Measurement in Physics

AP Physics B

SI units for Physics

The SI stands for "System International". There are 3 fundamental SI units for LENGTH, MASS, and TIME. They basically breakdown like this:

SI Quantity	SI Unit
Length	Meter
Mass	Kilogram
Time	Second

Of course there are many other units to consider. Many times, however, we express these units with prefixes attached to the front. This will, of course, make the number either larger or smaller. The nice thing about the prefix is that you can write a couple of numbers down and have the unit signify something larger.

Example: 1 Kilometer – **The unit itself denotes that the number is actually larger than "1" considering fundamental units. The fundamental unit would be 1000 meters**

Most commonly used prefixes in Physics

Prefix	Factor	Symbol
Mega- (mostly used for radio station frequencies)	**x 10^6**	M
Kilo- (used for just about anything, Europe uses the Kilometer instead of the mile on its roads)	**x 10^3**	K
Centi- (Used significantly to express small distances in optics. This is the unit MOST people in AP forget to convert)	**x 10^{-2}**	c
Milli- (Used sometimes to express small distances)	**x 10^{-3}**	m
Micro- (Used mostly in electronics to express the value of a charge or capacitor)	**x 10^{-6}**	μ
Nano (Used to express the distance between wave crests when dealing with light and the electromagnetic spectrum)	**x 10^{-9}**	n

Tip: Use your constant sheet when you forget a prefix value

Example

If a capacitor is labeled 2.5mF(microFarads), how would it be labeled in just Farads?

The **FARAD** is the fundamental unit used when discussed capacitors!

2.5 x 10^{-6} F   **Notice that we just add the factor on the end and use the root unit.**

The radio station XL106.7 transmits at a frequency of 106.7 x 10^6 Hertz. How would it be written in MHz (MegaHertz)?

A **HERTZ** is the fundamental unit used when discussed radio frequency!

106.7 MHz   **Notice we simply drop the factor and add the prefix.**

Dimensional Analysis

Dimensional Analysis is simply a technique you can use to convert from one unit to another. The main thing you have to remember is that the **GIVEN UNIT MUST CANCEL OUT.**

Suppose we want to convert 65 mph to ft/s or m/s.

$$65\frac{miles}{hour} \cdot \frac{1hour}{60\min} \cdot \frac{1\min}{60\sec} \cdot \frac{5280\,ft}{1mile} \Rightarrow \frac{65\times1\times1\times5280}{1\times60\times60\times1} = 95\frac{ft}{s}$$

$$95\frac{ft}{s} \cdot \frac{1meter}{3.281\,ft} \Rightarrow \frac{95\times1}{1\times3.281} = 29\,m/s$$
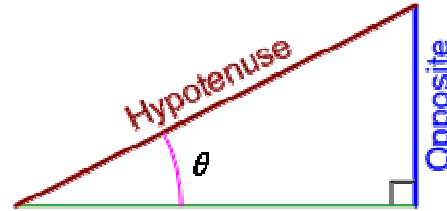
Trigonometric Functions

Many concepts in physics act at angles or make right triangles. Let's review common functions.

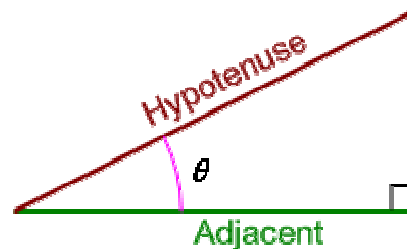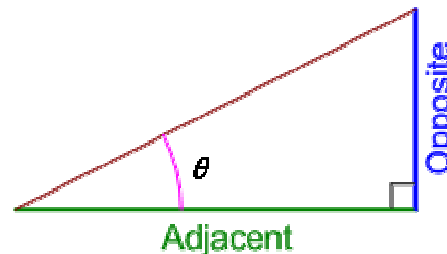$$c^2 = a^2 + b^2$$

Pythagorean Theorem

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

$$\text{Sin } \theta = \frac{\text{Opposite}}{\text{Hypotenuse}}$$
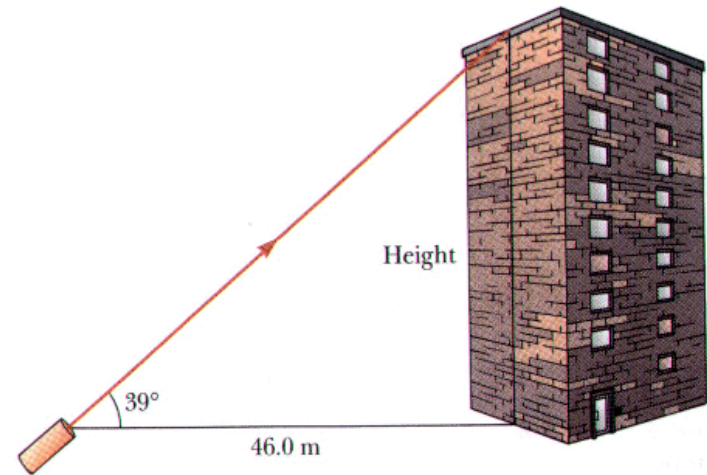
$$\text{Cos } \theta = \frac{\text{Adjacent}}{\text{Hypotenuse}}$$

$$\text{Tan } \theta = \frac{\text{Opposite}}{\text{Adjacent}}$$

Example

A person attempts to measure the height of a building by walking out a distance of 46.0 m from its base and shining a flashlight beam toward its top. He finds that when the beam is elevated at an angle of 39 degrees with respect to the horizontal ,as shown, the beam just strikes the top of the building. a) Find the height of the building and b) the distance the flashlight beam has to travel before it strikes the top of the building.

Height

39°

46.0 m

$$Tan\,39.0° = \frac{height}{46.0m}$$

$$height = (Tan39.0°)(46.0m) = 37.3m$$

What do I know?	What do I want?	Course of action
•The angle •The adjacent side	The opposite side	USE TANGENT!

$$c = \sqrt{a^2 + b^2} = \sqrt{(37.0m)^2 + (46.0m)^2} = 59.2m$$

Example

A truck driver moves up a straight mountain highway, as shown above. Elevation markers at the beginning and ending points of the trip show that he has risen vertically 0.530 km, and the mileage indicator on the truck shows that he has traveled a total distance of 3.00 km during the ascent. Find the angle of incline of the hill.

3.00 km

0.530 km

θ

What do I know?	What do I want?	Course of action
•The hypotenuse •The opposite side	The Angle	USE INVERSE SINE!

$$Sin\,\theta = \frac{0.530}{3.00} = 0.177$$

$$\theta = Sin^{-1}(0.177) = 10.2°$$