 Name: _____

Lesson 3.10. The Speedometer

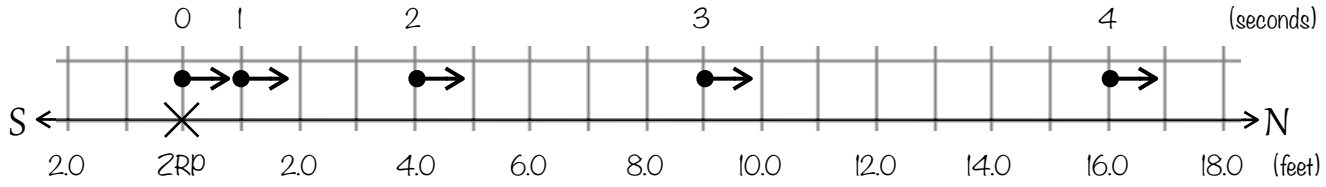
Date: _____ Period: _____

Here are some interesting facts!

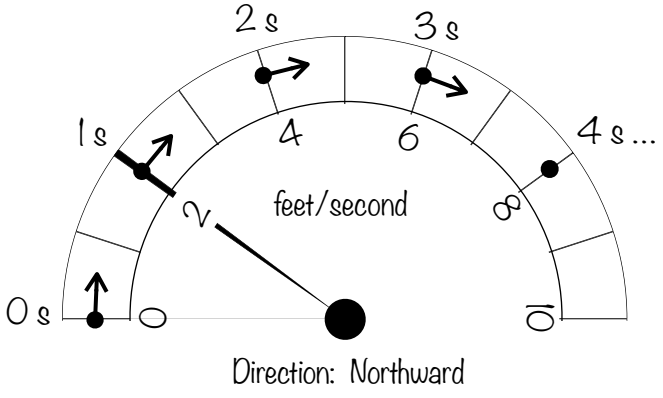
- On May 16, 2011, the final launch of space shuttle Endeavor occurred at the Kennedy Space Center. During the first 7 seconds after lift-off, Endeavor's velocity increased from rest to about 93 mph.
- Top Fuel dragsters are the fastest sanctioned category of drag racers, with the fastest competitors reaching speeds of 330 mph and finishing the 1,000 feet run in less than 3.10 seconds! Once across the finish line, the dragster deploys a parachute system which reduces the speed from 330 mph to about 20 mph in 10 seconds so the vehicle can exit the dragstrip safely.
- At the Berlin World Championships on 16 August, 2009, Usain Bolt set the world record for the 100 m dash. Starting from rest, he achieved a velocity of about 28 mph in approximately 7.11 seconds. (This may actually be an average velocity over an interval. Nevertheless, it's *fast*!)

These facts describe *changes of velocity during a time interval*; in other words, they tell how much the speed changed and how long it took to speed up or slow down.

Before you learned to represent *changes of position (displacements)* on a position graph, you practiced drawing *motion maps*. This was because it's easier to imagine something moving when you read a motion map.



Likewise, before learning to represent *changes of velocity* on a velocity graph, we will start with a new diagram: the *speedometer*.



The motion map and the speedometer above both represent the motion of a student walking to class. The ZRP is the door of Mrs. Willingham's biology classroom in the back hallway. Using information from both diagrams, describe the student's motion as completely as you can.

_____

_____

_____

_____

Beginning at rest in front of the biology classroom, the student traveled northward, faster and faster, toward the physics classroom. At 4 seconds, he was 16 feet, north of the biology classroom, and his speed had increased to 8 feet per second, northward. His speed increased by 2 feet/second during each second.

Reading the Speedometer

Example: (Starting at rest)[A], (the car's velocity increased by 1 mph, southward during every second.)[B] (At 6 seconds)[C], (its velocity reached 6 mph, southward)[D] and it (continued at that constant speed.)[E]

Identify the parts of the example so you'll know what's included!

