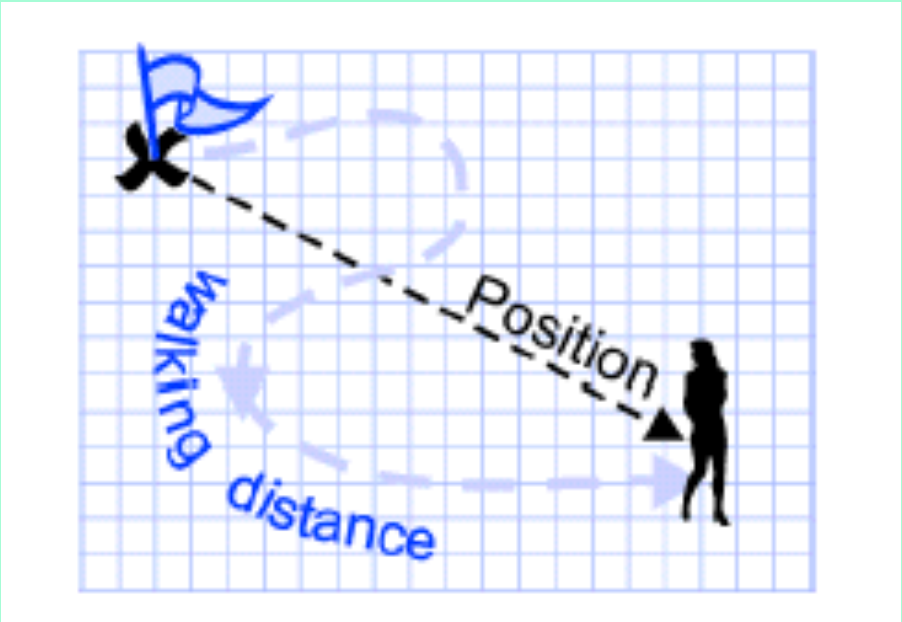
# Chp 2.2-2.3

Position, Time, and Acceleration

# Position vs Distance

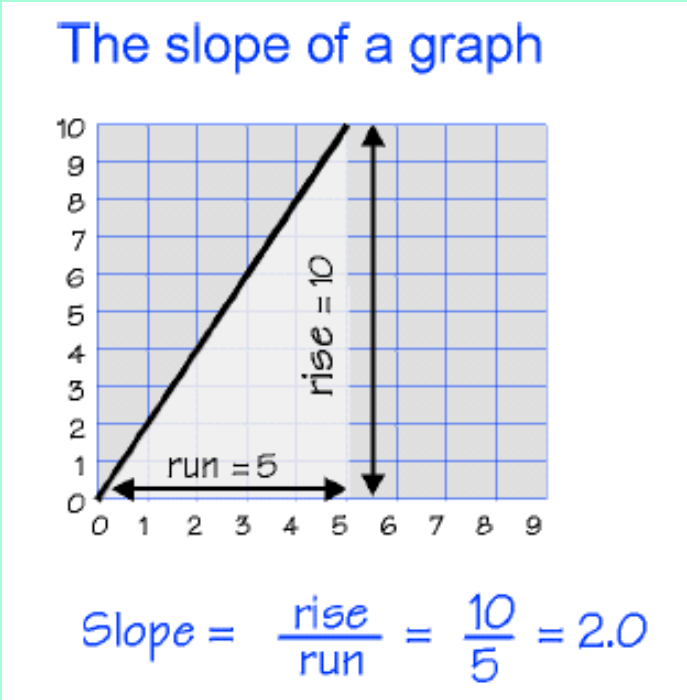
- Position means where something is compared with where it started, including direction
- Distance is a length without regard to direction
- If you are 7 km north of school this is your position. If you walk back to the school you position is zero even though you walked 14 km. (7km away plus 7 km back)




If there are turns, the position might be different from the distance traveled

# Position vs time graph

- The position vs time graph shows where things are at different times
- Speed is the slope of the position vs time graph

