


Speed and Velocity

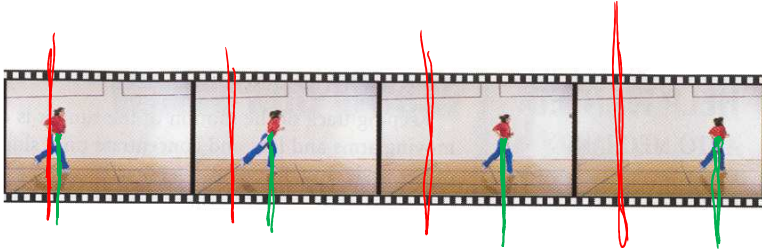
Measuring motion



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Describing Motion – Motion Diagrams

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



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Describing Motion – Particle Model

SLOPE = VELOCITY
as X vs T
GRAPH

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

$m=0$

No Motion

a

$m = \text{constant}$

Constant Velocity

b

$m = \text{increasing}$

Increasing Velocity

c

$m = \text{decreasing}$

Decreasing Velocity

d

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

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Types of Measurements

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

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Measuring Distance

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



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Average Speed

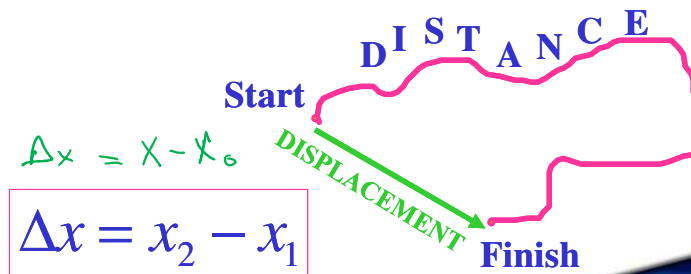
- **Scalar Quantity**
- **The average rate at which an object moves (rate of motion)**

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

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Displacement

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



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Velocity

- Velocity – the **SPEED** and **DIRECTION** of an object. *STRAIGHT LINE*

– Example:

- An airplane moving North at 500 mph
- A missile moving towards you at 200 m/s



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Average Velocity

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

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

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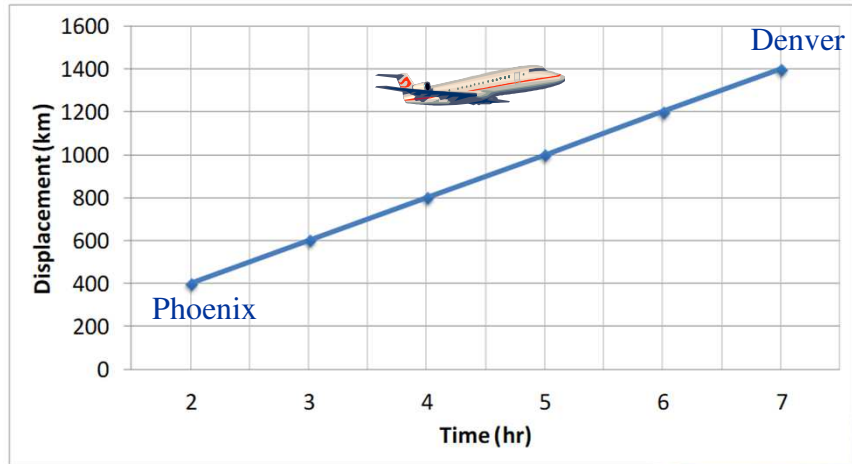
Question

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

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Graphing Velocity: Displacement vs. Time Graphs

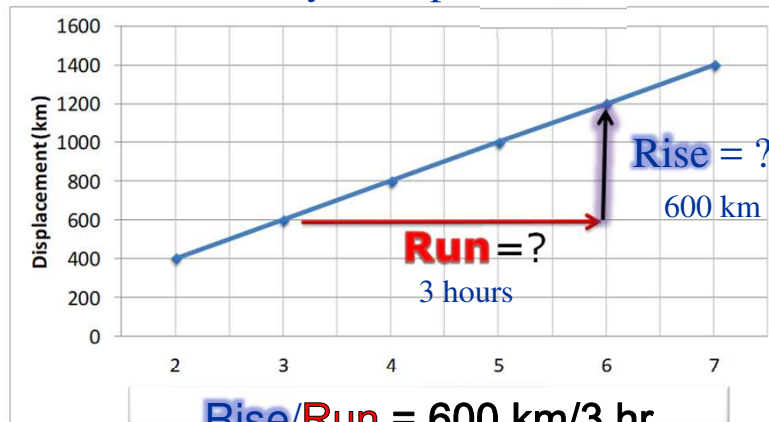
What is the average velocity of the plane?