A) The initial velocity

B) _____

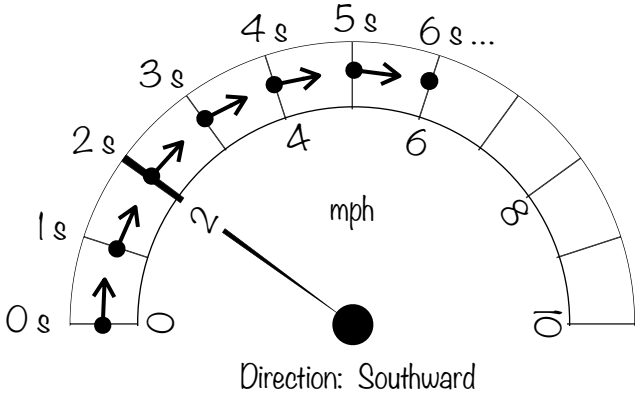
C) _____

D) _____

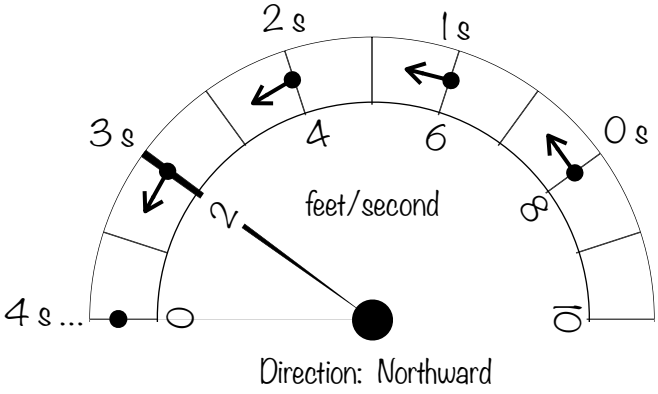
E) _____

☐ _____

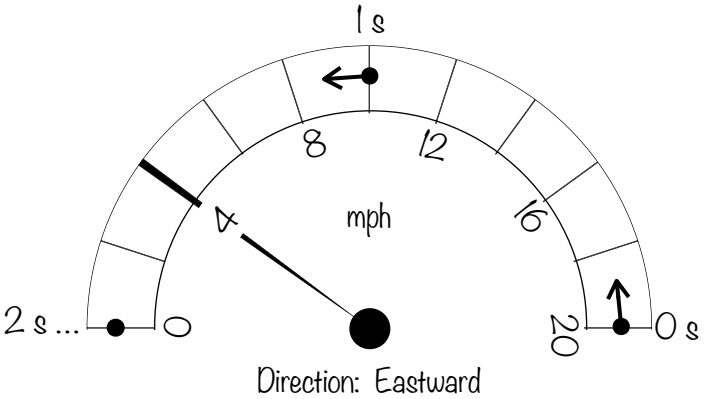
☐ _____



Direction: Southward



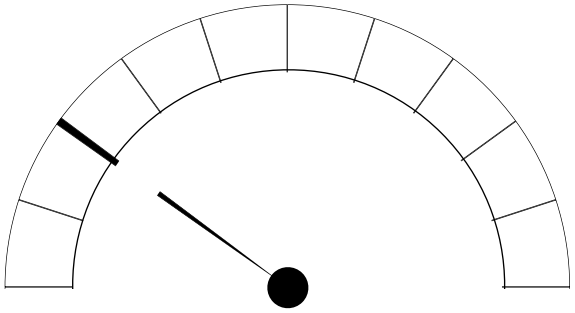
Direction: Northward



Direction: Eastward

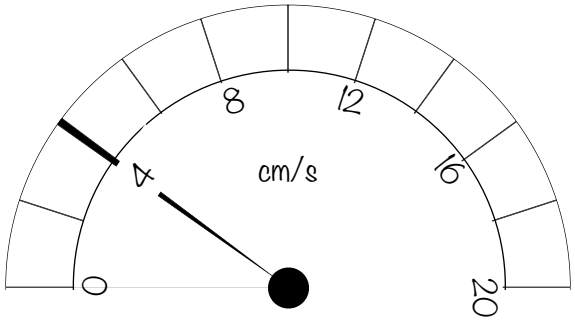
Drawing the Speedometer

Example: Someone pushed a red toy truck up an inclined plane. At the instant she stopped pushing, it was traveling at 12 cm/s, westward. It slowed by 4.0 cm/s, westward during each second of motion until coming to rest near the top of the incline. Once it stopped, someone held it in place so it wouldn't roll back down.



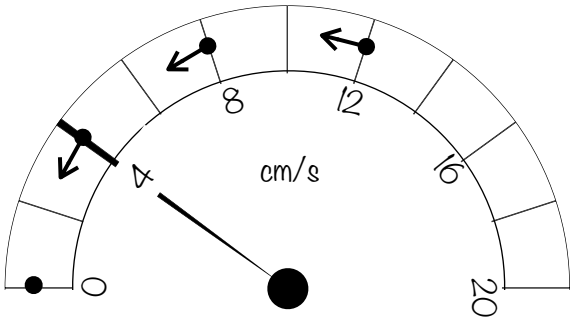
Direction: _____

- ☐ Fill in the direction of motion ***and the unit of velocity***. That's easy!
- ☐ Scale the speedometer so that the whole story will fit. Use as much of the arch as possible. This takes practice.



