Describing Motion in One Dimension

Pre-Class Questions:

1. Which things do I look at for the pre-class work?
2. Is googling conversions acceptable while doing homework?

Problem Set #2 (due next time)

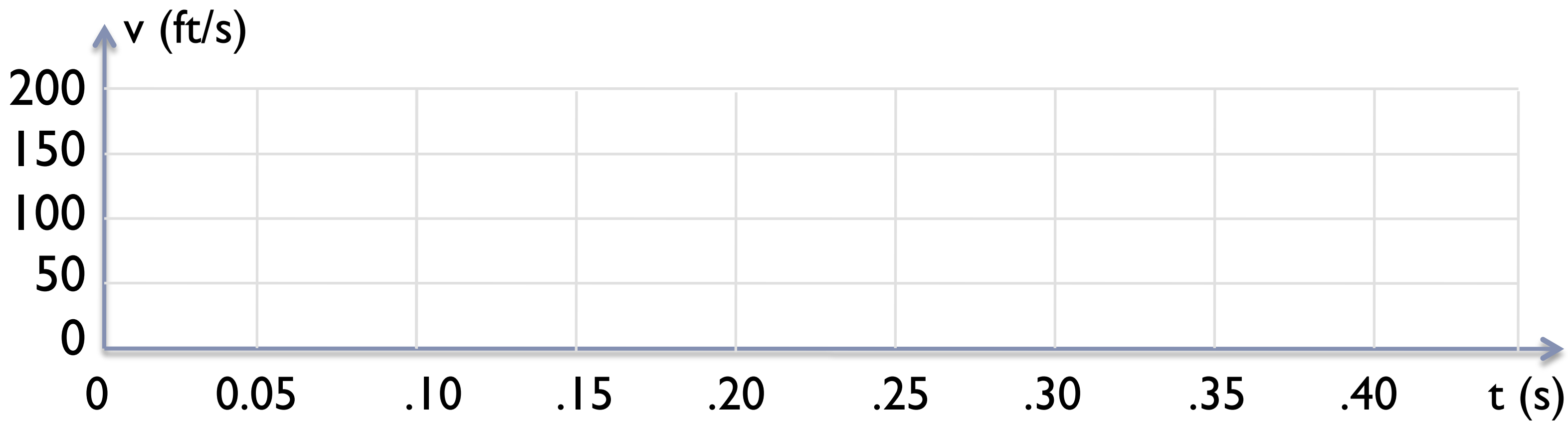
Lecture Outline

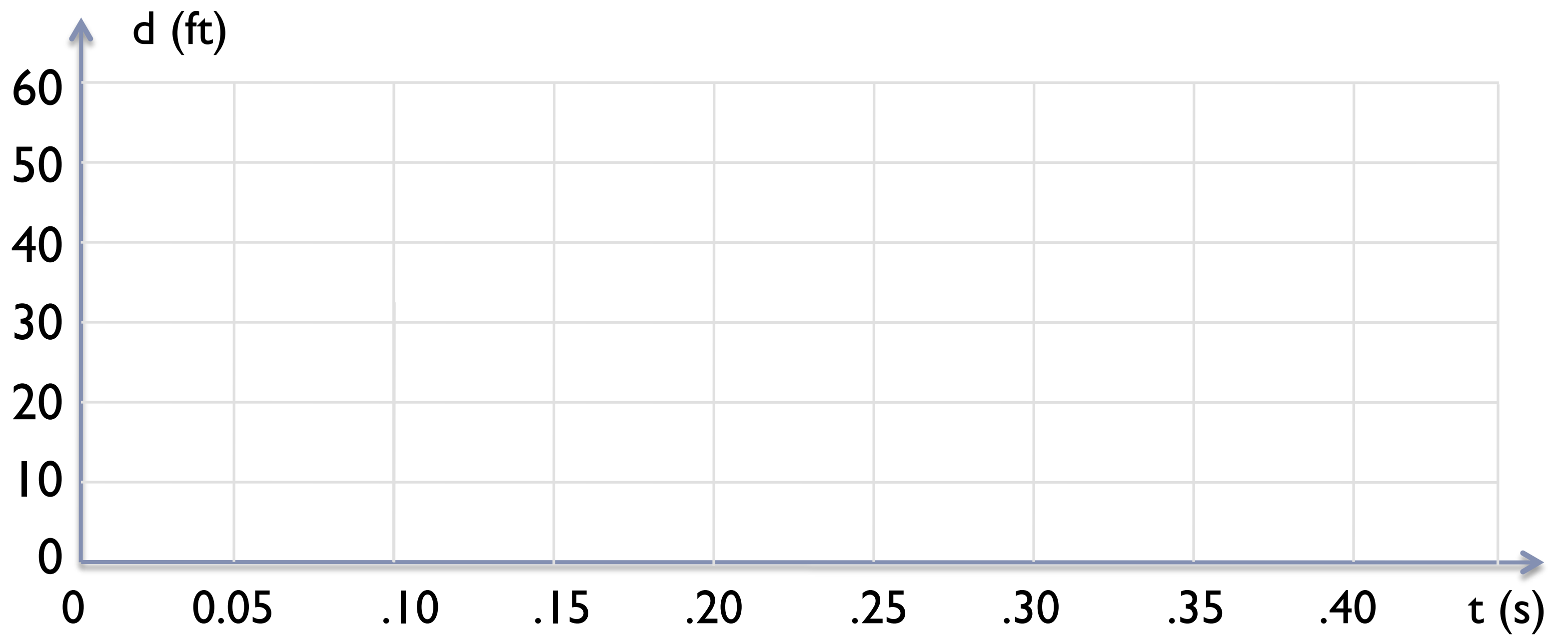
1. A Summary of the Definitions
2. Understanding the Definition of Average Velocity
3. Understanding the Definition of Average Acceleration