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Graphing Velocity: Displacement vs. Time Graphs

Velocity = Slope = Rise/Run

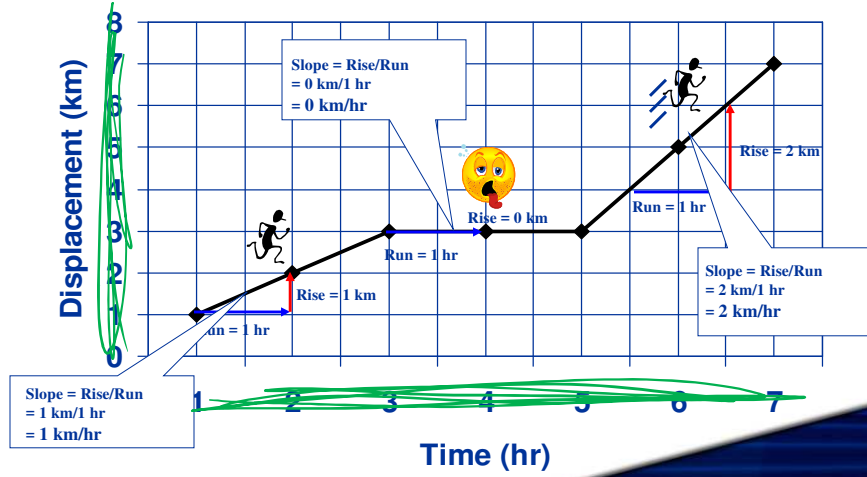


$$\begin{aligned} \text{Rise/Run} &= 600 \text{ km}/3 \text{ hr} \\ &= 200 \text{ km/hr} \end{aligned}$$

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Different Slopes Mean Different Velocities

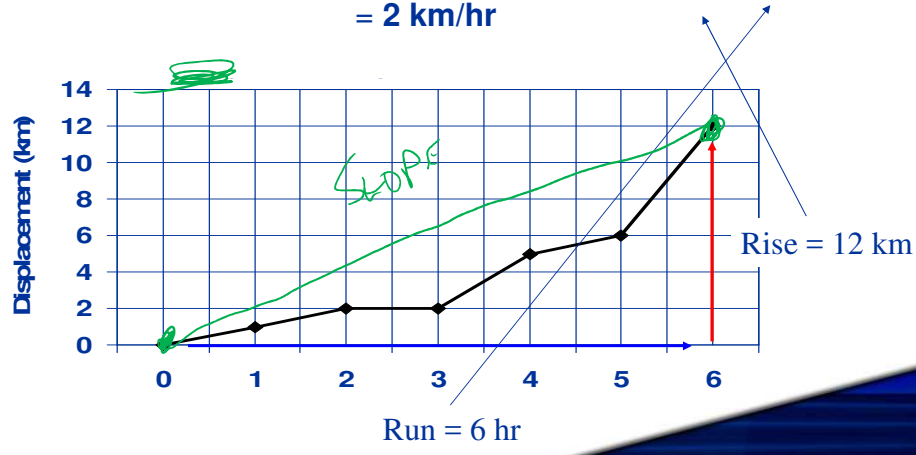
What is the average velocity of the runner during each segment?



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Question

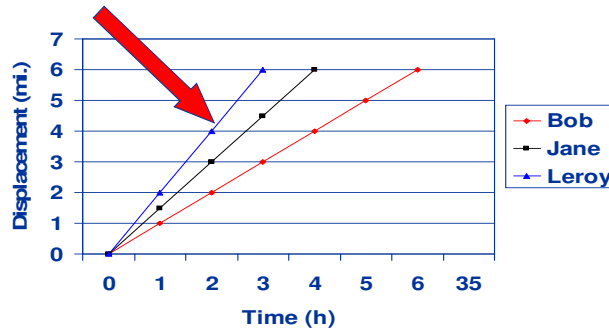
Average Velocity = Total Displacement/Total time = 12 km/6 hr = 2 km/hr



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Question

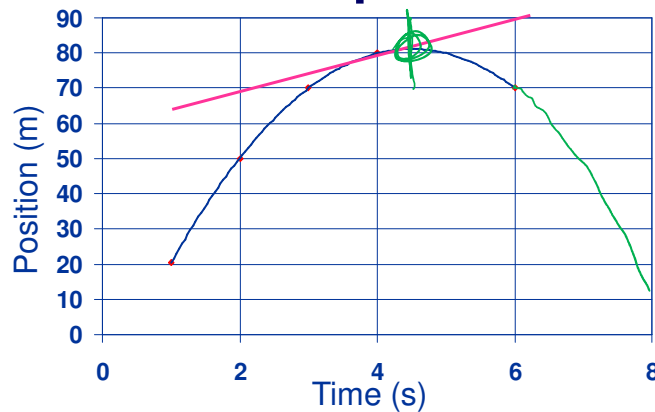
- Below is a displacement vs. time graph for 3 runners. Who is the fastest?



Leroy is the fastest. His slope is the greatest.

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Graphing Speed: Changing Slope



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

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