Direction: Westward

- ☐ Draw the initial velocity dot. Add a short arrow to indicate whether the velocity increases or decreases.
- ☐ The description tells you how much the velocity changes during each second, so for this example, place each velocity dot at 4 cm/s slower than the one before it.
- ☐ Add a short arrow to each dot to indicate whether the velocity increased or decreased.

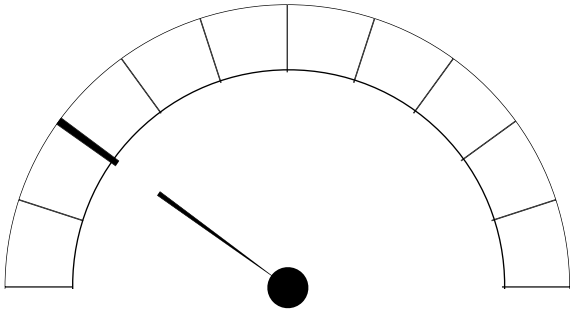


Direction: Westward

- ☐ Finally, label the time point values. For this example, write an elipsis (…) after the "3 s" label to show that the truck remained at rest after it stopped because someone held it in place.

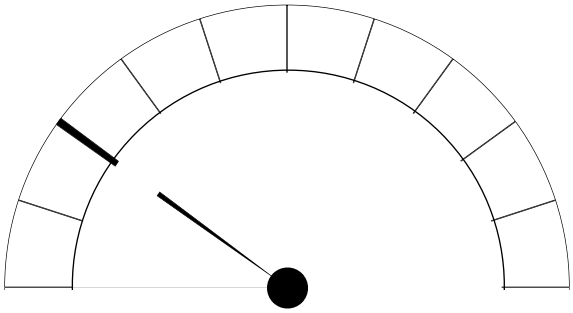
Practice

- Starting at rest when the traffic light turned green, a midnight black Toyota Titan® (its rear bumper is at the same level as your windshield) increased velocity by 3 mph, southward during each second. Its velocity remained constant after it reached 15 mph, southward.



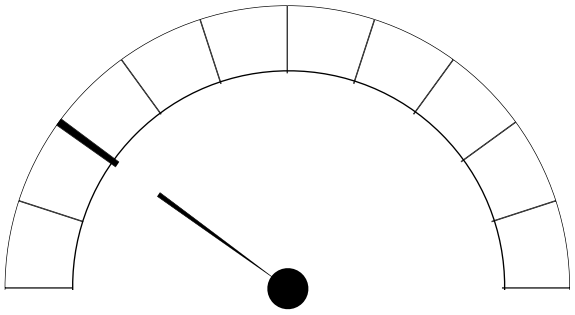
Direction: _____

- Rats. The traffic light ahead just turned red. Beginning at 15 mph, southward, the Titan®'s driver applied the brakes causing the velocity to decrease by 7.5 mph, southward during each second until the truck came to a full stop.



Direction: _____

- Someone released a red truck from rest at the top of an inclined plane. Its velocity increased by 3 cm/s, eastward during each second as it rolled down the incline. Once its velocity reached 12 cm/s, eastward, it continued along the flat table top at a constant velocity.



Direction: _____

Name: _____

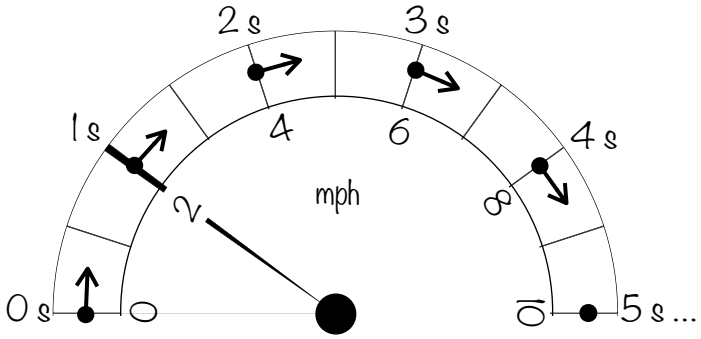
HW 3.10. The Speedometer

Date: _____ Period: _____

Please perform the following tasks neatly, in pencil, right on this sheet. Carefully study the lesson for examples of complete and correct work.