Pre-Class Summary:

Quantity	Definition	Mathematical Representation
Position	The location of an object with respect to a coordinate system	x
Displacement	A change in position	$\Delta x = x_f - x_i$
Average Velocity	The average rate of displacement	$\bar{v} \equiv \frac{\Delta x}{\Delta t} = \frac{x_f - x_i}{t_f - t_i}$
Speed	The magnitude of the velocity	$v = \lvert v \rvert$
Average Acceleration	The average rate of change of velocity	$\bar{a} \equiv \frac{\Delta v}{\Delta t} = \frac{v_f - v_i}{t_f - t_i}$

Example 1: A pitched baseball covers the last 50ft from the pitcher to the batter in about 0.40s. (a)Find the average speed of the ball. (b)Sketch a graph of the velocity of the ball versus time and (c)sketch a graph of the distance covered by the ball versus time.


v (ft/s)
200
150
100
50
0
0
0.05
.10
.15
.20
.25
.30
.35
.40
t (s)


d (ft)
60
50
40
30
20
10
0
0
0.05
.10
.15
.20
.25
.30
.35
.40
t (s)

Let's summarize our understanding of the definition of average velocity, $\bar{v} \equiv \frac{\Delta x}{\Delta t}$:

1. Algebraically, it can be thought of as an equation:

$$\bar{v} = \frac{x_f - x_i}{t_f - t_i}$$

2. Graphically, it can be thought of as the slope of the position versus time graph:

$$\bar{v} = \frac{\Delta x}{\Delta t} = \frac{rise}{run} = slope$$

3. It can be rearranged and thought about in terms of the area under the velocity versus time graph:

$$\bar{v} = \frac{\Delta x}{\Delta t} \Rightarrow \Delta x = \bar{v}\,\Delta t = (height)(wide) = area$$

Let's summarize our understanding of the definition of average acceleration, $\bar{a} \equiv \dfrac{\Delta v}{\Delta t}$:

1. Algebraically, it can be thought of as an equation:

$$\bar{a} = \frac{v_f - v_i}{t_f - t_i}$$

2. Graphically, it can be thought of as the slope of the velocity versus time graph:

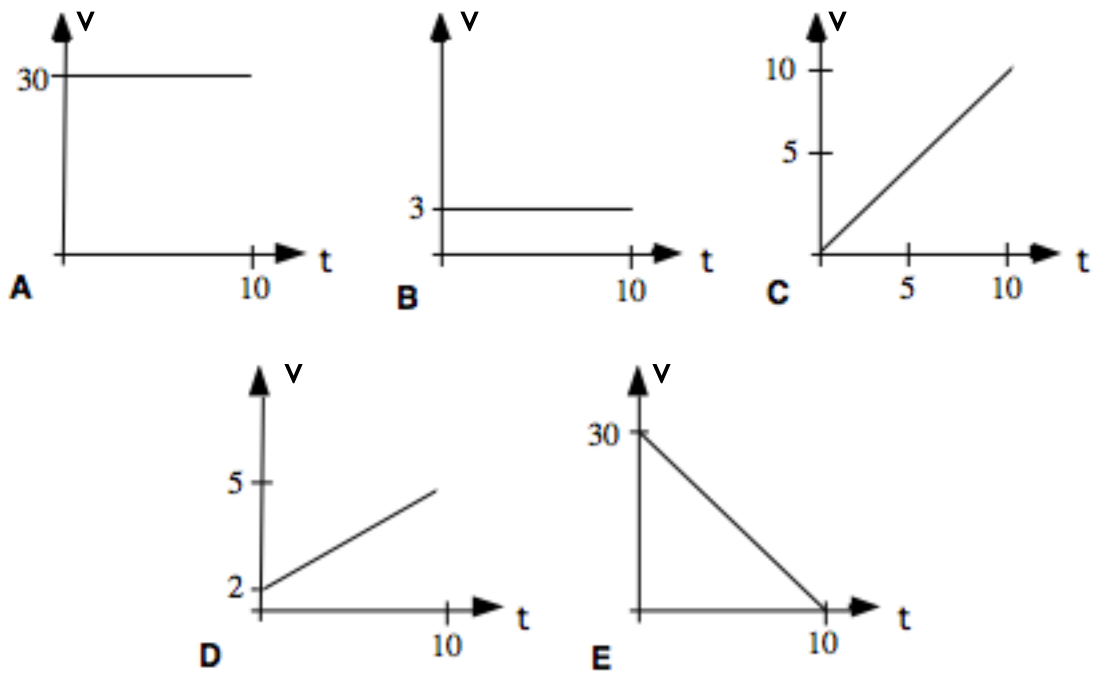
$$\bar{a} = \frac{\Delta v}{\Delta t} = \frac{rise}{run} = slope$$

