General Physics 1

- Class Goals
  - Develop problem solving skills
  - Learn the basic concepts of mechanics and learn how to apply these concepts to solve problems
  - Build on your understanding of how the world works

Chapter 1
Homework Problems: 18, 28, 36, 41, 43
Units Systems

SI Base units

Length - meter (m)

Mass - kilogram (kg)

Time - second (s)

Temperature - kelvin (K)

Electric current - Amps (A)

Amount of substance - mole

Luminous intensity – candela (cd)

Other Units can be derived by combining the base units

Force - newton (N)

$N = kg*m/s^2$

Pressure - pascal (Pa)

$Pa = N/m^2 = kg/(m*s^2)$

Dimensional Analysis

Example – acceleration has units of length/time^2

Accelaration has units: m/s^2

Velocity = displacement/time = length/time

In SI units, the units for velocity are m/s

Checking the units of your answer is a good way of checking your work for any mistakes.

Converting units

- Suppose you want to convert miles per hour to meters per second.

(miles/hour)*(1 hour/3600 seconds)*(1609 meters/1 miles) =#meters/second

Example: A car is driving 60 miles per hour. How fast is the car going in meters per second?

(60 mi/hr)*(1hr/3600 s)*(1609 m/1 mi) = 60*1609/3600 m/s

= 27 m/s

Convert a measurement in feet to meters

- A basketball hoop is 10 feet above the ground. How high is it in meters?

  What you need to know is how many feet are in a meter. (~ 3ft/m)

  What I know: 12 inches in a foot

  2.54 centimeters in an inch

  100 centimeters in a meter

10 ft *(12 in/1 ft)*(2.54 cm/1 in)*(1 m/100 cm) = 10*12*2.54/100 m

= 3.048 m

So 10 feet is just a bit more than 3 meters.

Uncertainty and Significant digits

Uncertainty deals with the accuracy of a measurement.

When you take a measurement, the number of digits that you know accurately are significant.

If you were to use a meter stick to measure a the length of a book, you could see the number of centimeters and hopefully the number of millimeters. Since the meter stick doesn't have any smaller marking you can't be any more accurate.

Counting Significant digits.

- Any number that is not a zero is significant.
- Zeroes in between non-zeroes are also significant.

Examples: 2632 has 4 s.d.

1420000 has 3 s.d.

0.0000002 has 1 s.d.

407 has 3 s.d.

Math involving significant digits.

- Multiplying or dividing numbers. Count to see how many s.d. each number has. Your answer should have the same amount as the number with the least amount of s.d.

  example: 74.2 *2.2 = 163.24

  = 160

Adding and subtracting numbers

- Answer should as accurate as your least accurate number.

  Example: 12.2 + 2.345436434625

$$\begin{array}{r} 12.2\text{xxxxxxxxxxxx} \\ +\quad 2.345436434625 \\ \hline 14.5 \end{array}$$

Dealing with really big or small numbers

- Really big or small numbers can get annoying to work with.
- Make use of scientific notation.

example: 299 792 458 m/s

rewrite as 3.0×10^{8} m/s

0.00000065 m

rewrite as 6.5×10^{-7} m

Estimations and order of magnitude calculations

- Very useful when an exact number is not necessary.
- The order of magnitude is the power of 10 found when writing a number in scientific notation.

  example: Speed of light is 299 792 458 m/s or 3×10^8 m/s

  You can say that the speed of light is on the order of 10^8 m/s.

Estimations and order of magnitude calculations

- Make rough calculation easier.
- Handy when you don't have your calculator.

Example: Find area of a circle with a radius of 2 meters.

Area = π*(radius)^2

Estimated solution, with π approximately 3

Area = 3*(2 m)^2 = 12 m^2

If you typed in 3.14159 for π, your answer would be about 12.6 m^2

Estimations and order of magnitude calculations

Estimate the number of people needed to make ‘human chain’ across Tennessee.

Estimations and order of magnitude calculations

Estimate the number of people needed to make ‘human chain’ across Tennessee.

TN is about 500 miles long

1 mile about 1.6 km

So TN is about 800 km long.

Reach of a person is about 1 meter.

800km is 800*1000 meters.

You would need about 800 000 people.

Coordinate Sytems

We will mostly use Cartesian coordinates. (x, y)

You can pick whatever point you want to be the origin or reference point. Pick one that is convenient.

There is also the polar coordinate system, but we won't use it much. (r, θ). The r is for a magnitude, and θ is the angle from a reference axis.

Trigonometry

We will be using trig in General Physics.

Important when dealing with vectors. (will cover vectors soon)

Need to know how to use trig functions.

sine, cosine, tangent…

Measuring a building's height

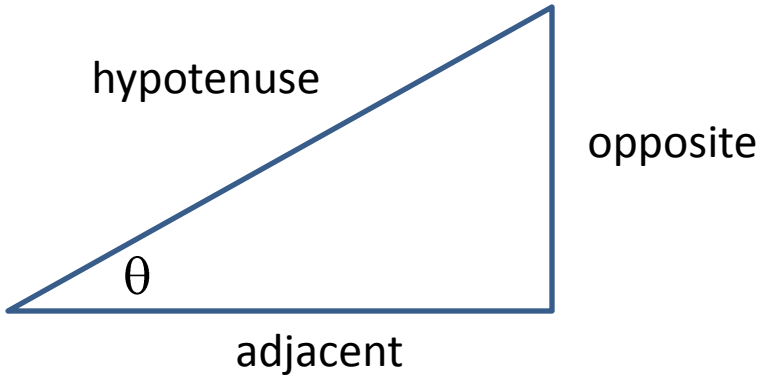
Using trig to measure how tall a building is:

Suppose you walk 20 meters from the base of a building and then you shine a laser pointer to the top of the building's wall. The laser beam makes an angle of 60 degrees with the ground. Using trig you can find how high the building is.