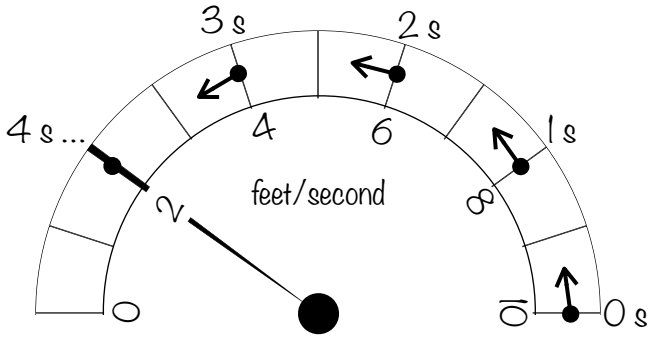
1) Please describe the motion represented by each speedometer at right.

a) _____



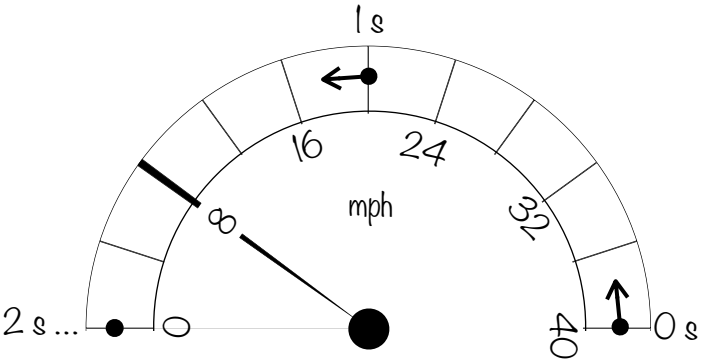
Direction: Northward

b) _____



Direction: Eastward

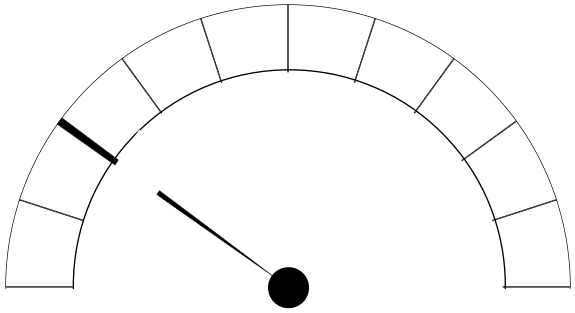
c) _____



Direction: Eastward

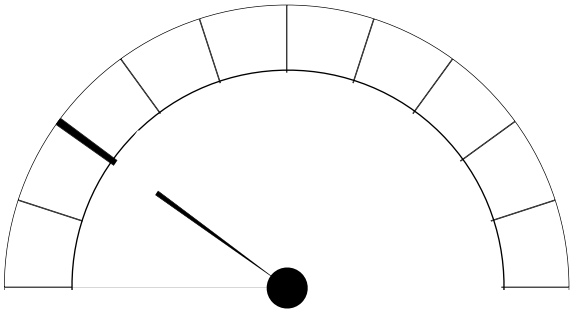
2) Please plot a speedometer to represent the following motions.

a) On May 16, 2011, the final launch of space shuttle Endeavor occurred at the Kennedy Space Center. Starting at rest, Endeavor's velocity increased by about 10 mph, upward during each second. (Actually, it accelerated faster than that, but I made the numbers easier to plot.) After 7 s of travel, it continued to gain speed, but at a slower rate; so continue your plot for just the first 7 s.



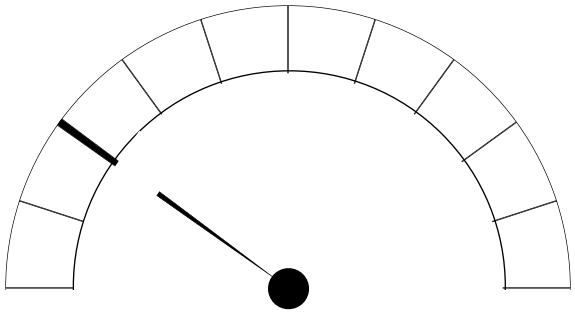
Direction: _____

b) Top Fuel dragsters are the fastest sanctioned category of drag racers. Starting at rest, a dragster gained 80 mph, westward during every second of the race. He finished the race in 4 s.



Direction: _____

c) At the end of the race, the Top Fuel Dragster must deploy a parachute to stop the vehicle. Starting at about 300 mph, westward, the velocity decreases at about 100 mph, westward during each second until the dragster comes to a full stop.[1] (Again, I've simplified the numbers somewhat. The actual acceleration is about "6 g", which is a very violent ride.)



Direction: _____

[1] <http://iml.jou.ufl.edu/projects/Spring06/Gregorzek/> 11/7/2014