One Dimensional Kinematics – Part 2 (description of motion, not concerned with the *cause* of motion)

Acceleration: When the ________________ of an object is ______________________, the rate at which it changes is defined as the acceleration. The symbol for acceleration is ***a***.

Acceleration is a vector quantity, just like velocity.

Example Problems:

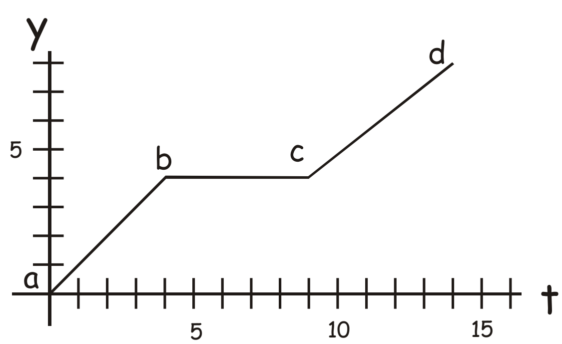
1) A plane goes from rest to speed of 65.28 m/s in 15.0 s. Find the acceleration.

- 4.35 m/s^2 means that the velocity changes by 4.35 m/s every second. At the end of the first second it is 4.35 m/s, after two seconds it is 8.70 m/s, after three seconds it is 13.0 m/s, after four seconds it would be 17.4 m/s, etc.

2) A car slows from 85.5 m/s to a speed of 33.2 m/s in 1.25 s. Find the acceleration.

(The minus sign means that the acceleration is in the opposite direction from the velocity.)

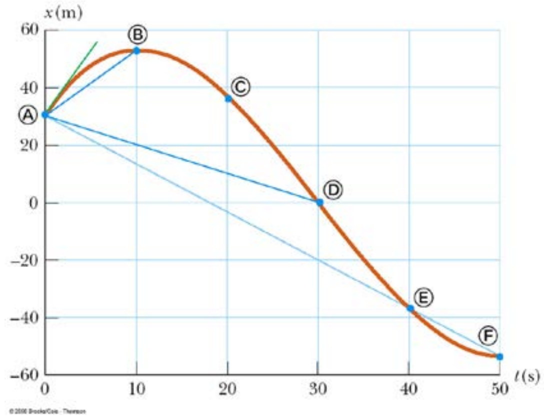
Let us now look at another position vs time graph.
In this graph, the slope of the graph changes from section ***ab*** to ***bc*** and then ***cd***. This means that the velocity has to change along these paths. The object moves at a constant velocity from zero displacement to a displacement of 4 m (this is from ***a – b***). This takes 4 seconds. Its velocity is a constant 1 m/s (the slope, right?). After the 4 seconds the object stops. It remains at rest for five seconds (***b – c***) and moves with a constant speed from time 9 s to time 14 s (***c – d***).



Example Problems:

3) Its velocity from 9 s to 14 s is?

4) What is the average velocity during the 14 seconds?

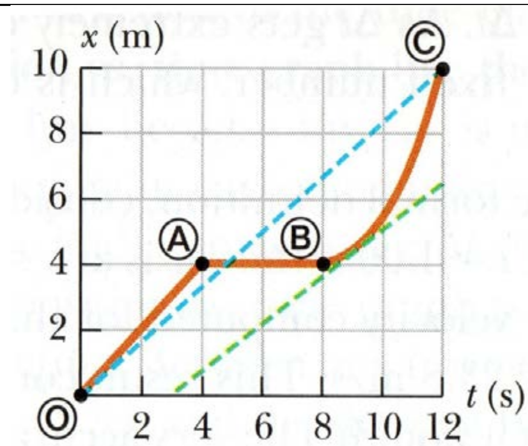


- The average velocity is the slope of the line connecting point A to B, D, E, or F

- The slope of the dashed line at each point represents the instantaneous velocity at that instant in time. This line is the tangent line to the curve at that point.

  - You can ______________ this __________ to make it larger in order to _____________ the ____________ & _____________.

5) A train moves slowly along a straight portion of track according to the graph of position vs. time. A) Find the average velocity for the total trip.



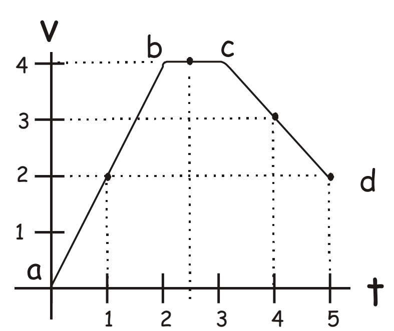
B) The *v* during the first 4 s.

