

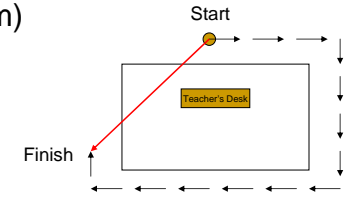
# Motion

Chapter 11 – Prentice Hall *Physical Science*

# Distance and Displacement

- **Distance:** length of a path between 2 points
- **Displacement:** straight-line distance between starting and ending points and the direction from start to finish
- SI Unit: meter (m)

Key:  
→ = Distance  
→ = Displacement



# Vectors

- **Vector:** any quantity that has both magnitude and direction
- Examples:
  - Displacement: Grandma's house is 50 miles North of my house.
  - Velocity: The woman drove 65 mph Southwest.
  - Acceleration: The acceleration due to gravity is  $9.8 \text{ m/s}^2$  toward the ground.

# Speed and Velocity

- **Speed:** ratio of distance moved to the time of movement
- **Velocity:** speed and the direction of motion
- SI Unit: meters per second (m/s)

Average Speed	Instantaneous Speed
Calculated for entire duration of trip	Measured at a particular instant

## Calculating average speed

- Average speed is the *total* distance traveled divided by the *total* time, or

$$\text{Average Speed} = \frac{\text{Total Distance}}{\text{Total Time}}$$
$$\bar{v} = \frac{d}{t}$$

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## Example: p. 333 #2

A train travels 190 km in 3.0 hrs, and then 120 km in 2.0 hrs. What is its average speed?

$$d = 190 \text{ km} + 120 \text{ km} = 310 \text{ km}$$
$$t = 3.0 \text{ h} + 2.0 \text{ h} = 5 \text{ hrs}$$

$$\bar{v} = \frac{d}{t} = \frac{310 \text{ km}}{5 \text{ hrs}} = \boxed{62 \frac{\text{km}}{\text{hr}} = \bar{v}}$$

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## Acceleration

- **Acceleration:** rate at which velocity changes
- Examples:
  - Change in speed (35 mph to 0 mph as you approach a stop sign)
  - Change in direction (spinning around a carousel)
  - Change in both speed and direction (slowing as you take a curved exit)

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## Calculating Acceleration

- Equation:

$$\text{Acceleration} = \frac{\text{Change in velocity}}{\text{Total time}}$$
$$a = \frac{(v_f - v_i)}{t}$$

Note that  $a$  = acceleration,  $v_f$  = final velocity,  $v_i$  = initial velocity, and  $t$  is time.

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## Example: p. 346 #2

An airplane travels down a runway for 4 seconds, with an acceleration of  $9.0 \frac{m}{s^2}$ . What is its change in velocity for this time?

$$a = 9.0 \frac{m}{s^2}$$

$$t = 4.0 s$$

$$\Delta v = ?$$

$$t(a) = \left(\frac{\Delta v}{t}\right) t$$

$$at = \Delta v$$

$$\Delta v = at = (9.0 \frac{m}{s^2})(4.0 s)$$

$$\Delta v = 36 \frac{m}{s}$$

$$(v_f - v_i)$$

$$t(a) = \left[\frac{(v_f - v_i)}{t}\right] t$$

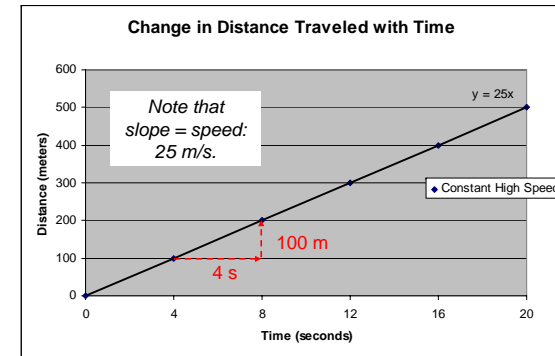
$$ta = (v_f - v_i)$$

$$(v_f - v_i) = at = (9.0 \frac{m}{s^2})(4.0 s)$$

$$(v_f - v_i) = 36 \frac{m}{s}$$

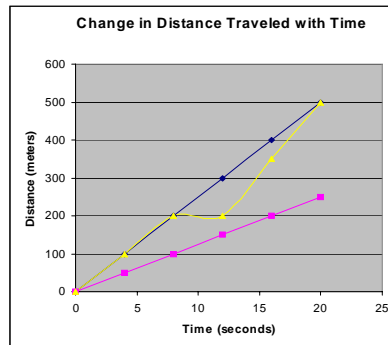
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## Graphing Distance vs. Time



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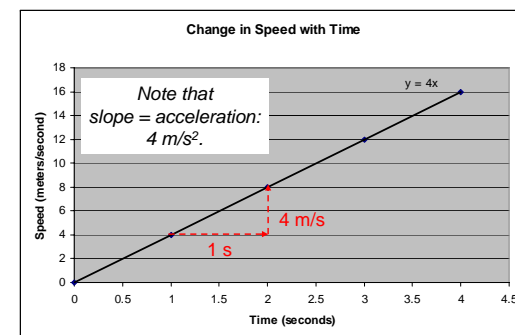
## Graphing Distance vs. Time (cont'd)



1. If the 3 lines on the graph represent cars moving, which one shows the fastest car?
  2. Which shows the slowest car?
  3. What does the straight-line represent?
  4. What does the curve mean in the yellow line?
- ◆ Constant High Speed
  - Constant Low Speed
  - ▲ Varying Speed

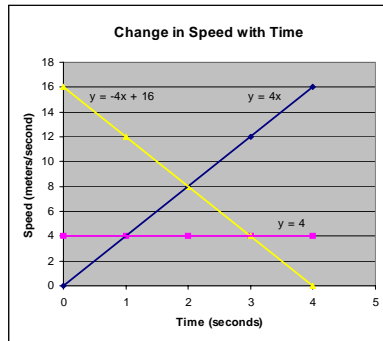
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## Graphing Speed vs. Time



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## Graphing Speed vs. Time (cont'd)



1. If the 3 lines on the graph represent cars traveling, which one is speeding up?
2. Which is slowing down?
3. Which car has the cruise control on?

- ◆ Positive acceleration
- Zero acceleration
- ▲ Negative acceleration