**Describing Motion**

**Textbook References**: 11.7 Velocity, 9.9 Simulation: Average Speed on an Air Table, and 9.10 Investigation: Determining an Average Speed

*Uniform Motion*: This is motion with a constant speed in a straight line. Speed or direction are not changing. If either speed or direction changes, then it is described as accelerated motion.

Examples: A vehicle traveling at exactly 60 km/hr down a perfectly straight road, hands of a clock, earth, moon.

*Constant Speed:* Traveling at a steady pace without any acceleration or deceleration

*Instantaneous Speed:* This is the speed that an object is moving at a particular moment in time. It is not affected by an object’s previous speed or how long that it has been moving.

For any object moving at a constant speed, the instantaneous speed is the same at any time, and equals the constant speed.

Examples:

**Distance-Time Graph**

The slope is the same at any point along the line. The object is moving at a constant speed.

The instantaneous speed is the same at all points. It is determined by finding the slope

The slope is zero because the speed stays the same. There is a constant speed.

Instantaneous speed is the same at all points. It is determined by looking at the y-intercept.

# Velocity-Time Graph

d(m)

v(m/s)

d(m)

t(s)

t(s)

t(s)

The slope of the line changes with time.

The instantaneous speed will change. It is determined by drawing a line tangent to the curve at the instant in time and the finding the slope.

# Distance-Time Graph

*Average Speed*: Defined as the total distance traveled divided by the total time it took to travel this distance or the speed as determined for a time interval.

In order to find average speed we use the following equation:

v av = d

 t

where d= change in distance (d2-d1) and t = change in time (t2-t1)

*Average Velocity*: It is the resultant displacement per unit of time. (This may not be uniform motion.)

v av = d

 t

# Examples

1. What is the average speed of a train that travels 560 km in 7.0 h?
2. A car traveling at 100 km/h reaches its destination in 4.5 h. What distance did it travel?

3. What is the average velocity of a runner who has a resultant displacement of 96 m[N] in 12 s?

**Identify the following examples of constant speed, instantaneous speed or average speed.**

|  |  |
| --- | --- |
| Example of Motion | Type of speed: constant, instantaneous, or average |
| A pilot sets a plane on autopilot  |  |
| The speed of a triathlete for an entire race is determined to be 10.0 km/h |  |
| An automated highway radar records your speed at 65 km/h |  |
| A car drives east on the TCH with the cruise control set at 110.0 km/h |  |
| A captain of a boat reads that his boat is traveling 2 knots |  |
| A jogger runs at a steady rate of 2.0 m/s for 1.0 h  |  |

**Exercises:**

1. Greg jogs to school a total distanceof 5.2 km. If the trip takes him 0.84 h, what is his average speed?

1. Andrea drives her car at an average speed of 65 km/h in a time of 122 minutes. How far does she travel in this time?
2. How long would it take a dolphin to swim 2.0 km if his speed is 3.75 m/s? Express your answer in seconds and minutes.
3. Sally and Mary are competing in a 500.0 m race. Sally can run at 2.5 m/s while Mary can run at 1.8 m/s.
4. How long will it take each person to finish the race?
5. When Sally crosses the finish line, how much time is left for Mary to cross?
6. A girl runs at 12 km/h for 2.0 h and then bicycles at 21 km/h for 1.0 h. What was her average speed for this motion? Note: Do not take an average of the 2 speeds.