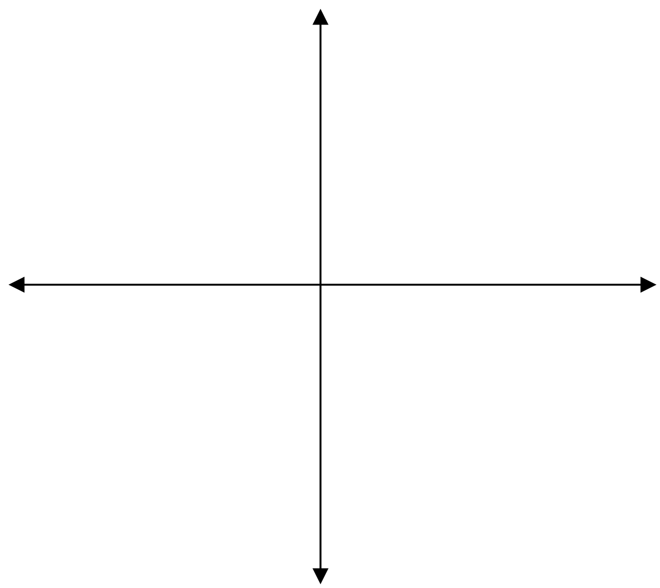
Navigational:



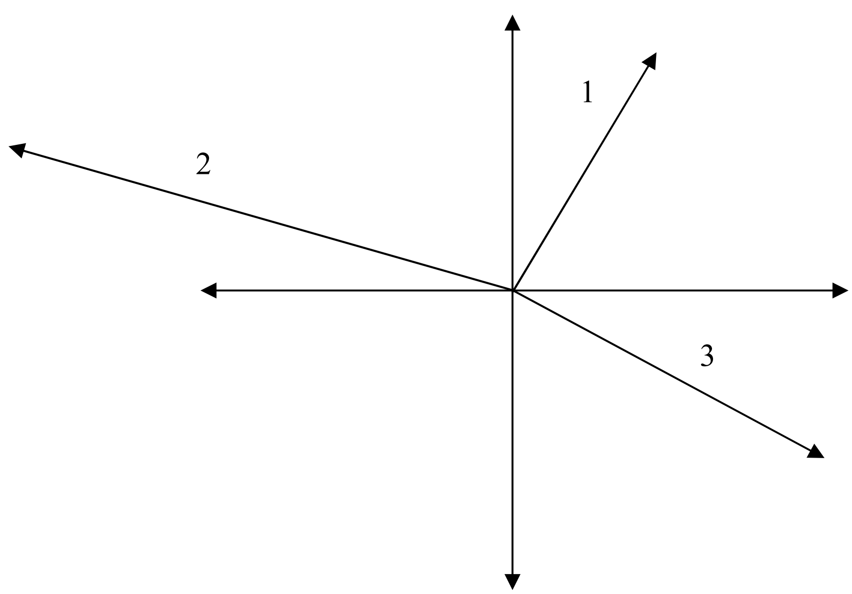
II. Scaling Vectors

- Draw the following vectors using a scale of 1 unit = 1 cm and a Cartesian coordinate system.

Vector #	Magnitude	Direction (^{o})
1	3 units	30
2	5 units	137
3	4 units	210



- Measure the magnitude and direction of the vectors below. Use the Navigational system and a scale of 1 cm= 5 units.



Vector 1: Mag. = ______ Dir. =____
Vector 2: Mag. = ______ Dir. =____
Vector 3: Mag. = ______ Dir. =____

Vector Addition

I. Resultant Vector

- What is it?

  __________________ of vectors

- Equilibrant Vector

  Same ________________________ as resultant, but opposite ________________________

- How do I add vectors to determine a resultant?
  Head to tail method:

  1. Draw the first vector starting at the origin
  2. Set up a new origin at the head of the first vector
  3. Draw the second vector at the head of the first vector

The resultant is drawn from the starting position of the first vector to the head of the last vector

- **Examples**:

1. 3 m @ 0^o + 2 m @ 0^o

2. 3 N @ 180^o + 2 N @ 0^o

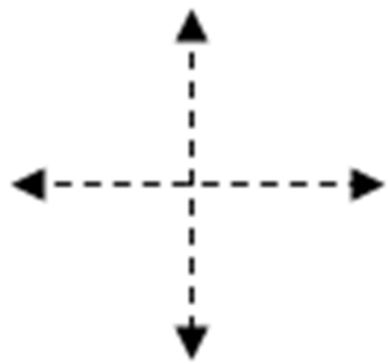
3. 3 m @ 0^o + 2 m @ 90^o

4. 3 unit @ 180^o + 2 units @ 270^o

5. 25 km @ 0^o + 20 km @ 270^o

II. Vector's X and Y Components

- Vector Resolution: Breaking a vector into its horizontal and vertical components



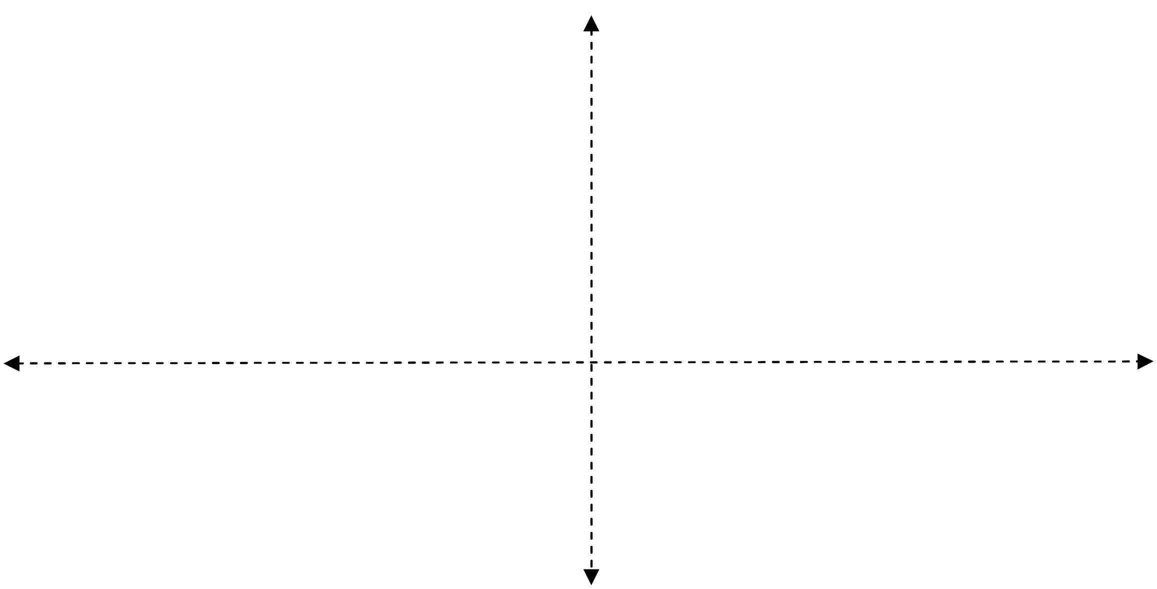
III. Vector Scale Diagram

1. A student walks 10 m east, 5 m north, and then 12 m west.

A. Determine a scale to use in a diagram.

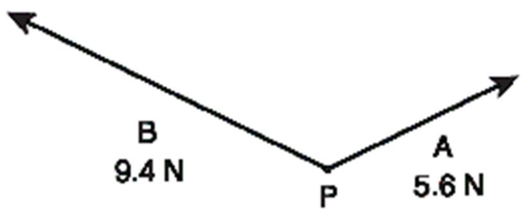
1 cm = ___________ m

B. Using your scale, create a vector map of each of the vectors.
C. Determine the total distance traveled.
D. Determine the resultant (magnitude and direction) of the student.



- Use the head-to-tail method. Based on the diagram below, do the following:

1. Using a ruler and protractor, construct a vector representing the resultant of the forces.
2. Construct a vector to represent the equilibrant of the forces
3. Determine the scale used in the diagram: 1 cm = ______ N
4. Based on your diagram and scale, what is the magnitude of the resultant and equilibrant?



- Use head to tail method to find the resultant of the vectors.

Bertha and Bob want to steal a cow. They go to a farm and each tie a rope around the biggest cow at the farm. Bertha pulls with a force of 40 N at 45^{o} and Bob pulls with a force of 25 N at 90^{o}. 1) What is the sum of their forces? 2) As soon as they start pulling on the cow, the farmer catches them and begins to pull on the cow. Which way and how much for must the farmer pull to keep his cow?