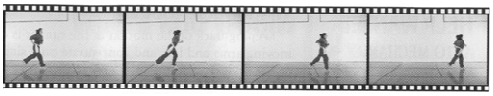
Speed and Velocity

Measuring motion

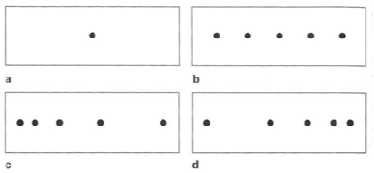
Describing Motion – Motion Diagrams

- **A series of images of a moving object that records its position after equal time intervals**



Describing Motion – Particle Model

- **Replacing the observed object in a motion diagram with a single point.**



- **Describe each motion and sketch a position vs. time graph for each.**

Types of Measurements

- **Scalar**
  - **measure of quantity only**
- **Vector**
  - **measure of quantity and direction**

Measuring Distance

- **Scalar Quantity**
- **The change in position of an object along a path.**

Average Speed

- **Scalar Quantity**
- **The average rate at which an object moves (rate of motion)**

$$\text{Average Speed} = \frac{\text{Total Distance}}{\text{Total Time}}$$

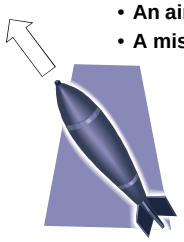
Displacement

- Vector Quantity
- The change in position in a particular direction <u>when comparing starting and ending positions.</u> (path independent)

$$\Delta x = x_2 - x_1$$

Velocity

- Velocity – the SPEED and DIRECTION of an object.
  - Example:
    - An airplane moving North at 500 mph
    - A missile moving towards you at 200 m/s



Average Velocity

- Vector Quantity
- Change in position or direction (displacement) over a certain time

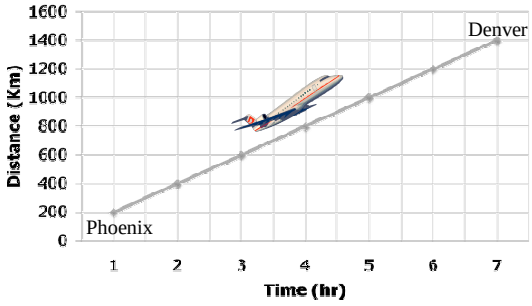
$$\bar{v} = \frac{\Delta x}{\Delta t} = \frac{x - x_0}{t - t_0}$$

Question

- **What is the difference between speed and velocity?**
- **Speed is just distance/time. Velocity includes direction as well.**

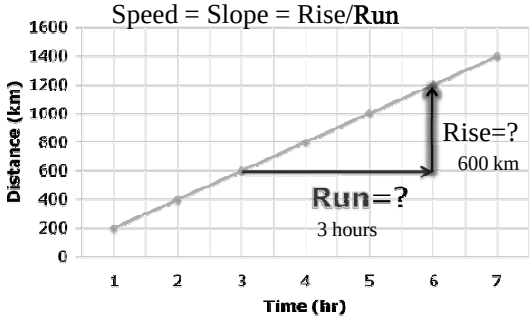
Graphing Speed: Distance vs. Time Graphs

What is the average speed of the plane?



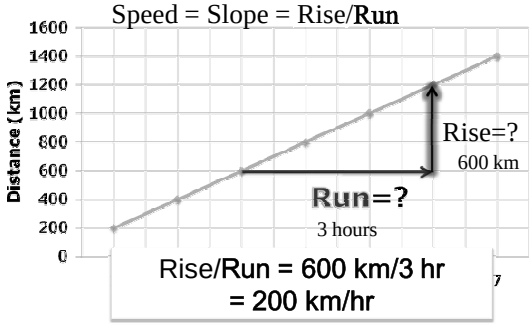
Graphing Speed: Distance vs. Time Graphs

Speed = Slope = Rise/**Run**



Graphing Speed: Distance vs. Time Graphs

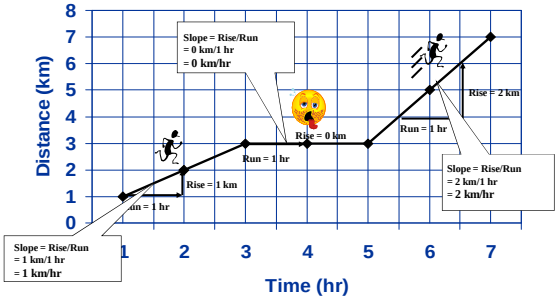
Speed = Slope = Rise/Run



Rise/Run = 600 km/3 hr
= 200 km/hr

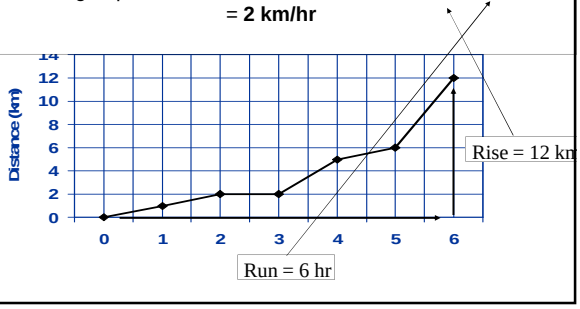
Different Slopes Mean Different Speeds

What is the average speed of the runner during each segment?



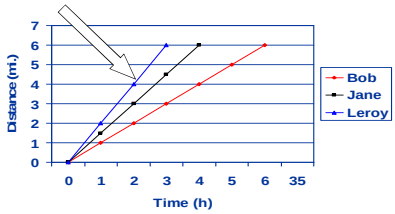
Question

Average Speed = Total distance/Total time = 12 km/6 hr
= **2 km/hr**



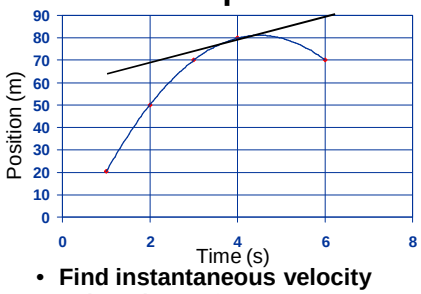
Question

- **Below is a distance vs. time graph for 3 runners. Who is the fastest?**



Leroy is the fastest. He completed the race in 3 hours

Graphing Speed: Changing Slope



- **Find instantaneous velocity using slope of a tangent line at that point.**

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