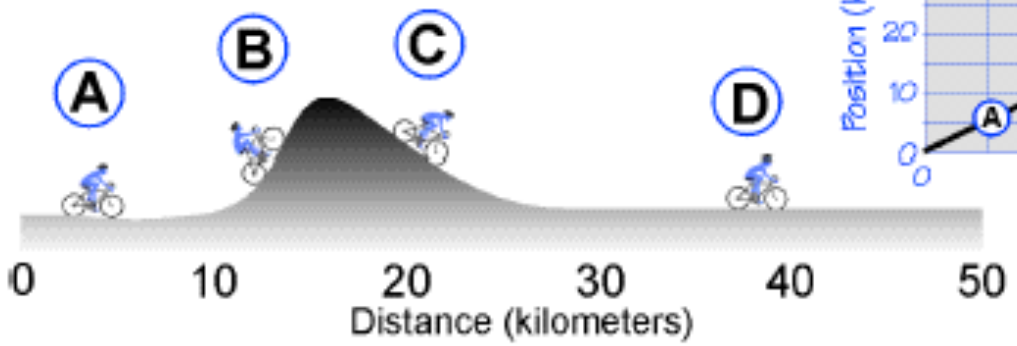


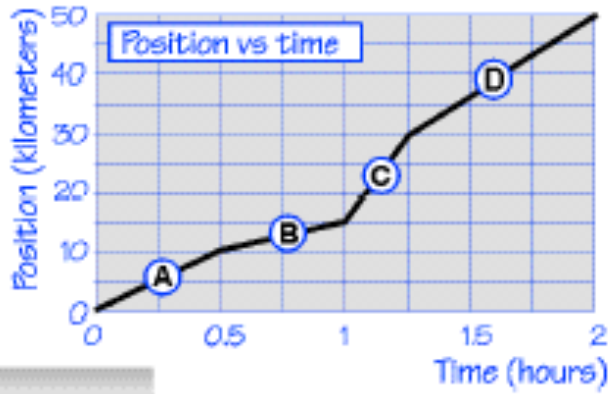
# Instantaneous and Average Speed

- Does your speed stay the same during a real trip?
  - Of course not!  You stop at lights, speed up to pass
- Average speed is how fast something moves over a certain distance
  - You travel 50 km in 2 hours

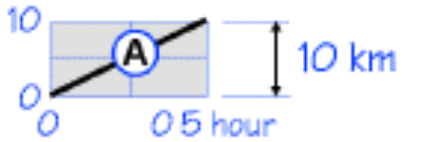
    average speed = 25 km/hr
- Instantaneous speed is the speed of an object at a specific point in its journey

## A bike trip with a hill



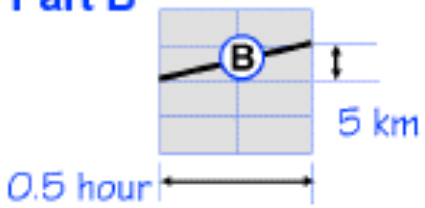




### Part A



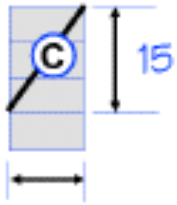

$$\text{speed} = \frac{10 \text{ km}}{0.5 \text{ hours}} = 20 \text{ kmh}$$

### Part B



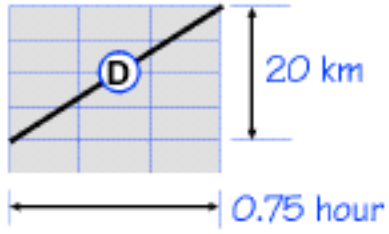

$$\text{speed} = \frac{5 \text{ km}}{0.5 \text{ hours}} = 10 \text{ kmh}$$

### Part C




$$\text{speed} = \frac{15 \text{ km}}{0.25 \text{ hours}} = 60 \text{ kmh}$$

### Part D




$$\text{speed} = \frac{20 \text{ km}}{0.75 \text{ hours}} = 27 \text{ kmh}$$

Average speed = $\frac{50 \text{ km}}{2 \text{ hr}} = 25 \frac{\text{km}}{\text{hr}}$

