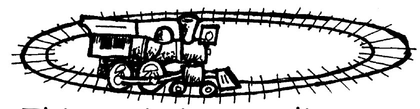
One Dimensional Kinematics (description of motion, not concerned with the *cause* of motion)

Velocity and speed are two closely related words. You might think that they are the same thing, but in physics we find that they are very different.

______________is a measure of how fast something moves. It is a __________. Rates are quantities divided by time. In addition, speed is a _____________ quantity.

______________ is also a rate – the rate that displacement changes with time. The key thing here is that velocity is a ____________. It has _____________ – just as speed does – but it also has a ________________. When we talk about speed, we don't care about the direction of motion. The car went at a speed of 50 miles per hour. We don't care if it went south, north, east, west, whatever. With velocity we do care about the direction. Velocity would be the motion of a car that is going _____________ at ____ mph. The standard units for velocity and speed are meters per second (______).

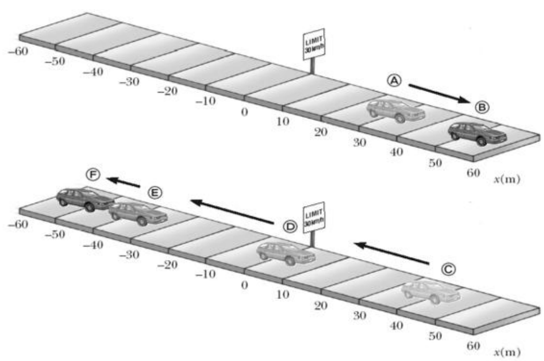
A ***vector*** is a quantity that has both magnitude and direction.



This train is traveling at a constant speed

A toy train traveling around a circular track is moving at a constant speed. It ____________________ have a ________________ velocity, however, because its direction is constantly changing.

Distance is a scalar – just how far you are from some point.



______________________, on the other hand, is a _____________ – ____________________ & ___________________. It is the change in position $\Delta x = x - x_i$ (*x* is the final and *i* is for initial). The standard units are meters (__).

***** ______ is used to ___________________________ mathematically ****

___________________________ ***velocity*** is the velocity of an object at any given instant of time. A car traveling from ***C*** to ***F*** does not always travel at a constant velocity - it stops, speeds up, slows down, etc. The speedometer on the dashboard reads out the instantaneous speed. At a stop sign it reads 0 mph, later on after the light turns green it might read 36 mph, and so on.

_________________ ***velocity*** is the velocity for an entire trip. It is the total displacement divided by the total time.

$$average\ velocity = \frac{change\ in\ position}{time\ interval}$$

t

The symbol ***v*** is used for velocity (and is also used for speed). Some texts use $\bar{V}$, where a little bar is placed over the "v" indicating that it is a vector. We won't do that.

Average velocity is defined mathematically as: [ ]

This equation is not given on the AP equations sheet

Δx means the change in ***x***, the displacement, ***Δt*** is the change in ***t***.

If the initial conditions are zero, in other words, the motion started at time = 0 and at position = 0, then the equation for average velocity can be shortened to:

$$v = \frac{x}{t}$$ This is also used when an object has a constant velocity.

We end up with three equations for average velocity, but they're all just variations of the same equation.

or

It is very common to use other letters for displacement. For example, you might use ***s*** for some general displacement. You might use ***y*** if the motion is in the ***y*** direction. ***h*** is sometimes used if the distance is a vertical distance and ***r*** might be used if we're talking about the radius of a circle.

Example Problems:

1) In the 1988 Summer Olympics, Florence Griffith-Joyner won the 100 m race in a time of 10.54 s. Assuming the distance was laid out to the nearest centimeter so that it was actually 100.00 m, what was her average velocity in m/s and km/h?

Converting to km/h:

2) You begin a trip and record the odometer reading. It says 45,545.8 miles. You drive for 35 minutes. At the end of that time the odometer reads 45,569.8 miles. What was your average speed in miles per hour?

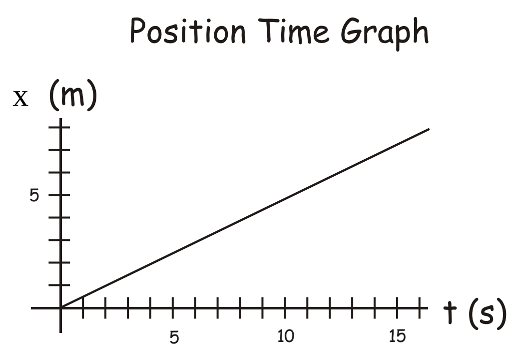
3) A high speed train travels at an average speed of 227 km/h for 2 hours. It takes 15 minutes for passengers to exit/enter the train. It then travels at 220 km/h for 1 hour. What is the train's average speed?

4) Car one is traveling at a constant velocity of 45 mph and car 2 is traveling at a velocity of 50 mph. When and where will car 2 catch car 1 if car one is 075 miles ahead of car 2?

All Motion Is Relative: Motion, i.e. velocity, is said to be relative. This is an important concept. What it means is that when we say that something has a given velocity, that velocity is relative to something else (these are called reference frames). So a car traveling to the east at 125 km/h is doing so relative to the earth. Sitting in this room, you are not moving – you have no motion. This is true with respect to the room. However, the room and everything in it is rotating around the center of the earth. Not only that, but the earth itself is moving around the sun in its orbit! The solar system is moving around the center of the galaxy! The galaxy (and everything in it) is also moving away from the center of the universe!

If you are a passenger in an ____ over the earth, you are moving at ______ mph ______________________________, but have ____, unless you get up and go _______________ in the aisle, then you might have a motion, relative to the plane, of, say, __ mph. Depending on which way you go, your motion _______________________ the _______________ could be ______ mph or ______ mph.

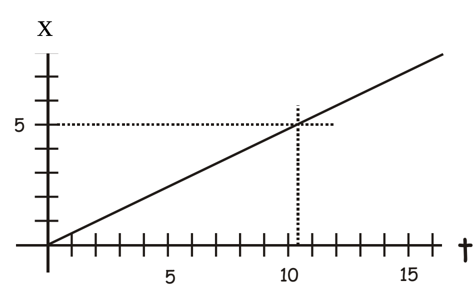
Position vs Time Graphs: Let's look at a graph of position vs time:



Displacement is plotted on the ***y*** axis and time is plotted on the ***x*** axis. The curve is a straight line. No doubt you recall that the equation for a straight line is:

m is the slope and ***b*** is the ***y*** intercept

The slope is the change in ***y*** divided by the change in ***x***. (Otherwise known as "the rise over the run".)



Since we are graphing _______________________ on the __ axis, the change in ***x*** is simply the change in displacement, or Δx. We have ____ for the ___ axis. So the slope is:

Therefore the slope of the displacement *vs.* time graph is the __________________.

- What is the velocity of the object whose motion is depicted in this graph