2.1 – Distance and Motion

Terms

Mechanics: Study of what produces and affects motion (changes in position).

Kinematics: Description of motion.

Dynamics: Causes of motion.

Distance: Total path length → Scalar quantity.
Scalars have only magnitude (no direction).
Others scalars are time, mass, and temperature.

Terms

Average Speed $\bar{s} = \frac{d}{\Delta t} = \frac{d}{t_2 - t_1}$

Note: Symbol Δ (capital Greek delta) = change. Final value minus initial.

Instantaneous Speed How fast at an instant in time something is moving.

Position: Coordinate of an object (x or y).

Note on AP Test Equations

Turn to Resources P. 7 - 9.

These equtions are furnished by the College Board to on the AP Physics test.

You will get other equations periodically, but all of the equation you use in here should be derivable from the AP test resource.

Look at Resources P. 8 - second equation: $x = x_0 + v_0 t + \frac{1}{2} a t^2$

This equation governs position (x or y) in any situation.

You may want to add this: $d = r \bullet t$

d = distance (x or y) (m)
r = rate (m/s)
t = time (s)

Ex 1.

Solve these with your table partner.
An ant travels at a constant speed of 1.5 cm/s. How long will it take to travel 0.75 m?

Convert: $1.5\frac{cm}{s} \bullet \frac{1\,m}{100\,cm} = 0.015\,m/s$

$d = r \bullet t$

$t = \frac{d}{r} = \frac{0.75\,m}{0.015\,m/s} = 50.\ \text{seconds}$

How long would it take if the ant takes a 5 second rest every 20 seconds?

Move	Rest	Move	Rest	Move
20. seconds	5 s	20. seconds	5 s	10. seconds

= 60. seconds

Displacement

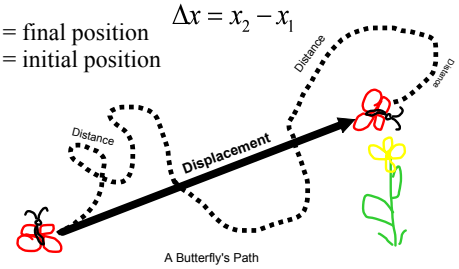
This is the straight line distance between two points.

Vector Quantity– has magnitude **and** direction.

In one dimensional movement, direction is noted with + or -.

$\Delta x = x_2 - x_1$

x_2 = final position
x_1 = initial position



Velocity

Tells speed and direction – is a vector quantity.

$$v = \frac{displacement}{time} = \frac{\Delta x}{\Delta t} = \frac{x_2 - x_1}{t_2 - t_1}$$

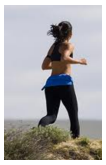
x_2 = final position (m),
x_1 = initial position (m),
t_2 = final time (s),
t_1 = initial time (s).

Note: x_1 & t_1 often referred to as x_0 ('x naught') or t_0 ('t naught')
x_2 and t_2 are often referred to as "x" or "t".

Ex 2.

Solve these with your table partner:

A jogger runs 300. m in 150 seconds, then runs back to the start in 198 seconds.



What is:

A. The average velocity during the 1st leg?

$$v = \frac{\Delta x}{\Delta t} = \frac{300.m - 0.0\,m}{150.s - 0.0\,s} = +2.00\,m/s$$

B. The average velocity during the 2nd leg?

$$v = \frac{0.0\,m - 300.m}{198.s - 0.0\,s} = -1.52\,m/s$$

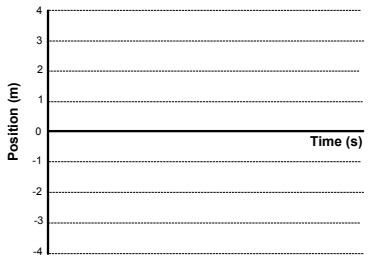
C. The overall average velocity of her run? → 0 m/s.

$$v = \frac{0.0\,m - 0.0\,m}{348.s - 0.0\,s} = 0.0\,m/s$$

Graphing

Interpreting graphs in physics is a very important skill.

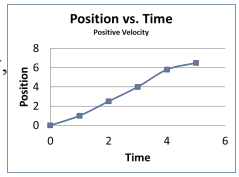
A blank velocity vs. time graph could look like this:



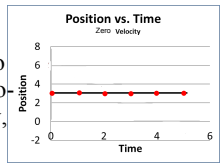
Ex. 3.

Produce position vs. time graphs for:

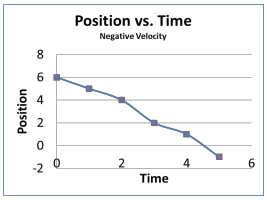
Positive Velocity,



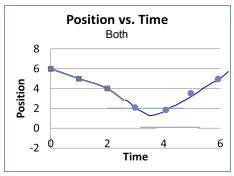
Zero Velocity,



Negative Velocity,

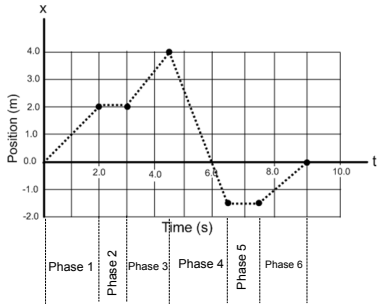


Both.



Example 4

A person moves in one dimension. What are a) the average speed and b) the average velocity for each phase of the motion?



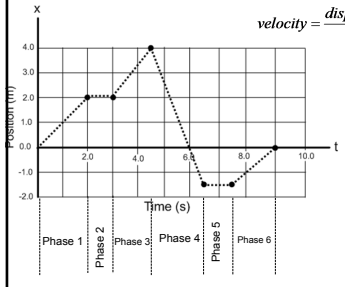
Example 4 - Parts a & b

A person moves in one dimension. What are a) the average speed and b) the average velocity for each phase of the motion?

Phase 1:

$$speed = \frac{distance}{time} = \frac{2.0\,m - 0.0\,m}{2.0\,s - 0.0\,s} = 1.0\,m/s$$

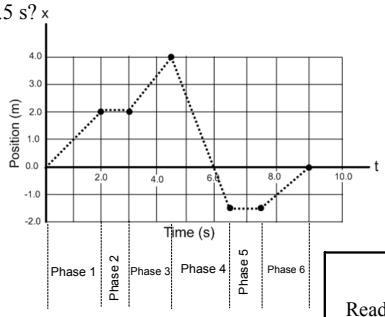
$$velocity = \frac{displacement}{time} = \frac{2.0\,m - 0.0\,m}{2.0\,s - 0.0\,s} = +1.0\,m/s$$



Phase 2:	Speed = 0.0 m/s Velocity = 0.0 m/s
Phase 3	Speed = 1.33 m/s Velocity = + 1.33 m/s
Phase 4	Speed = 2.75 m/s Velocity = - 2.75 m/s
Phase 5	Speed = 0.0 m/s Velocity = 0.0 m/s
Phase 6	Speed = 1.0 m/s Velocity = + 1.0 m/s

Example 4

c) What are the instantaneous velocities at t = 1.0 s, 2.5 s, 4.5 s, and 5.5 s?



1.0 s = + 1.0 m/s
2.5 s = 0.0 m/s
4.5 s = 0.0 m/s
5.5 s = - 2.75 m/s

Homework

Read 2.1 - 2.3 in your book
2.1 Problems in your Booklet
Due: Next Class