$\sin \theta = \text{opp/hyp}$

$\cos \theta = \text{adj/hyp}$

$\tan \theta = \text{opp/adj}$

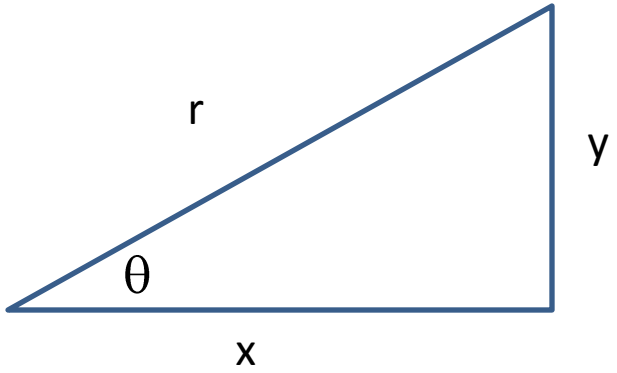


$\sin^{-1} (\text{opp/hyp}) = \theta$

$\cos^{-1}(\text{adj/hyp}) = \theta$

$\tan^{-1}(\text{opp/adj}) = \theta$ also $\tan = \sin/\cos$

Angle	sin	cos	tan
0	0	1	0
30	½	$\sqrt{3}/2$	$1/\sqrt{3}$
45	$\sqrt{2}/2$	$\sqrt{2}/2$	1
60	$\sqrt{3}/2$	½	$\sqrt{3}$
90	1	0	undefined

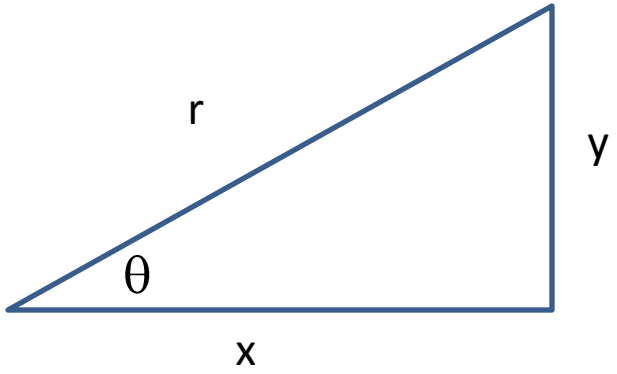


Using definitions of sin and cos we get:

$r*\cos\theta = x$

$r*\sin\theta = y$

Pythagorean theorem



Good for right triangles

$r^2 = x^2 + y^2$

$r^2 = (r*\cos\theta)^2 + (r*\sin\theta)^2 = r^2(\cos^2\theta + \sin^2\theta)$

$= r^2 (\quad 1 \quad)$

Taking square root of both sides shows r = r

Trig identities are in text's appendix

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Using trig to measure how tall a building is:

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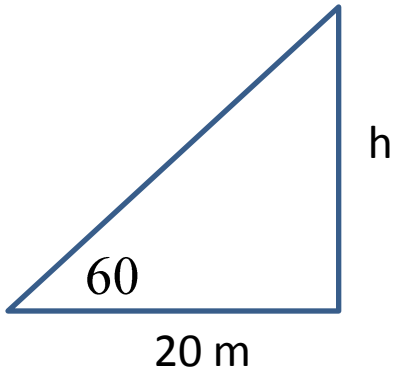
Use tan 60 = (h/20 m)

h = 20 tan 60 = 35 m



Physical quantities.

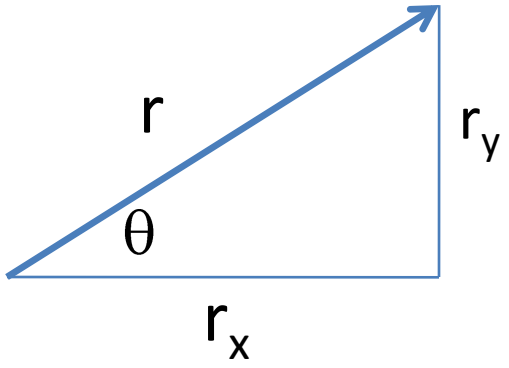
2 Types of quantities

- scalars
  - magnitude
    - (mass, speed, energy)
- vectors
  - magnitude and direction
    - (velocity, acceleration, force)

Vectors

- Components

  The components of a vector can be found using trig.



$r*\cos\theta = r_x$

$r*\sin\theta = r_y$

Vector Addition

When adding vectors, you add the like components.

Vector A has component $A_x = 2$ and $A_y = 4$

Vector B has components $B_x = 5$ and $B_y = 6$

The resultant vector (C) has components:

$C_x = 2+5 = 7$

$C_y = 4+6 = 10$

Vector Addition

Graphically adding vectors A (2,4) and B (5,6)