

These notes are posted on my site for the following reasons:

- for students to copy in their own hand-writing
 - ◆ in order to complete their class notes
 - ◆ if student did not have enough time in class
 - ◆ if student was away and missed this section
- for assistants and tutors to follow progress of the concepts taught

Photocopied/printed notes can not be used during the Unit Notebook Check in class.

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8.2 Average Velocity



- **Speed (v) is the distance an object travels during a given time interval divided by the time interval.**
 - ◆ **Speed is a scalar quantity.**
- **Velocity (\vec{v}) is the displacement of an object during a time interval divided by the time interval.**
- **Velocity is a vector quantity therefore must include direction.**
- **The SI unit for velocity and speed is metres per second (m/s).**



These two ski gondolas have the same speed but have different velocities since they are travelling in opposite directions.

See pages 363

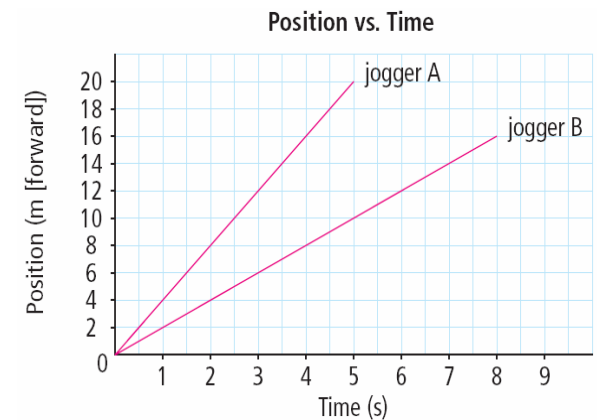
Calculating the Slope of the Position-Time Graph



- The slope of a graph is represented by rise/run.
- This slope represents the change in the y-axis divided by the change in the x-axis.
- On a position-time graph the slope is the change in position ($\Delta \vec{d}$) divided by the change in time (Δt).

$$\text{slope} = \frac{\Delta \vec{d}}{\Delta t}$$

- The steeper the slope the greater the change in displacement during the same time interval.



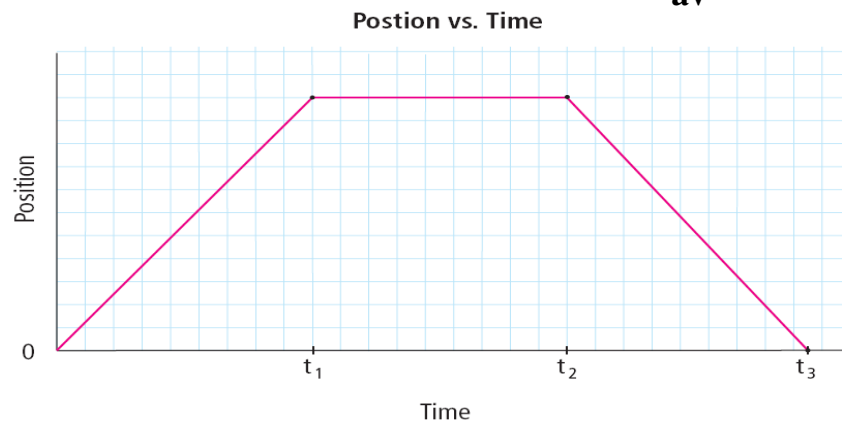
Which jogger's motion has a greater slope?
Which jogger is moving faster?

See pages 28 - 29

Average Velocity



- The slope of a position-time graph is the object's average velocity.
- Average velocity is the rate of change in position for a time interval.
- The symbol of average velocity is: \vec{v}_{av}



On a position-time graph if forward is given a positive direction:

- A positive slope means that the object's average velocity is forward.
- A negative slope means that the object's average velocity is backwards.
- Zero slope means the object's average velocity is zero.