# Acceleration

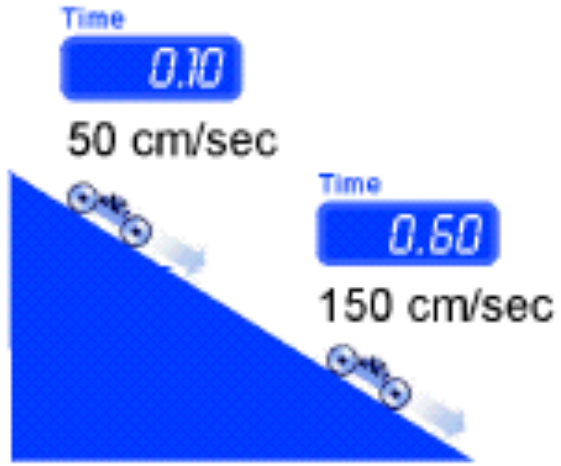
- Acceleration is the rate of the change of speed
  - Rate of change means the ratio of the amount of change divided by how much time it took to change

$$\text{Acceleration} = \frac{\text{Change in speed}}{\text{Change in time}}$$

- Units $cm/sec^2$

## Example

A car rolls down a ramp and you measure times and distances as shown. Calculate the acceleration in $cm/sec^2$.




Change in speed

$$\begin{array}{r} 150 \text{ cm/sec} \\ -\ 50 \text{ cm/sec} \\ \hline = 100 \text{ cm/sec} \end{array}$$

Change in time

$$\begin{array}{r} 0.60 \text{ sec} \\ -\ 0.10 \text{ sec} \\ \hline = 0.50 \text{ sec} \end{array}$$

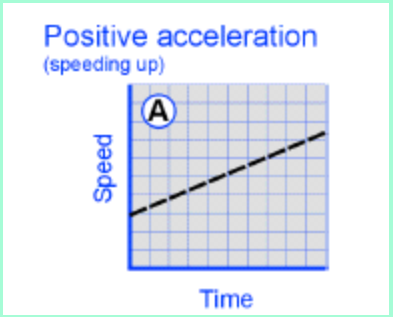
$$\text{Acceleration} = \frac{\text{Change in speed}}{\text{Change in time}}$$

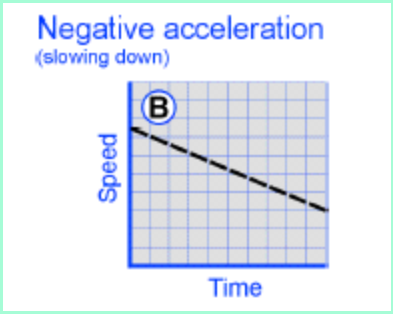
$$= \frac{100 \text{ cm/sec}}{0.50 \text{ sec}}$$

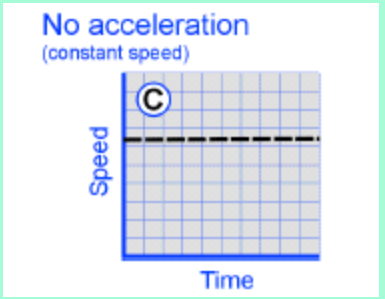
$$= 200 \text{ cm/sec}^2$$

# Types of Acceleration

- There are three different types of acceleration: positive, negative, and zero acceleration