3. It can be rearranged and thought about in terms of the area under the acceleration versus time graph:

$$\bar{a} = \frac{\Delta v}{\Delta t} \Rightarrow \Delta v = \bar{a}\,\Delta t = (height)(wide) = area$$

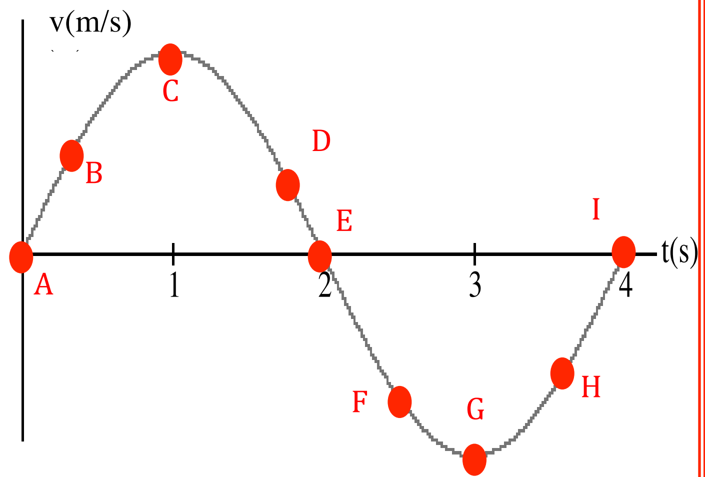
Example 2: A well hit baseball changes velocity from 130ft/s toward the batter to 145ft/s toward the pitcher in only 1.0ms. Find the average acceleration of the ball.

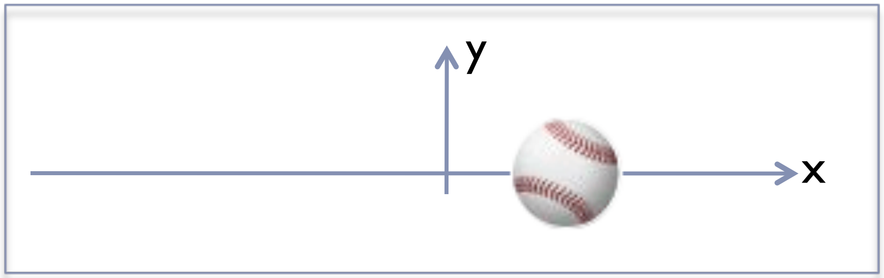
Below are five graphs of velocity of a car versus time where velocity is in meters/second and the time is in seconds. Rank them from greatest to least based upon the acceleration of the car.



The graph of velocity versus time for an object is shown at the right. For which labeled points does the object have

(a)a velocity toward the right?,
(b)a velocity toward the left?,
(c)a velocity of zero?,
(d)a positive acceleration?,
(e)a negative acceleration?,
(f)an acceleration of zero?





Lecture 02 - Summary

Quantity	Definition	Mathematical Representation
Position	The location of an object with respect to a coordinate system	x
Displacement	A change in position	$\Delta x = x_f - x_i$
Average Velocity	The average rate of displacement	$\bar{v} \equiv \frac{\Delta x}{\Delta t} = \frac{x_f - x_i}{t_f - t_i}$
Speed	The magnitude of the velocity	$v = \| v \|$
Average Acceleration	The average rate of change of velocity	$\bar{a} \equiv \frac{\Delta v}{\Delta t} = \frac{v_f - v_i}{t_f - t_i}$