Name: KEY

09/03/11

Assignment #4: 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 keep from being eaten?

$$V = \frac{\Delta d}{\Delta t} = \frac{100\,m}{4\,s} = \boxed{25\ m/s}$$

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?

$$V = \frac{\Delta d}{\Delta t} = \frac{19.16\,m}{4.5\,s} = \boxed{4.258\,s}$$

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

$$V = \frac{\Delta d}{\Delta t} \qquad \Delta d = V \cdot \Delta t = 70\,m/s \cdot 10\,s = \boxed{700\ m}$$

4. 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 J. M. Hanks High School, how far away is it now?

$\approx$ 450 seconds

$$V = \frac{\Delta d}{\Delta t} \qquad \Delta d = V \cdot \Delta t = 4\,m/s \cdot 450\,s = \boxed{1800\ m}$$

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?

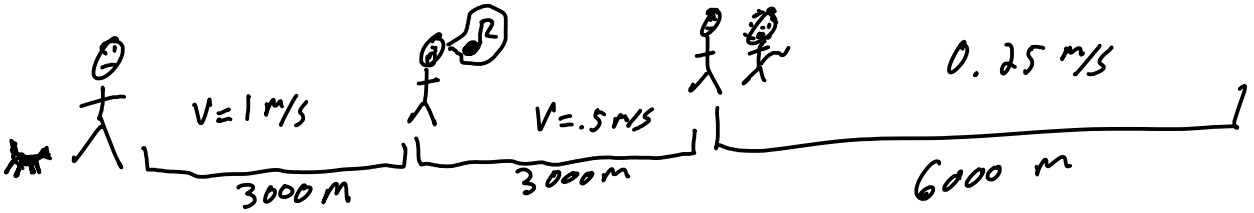
$$V = \frac{\Delta d}{\Delta t} \qquad \Delta t = \frac{\Delta d}{V} = \frac{1700\,m}{343\,m/s} = \boxed{4.956\ \text{seconds}}$$

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

$$V = \frac{\Delta d}{\Delta t} \qquad \Delta t = \frac{\Delta d}{V} = \frac{3.84 \cdot 10^8\,m}{3 \cdot 10^8\,s} = \boxed{1.28\ \text{seconds}}$$

Name: 09/03/11

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.



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

$$V = \frac{\Delta d}{\Delta t} \qquad \Delta t = \frac{\Delta d}{V} = \frac{3000\,m}{1\,m/s} = 3000\,s = \boxed{50\ minutes}$$

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

$$\Delta t = \frac{\Delta d}{V} = \frac{3000\,m}{.5\,m/s} = 6000\,s = 100\,min = \boxed{1\,hr\ 40\,min}$$

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

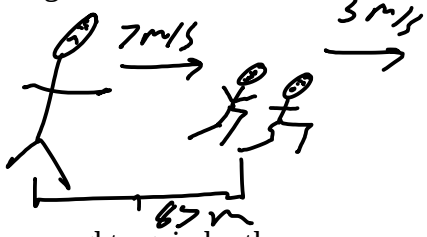
$$\Delta t = \frac{\Delta d}{V} = \frac{6000\,m}{.25\,m/s} = 24000\,s = 400\,min = \boxed{6\,hr\ 40\,min}$$

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

$$\Delta t_{total} = \boxed{9\,hr\ 10\,min}$$

8. Frodo 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 far do the Orcs have to run to catch Frodo and Sam?

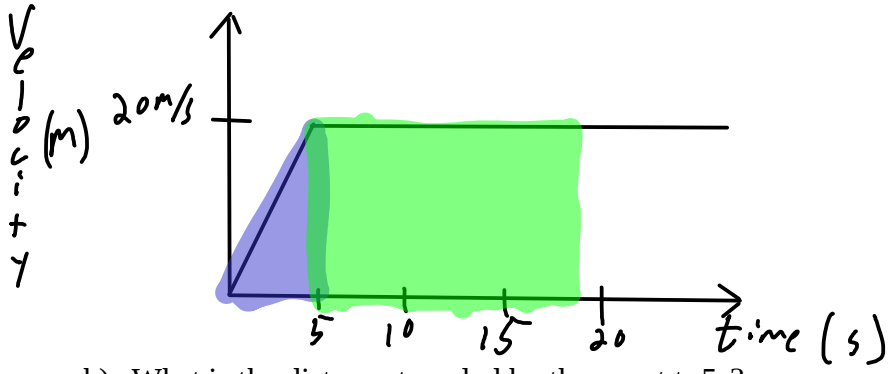
$$V = \frac{\Delta d}{\Delta t} \qquad \Delta d = V\,\Delta t = 7\,m/s \cdot 21.75\,s = \boxed{152.25\,m}$$



   b) How long do Frodo and Sam have to talk about the shire before they are caught again by the Orcs?

$$V = \frac{\Delta d}{\Delta t} \qquad \Delta t = \frac{\Delta d}{V} = \frac{87\,m}{4\,m/s} = \boxed{21.75\ seconds}$$

9. A car is stopped at a red light. The light turns green at t = 0s. The car accelerates at 4 m/s^2 to the speed limit of 20 m/s, and continues at a constant velocity.
   a) Make a velocity vs time graph for the above situation, from t=0s to t=20s:



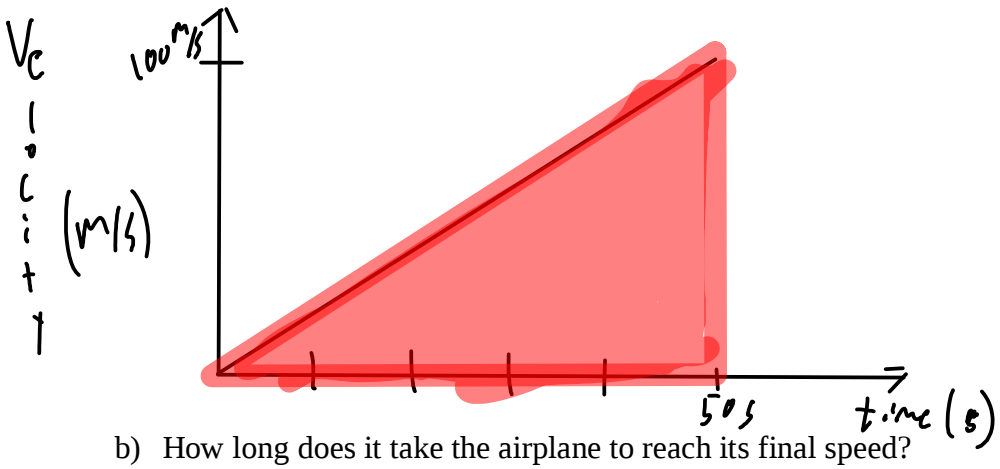
   b) What is the distance traveled by the car at t=5s?

$A = \frac{1}{2} B H = \frac{1}{2} (5_s)(20\ m/s) = \boxed{50\ m}$

   c) What is the distance traveled by the car at t=17?

$A = 50\ m + BH = 50m + 12_s \cdot 20\ m/s = \boxed{290\ m}$

10. An airplane is on the runway. At t=0s, the plane accelerates at a rate of 2 m/s^2 until it reaches its takeoff speed of 100 m/s.
   a) Make a graph of this situation.



   b) How long does it take the airplane to reach its final speed?

50 seconds

   c) What is the minimum length the runway should extend from the plane's initial position?

$\Delta d = \frac{1}{2} B \cdot H = \frac{1}{2} (50_s \cdot 100\ m/s) = \boxed{2500\ m}$