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Calculating Average Velocity



The relationship between average velocity, displacement, and time is given by:

$$\vec{v}_{\text{av}} = \frac{\Delta \vec{d}}{\Delta t}$$

Use the above equation to answer the following:

1. What is the average velocity of a dog that takes 4.0 s to run forward 14 m?



2. A boat travels 280 m East in a time of 120 s. What is the boat's average velocity?



Answers on the next slide.

See pages 31 - 32

Calculating Average Velocity



The relationship between average velocity, displacement, and time is given by:

$$\vec{v}_{\text{av}} = \frac{\Delta \vec{d}}{\Delta t}$$

Use the above equation to answer the following:

1. What is the average velocity of a dog that takes 4.0 s to run forward 14 m? **(3.5 m/s forward)**



2. A boat travels 280 m East in a time of 120 s. What is the boat's average velocity? **(2.3 m/s East)**



See pages 31 - 32

Calculating Displacement



The relationship between displacement, average velocity, and time is given by:

$$\Delta \vec{d} = (\vec{v}_{av})(\Delta t)$$

Use the above equation to answer the following:

1. What is the displacement of a bicycle that travels 8.0 m/s [N] for 15 s?



2. A person, originally at the starting line, runs west at 6.5 m/s. What is the runner's displacement after 12 s?



Answers on the next slide.

See page 32

Calculating Displacement



The relationship between displacement, average velocity, and time is given by:

$$\Delta \vec{d} = (\vec{v}_{av})(\Delta t)$$

Use the above equation to answer the following:

1. What is the displacement of a bicycle that travels 8.0 m/s [N] for 15 s? **(120 m [N])**



2. A person, originally at the starting line, runs west at 6.5 m/s. What is the runner's displacement after 12 s? **(78 m west)**



See page 32

Calculating Time



The relationship between time, average velocity, and displacement is given by:

$$\Delta t = \frac{\Delta \vec{d}}{\vec{v}_{av}}$$

Use the above equation to answer the following:

1. How long would it take a cat walking north at 0.80 m/s to travel 12 m north?



2. A car is driving forward at 15 m/s. How long would it take this car to pass through an intersection that is 11 m long?



Answers on the next slide.

See page 33

Calculating Time



The relationship between time, average velocity, and displacement is given by:

$$\Delta t = \frac{\Delta \vec{d}}{\vec{v}_{av}}$$

Use the above equation to answer the following:

1. How long would it take a cat walking north at 0.80 m/s to travel 12 m north? (15 s)



2. A car is driving forward at 15 m/s. How long would it take this car to pass through an intersection that is 11 m long? (0.73 s)



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Converting between m/s and km/h



- **To convert from km/h to m/s**
 - ◆ Change km to m: 1 km = 1000 m
 - ◆ Change h to s: 1 h = 3600 s
- **Therefore multiply by 1000 and divide by 3600**
or
- **Divide the speed in km/h by 3.6 to obtain the speed in m/s.**

For example, convert 75 km/h to m/s.

$$\frac{75 \text{ km}}{1 \text{ h}} \times \left(\frac{1000 \text{ m}}{1 \text{ km}} \right) \times \left(\frac{1 \text{ h}}{3600 \text{ s}} \right) = 21 \text{ m/s}$$



Speed zone limits are stated in kilometres per hour (km/h).

See page 33

Converting between m/s and km/h



Try the following unit conversion problems yourself.

1. Convert 95 km/h to m/s.
2. A truck's displacement is 45 km north after driving for 1.3 hours. What was the truck's average velocity in km/h and m/s?
3. What is the displacement of an airplane flying 480 km/h [E] during a 5.0 min time interval?



See next slide for answers

See page 34

Converting between m/s and km/h



Try the following unit conversion problems yourself.

1. Convert 95 km/h to m/s. (26 m/s)
2. A truck's displacement is 45 km north after driving for 1.3 hours. What was the truck's average velocity in km/h and m/s?
(35 km/h [N], 9.6 m/s [N])
3. What is the displacement of an airplane flying 480 km/h [E] during a 5.0 min time interval?
(40 km [E] or 40, 000 m [E])



[Take the Section 8.2 Quiz](#)

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