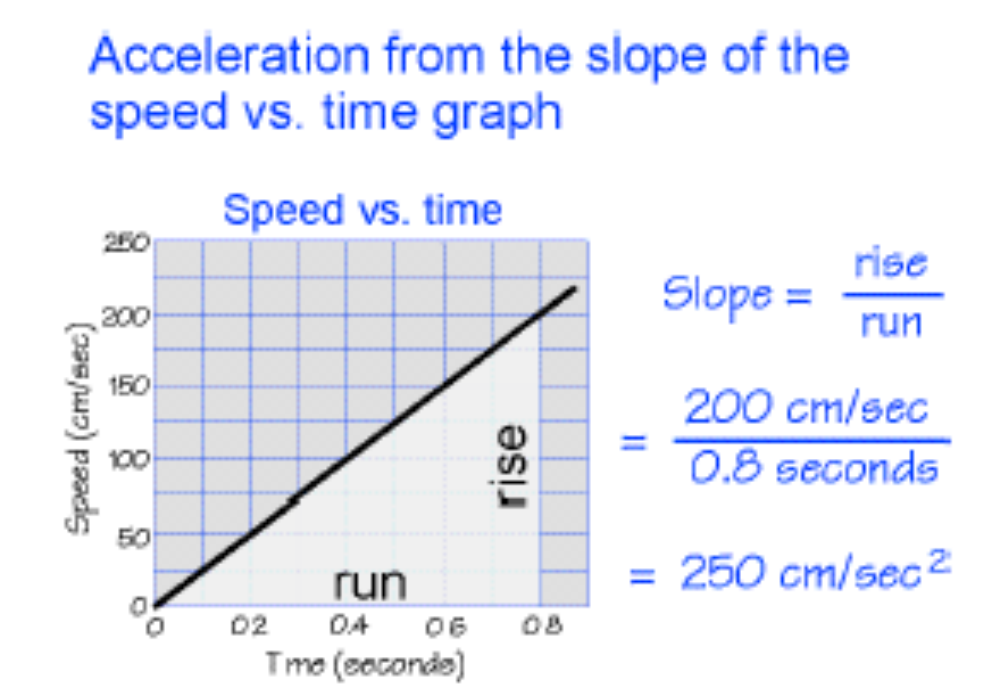




- Positive acceleration means the object is speeding up
- Negative acceleration means the object is slowing down
- Zero acceleration means the object is keeping the same speed

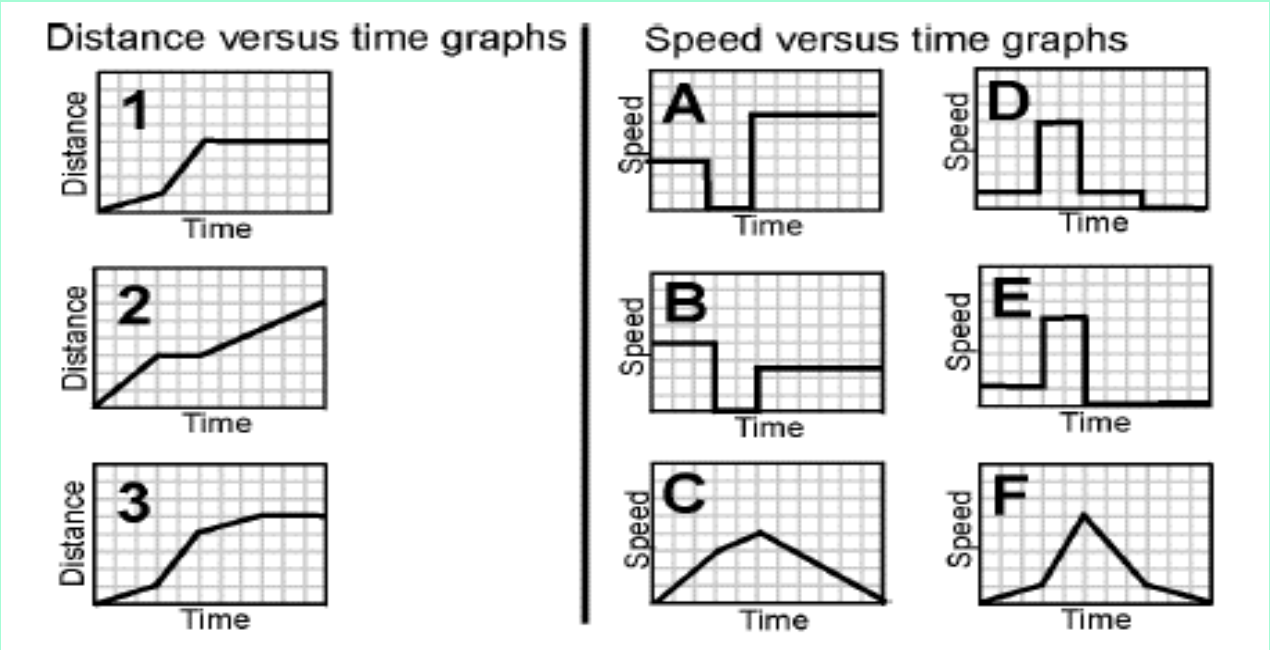
# Calculating Acceleration

- Acceleration is the slope of the speed vs time graph



# Homework 15

- Match each of the three distance vs time graph with the corresponding speed vs time graph.



# Homework 21

- A swimmer speeds up from 1.9 m/s to 2.6 m/s during the last 20 of a workout. What is the swimmer's acceleration during this time interval?