Assignment 2.01: Distance, Velocity, and Time

1. You are being chased by velociraptors. If you know that it takes a velociraptor 4 seconds to run 100 meters, what is the minimum speed you need to drive (in meters per second) in order to not be eaten?

$$v = \frac{d}{t} = \frac{100m}{4s} = 25m/s$$

2. A bowling alley is 19.16 meters long. If it takes 4.5 seconds from the time you throw it for the ball to strike the pins, what is the speed at which you threw the bowling ball?

$$v = \frac{d}{t} = \frac{19.16m}{4.5s} \approx 4.258m/s$$

3. How far does a baseball travel if it is airborne for 10 seconds, traveling at a speed of 70 m/s?

$$v = \frac{d}{t} \implies d = v \times t = 70m/s \times 10s = 700m$$

4. A thunderstorm is moving in from the north. It is traveling at a speed of 4 m/s toward the south. If it will take the storm 7.5 minutes to arrive at your school, how far away is it now?

$$\text{First, convert time to seconds: } 7.5min \times \frac{60s}{1min} = 450s$$

$$v = \frac{d}{t} \implies d = v \times t = 4m/s \times 450s = 1800m$$

5. Sound travels through the air at an average speed of 343 m/s. If a lightning bolt is seen 1700 meters away, how long will it take before we hear the thunder?

$$v = \frac{d}{t} \implies t = \frac{d}{v} = \frac{1700m}{343m/s} \approx 4.956s$$

6. The average distance from the earth to the moon is 3.84 x 10^8 meters. Light travels through empty space at an approximate speed of $3x10^8$ meters per second. How long would it take a laser-beam fired from the earth's surface to reach the moon?

$$v = \frac{d}{t} \implies t = \frac{d}{v} = \frac{3.84 \times 10^8 m}{3 \times 10^8 m/s} = 1.28s$$

7. You are following the road to town in order to meet with the ruler who has a strange affection for the color green. However, you think that you might never make it to your destination, because it is a hefty 12,000 meters away. For the first 3,000 meters you travel at an average rate of 1 meter per second. You then meet a brainless companion who likes to dance and sing, which only slows you down to a speed of 0.5 meters per second for the next 3,000 meters. Then you meet a heartless man as well as a fearful king, which causes your speed to drop to 0.25 m/s for the remaining portion of the trip.

   (a) Draw a diagram of the situation.

   Diagrams will vary. *Note the final portion is 6000m.

   (b) How long does the first part of the trip take?

   $$v = \frac{d}{t} \implies t = \frac{d}{v} = \frac{3000m}{1m/s} = 3000s = 50min$$

   (c) How long does it take to sing and dance your way through the second 3000 meters?

   $$v = \frac{d}{t} \implies t = \frac{d}{v} = \frac{3000m}{0.5m/s} = 6000s = 100 \text{ min} = 1 \text{ hr } 40 \text{ min}$$

   (d) How long does the final part of the trip take?

   $$v = \frac{d}{t} \implies t = \frac{d}{v} = \frac{6000m}{0.25m/s} = 24000s = 400 \text{ min} = 6 \text{ hr } 40 \text{ min}$$

   (e) What is the total time that the trip to see the ruler take?

   $$3000s + 6000s + 24000s = 33000s = 550 \text{ min} = 9 \text{ hr } 10 \text{ min}$$

8. Guido and Sam are 87 meters from a group of Orcs, but are cursed with shorter legs. They are running away from the Orcs at 3 m/s, but the Orcs are overtaking them by running at 7 m/s.

   (a) How long do Guido and Sam have before they are caught by the Orcs?
   There are several methods for solving this problem correctly. This solution uses relative motion, and calculates time from the orcs' point of view:

   $$v_{relative} = v_{orc} - v_{hobbit} = 7m/s - 3m/s = 4m/s$$
   $$t = \frac{d}{v} = \frac{87m}{4m/s} = 21.75s$$

   (b) How far do the Orcs have to run to catch Guido and Sam?

   $$v = \frac{d}{t} \implies d = v \times t = 7m/s \times 21.75s = 152.25m$$