Name _____Period _____Date _____

**Understanding Speeds and Velocities (10 points)**

We have talked about calculating speeds by using this formula:

$$\text{speed} = \frac{\text{distance}}{\text{time}} \quad \text{or} \quad s = \frac{d}{t}$$

**Speed** is the distance travelled by an object in a given amount of time.

Remember, whenever you do a calculation *show all your work* to get full credit!

1. A car travels 66 kilometers in 3 hours. What is its speed?

2. Carried by the wind, a hot air balloon took 0.6 hr to go 15 km. What is its speed?

Most moving objects do not have the same speed all the time. Instead, they speed up and slow down while they move.

For example, when you walk to a friend's house, you might have to stop at an intersection to wait for a car to go by. While waiting, your speed is zero! You also might go faster on level ground than when walking uphill.

Your speed at any one instant is called **instantaneous speed**. The instantaneous speed of most objects changes all the time and can be hard to calculate. But if you look at a longer period of time, you can easily calculate the **average speed** of an object.

$$\text{average speed} = \frac{\text{total distance}}{\text{total time}}$$

3. At the 2012 Olympic Games, a Jamaican athlete named Usain Bolt broke the Olympic record by running 100 meters in just 9.63 s. He started the race at rest and had to speed up. He also slowed down near the end of the race as he tired out. What was his *average* speed during the race?

4. A family takes a car trip. They travel 80 km in the first hour and another 80 km during the next 2 hours. Find their average speed. (Hint: Remember to use the total distance and the <u>total amount of time</u>.)

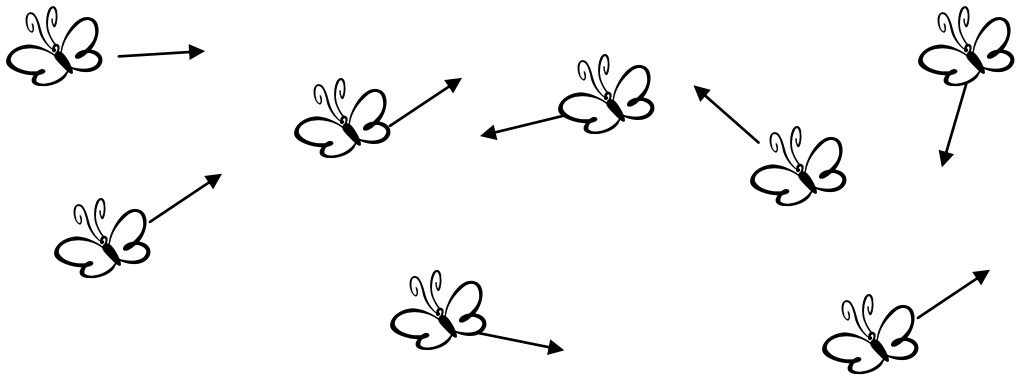
5. Suppose you ride your bicycle into the countryside on a bike path. You travel 6 kilometers the first hour, 3 kilometers the second hour, and 6 kilometers the third hour. What is your average speed for the whole ride?

Objects may be moving with the same speed but be going in different directions. When that happens, it is important to talk about those directions. Discussing the speed alone is not always enough information! When you include the speed and a direction, that is called a **velocity**. Examples of velocity include... "5 m/s to the right", "100 km/hr northwest", and "120 m/min toward Target".

6. Cara had just boarded a flight preparing to travel 3000 km westward from Ohio to California. Shortly after take off, the pilot informed the passengers that the flight should take about 5 and a half hours. Cara wondered just how fast (on average) the plane would be travelling. Find the plane's speed and velocity.

   Average speed: _____ Velocity (speed and direction): _____

7. Here are a bunch of bugs that all have the same speed. (All of their arrows are the same length.) Circle the bugs that have the same *velocity*.



*Now it is time for you to put all the pieces together. All of our recent topics are covered in the following questions! Remember* ***to show your work!!***

8. On a road trip, Seth and his friends drove 180 km in two hours. They then spent one hour eating lunch and looking around a museum. Finally, they drove for three more hours, going another 250 km.
    a. Complete this table describing the three parts of their trip, including the average speed for each of those parts.

| Part | Time | Distance | Avg. Speed |
|---|---|---|---|
| A | | | |
| B | | | |
| C | | | |

    b. What was the average speed for the entire trip?

9. Keisha wanted to measure the running speed of her dog, Marvin. She marked off 20 meters in her back yard, told Marvin to stay at the starting point, and then positioned herself at the finish point with a stopwatch. She started the stopwatch and called Marvin. Keisha repeated the measurement three more times. Her four measurements were: 4.0 s, 4.3 s, 4.1 s, and 4.4 s.
    a. What was the average of Marvin's times?

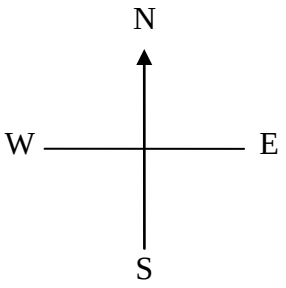
    b. Using the average of his times, calculate Marvin's average speed. (Round to the nearest hundredth.)

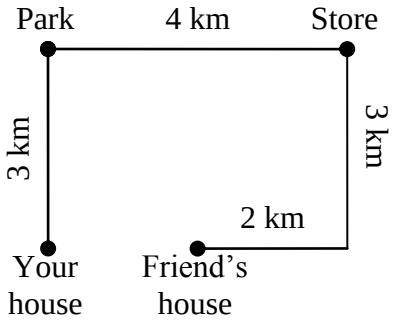
10. A car was driving at 50 km/hr, when the driver noticed a squirrel crossing the road and slammed on the brakes. The car slid to a stop and the squirrel survived. Phew! During this process, when was the car's instantaneous speed...
    a. ...largest?

    b. ...smallest?

*The remaining questions all relate to this map:*

Suppose you begin at your house and travel to the park, then to the store, and then to your friend's house.




11. What total distance did you travel?

12. If you leave home at 1:00 PM and get to your friend's house at 5:00 PM, what was your *average speed* for the entire trip to their house?

13. If you traveled from your house to the park in 0.5 hours, what was your *velocity*?

14. List one reference point you might have used along the way.

15. How do you know you were in motion relative to this reference point?