Name _____ per._____ Date _____

The Basics of Motion

1. How is distance different from displacement?

   displacement includes direction

2. Fluffy the Wonder Hamster rides his unicycle around a circular track that has a circumference of 9.4m and a diameter of 3 m. If Fluffy rides his unicycle 4.5 times around the track, how much distance does he travel? What is his displacement?

   distance: $(9.4m)(4.5) = 42.3 m$

   displacement: $(9.4)(.5) = 4.7 m$

3. What is the basic unit of speed and velocity?

   m/s

4. Speed is a scalar quantity while velocity is a vector quantity. What is the difference?

   velocity has direction

5. What is the difference between average speed and instantaneous speed?

   average speed is measured over a time interval and instantaneous speed is measured at a single point in time.

6. If a toy car has a constant speed of 5 m/s, what is its instantaneous speed? Explain.

   5 m/s
   if the speed is constant then the speed will be the same at any point in time.

7. What is acceleration? What is the unit of acceleration?

   the change in velocity divided by time

   m/s^2

8. Acceleration can be both positive and negative. What occurs if there is a positive acceleration? What occurs if there is a negative acceleration?

   positive — the object could be speeding up while moving forward or slowing down while moving backwards

   negative — the object could be slowing down while moving forward or speeding up while moving backwards

9. A young driver practicing in a parking lot drives 200m north. He then turns east and drives 75 meters. He then turns south and drives 200m. Finally, he drives 25 m west. It takes 40 seconds to complete his drive.
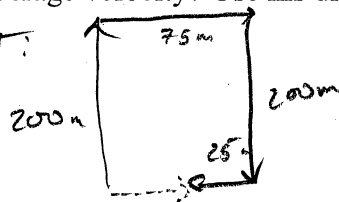
(a) What is his average speed? Use his distance.

distance: $200m + 75m + 200m + 25m = 500m$

$Speed = \dfrac{500m}{40s} = 12.5 \text{ m/s}$

(b) What is his average velocity? Use his displacement.

displacement:

$\vec{d} = 50m\ E$

$\vec{v} = \dfrac{\Delta \vec{d}}{\Delta t} = \dfrac{50m}{40s}$

$= 1.25 \text{ m/s East}$

10. A tennis ball is served and travels 24.0 m across the court in 0.60 seconds. Calculate its average velocity.

$\vec{v} = \dfrac{\Delta \vec{d}}{\Delta t} = \dfrac{24m}{.6s} = 40 \text{ m/s}$

11. A boy rides his bicycle at an average speed of 8.5 m/s for 300s. How far does he ride?

$\vec{v} = \dfrac{\Delta \vec{d}}{\Delta t}$

$\Delta \vec{d} = \vec{v}\, \Delta t$

$= \left(8.5 \text{ m/s}\right)\left(300\ s\right)$

$= 2550\ m$

12. Fluffy the Wonder Hamster likes to stay fit. He jogs 1300 m at a constant speed of 2m/s.

(a) How long will it take him to complete his run?

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

$$t = \frac{\vec{\Delta d}}{\vec{v}} = \frac{1300\,m}{2\,m/s} = 650\,S$$

(b) Fluffy finishes his jog only to meet a cat. Fluffy runs a displacement of 50 m in 5s, while the cat runs 10 m in 0.75s

(i) What is Fluffy's velocity?

$$\vec{v} = \frac{\vec{\Delta d}}{\Delta t} = \frac{50\,m}{5\,s} = 10\,m/s$$

(ii) What is the cat's velocity?

$$\vec{v} = \frac{\vec{\Delta d}}{\Delta t} = \frac{10\,m}{0.75\,s} = 13.3\,m/s$$

(iii) What happens to Fluffy?

the cat will eventually catch up to fluffy.

(c) When the cat catches up to Fluffy, a wrestling match begins. Using his super hamster strength, Fluffy manages to grab the cat by the tail, swing him over his head and throw him. The cat's velocity changed from 0 m/s to 20 m/s in 4s. What is the cat's acceleration?

$$\vec{a} = \frac{\vec{\Delta v}}{\Delta t} = \frac{20 - 0\,m/s}{4\,s} = 5\,m/s^2$$

(d) When the cat struck the ground, his velocity went from 20 m/s to 0m/s in 0.5 s. What was the cat's acceleration?

$$\vec{a} = \frac{\vec{\Delta v}}{\Delta t} = \frac{0 - 20\,m/s}{0.5\,s} = -40\,m/s^2$$

13. While out driving the hamstermobile one day, Fluffy drives by the cat, who recognizes him and begins to chase him. Fluffy, who was originally driving at a rate of 5 m/s speeds up at a rate of 8m/s². If he accelerated for 10s, what is his final velocity? How far did Fluffy travel while he accelerates?

$$\vec{a} = \frac{\Delta \vec{v}}{\Delta t} \qquad \Delta \vec{v} = \vec{a} \Delta t$$

$$\vec{V_f} - \vec{V_i} = \vec{a} \Delta t$$

$$\vec{V_f} = \vec{a} \Delta t + V_i = (8 m/s^2)(10s) + 5 m/s = 85 m/s$$

14. A jet lands on a runway with an initial velocity of 72 m/s. 12 seconds later it comes to a stop. What was the jet's acceleration?

$$\vec{a} = \frac{\Delta \vec{v}}{\Delta t} = \frac{0 - 72 m/s}{12s} = -6 m/s^2$$