C) the *v* during the next 4 s. ____

D) the instantaneous *v* at *t* = 2s. ____

E) The instantaneous *v* at *t* = 9 s.

6) This time we're looking at a velocity *vs.* time graph. During a baseball game a player runs after a fly ball. What is the player's acceleration from ***a*** to ***b***, ***b*** to ***c***, and ***c*** to ***d***?



Velocity Time Graph

Recall from last year that slope of the curve on a v *vs.* t graph represents the acceleration.

a to ***b***:

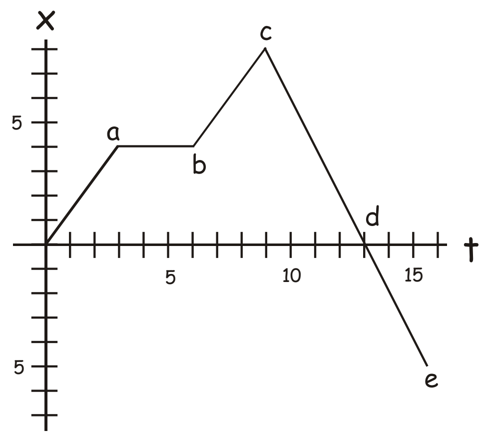
The player is initially at rest, the ball is hit and the player takes off to catch it. He accelerates from rest for two seconds. At the end of the two seconds, his velocity is 4 m/s.

b to ***c***: the ________________________, so ____________________. The player is moving at a constant speed of 4 m/s for this portion of the graph.

c to ***d***:

The player is _________________________. He ends up moving at ___ m/s when he _________________ catches the ball.

7) Using this graph, find (a) the velocity from start to ***a***, (b) the velocity from ***a*** to ***b***, (c) the velocity from ***b*** to ***c***, (d) the velocity from ***c*** to ***d***, (e) the velocity from ***d*** to ***e***, (f) find the displacement after 7.0 s, (g) make a velocity *vs.* time graph for this system.



Position Time Graph

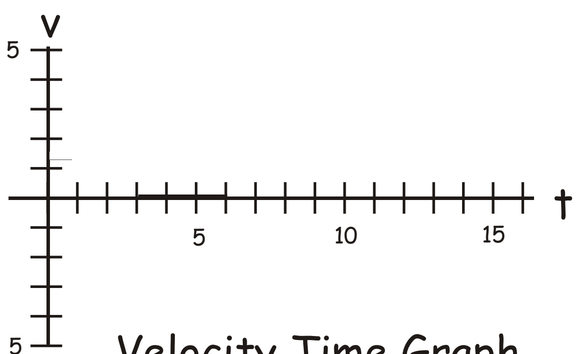
(a) 0 to ***a***: ***v*** = __________ (b) ***a*** to ***b***: ***v*** = _________

(c) ***b*** to ***c***: ***v*** = __________ (d) ***c*** to ***d***: ***v*** = _________

(e) ***d*** to ***e***: v = ___________

(f) Displacement = __________

(g)



Velocity Time Graph

One Dimensional Motion, Constant Acceleration:

If a body is undergoing a ___________________________________, we can analyze the motion and come up with ____________________________ that will describe the motion.

Start with the equation for acceleration:

$$a = \frac{v - v_0}{t - t_0}$$ can be rewritten as:

Here are two more important equations:

Example Problems:

8) A car undergoes an average acceleration of 3.55 m/s^2. If the car is accelerated for 8.50 seconds, how far has it traveled?

9) A truck undergoes an average acceleration of 2.50 m/s^2 as it speeds up. If it starts from rest, and accelerates for a distance of 875 m, how fast is it now moving?

10) A typical jet lands at a speed of 160 mi/h (1 mph = 0.447 m/s) and decelerates at a rate of (10 mi/h)/s. If the plane travels at a constant speed of 160 mi/h for 1 s after landing before applying the brakes, what is the total displacement of the aircraft between touchdown on the runway and coming to a stop?

(1)	(3)
(2)	(4)

11) A car traveling at a constant speed of 24 m/s passes a trooper hidden behind a billboard. One second after the speeding car passes the billboard, the trooper sets off in chase with an acc. of 3 m/s^2. A) How long does it take the trooper to overtake the speeding car? B) How fast is the trooper going at that time?