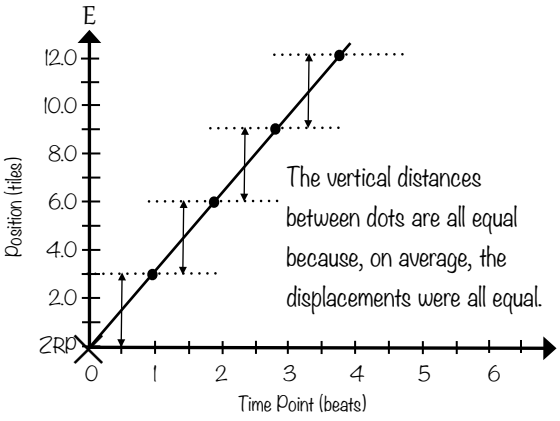
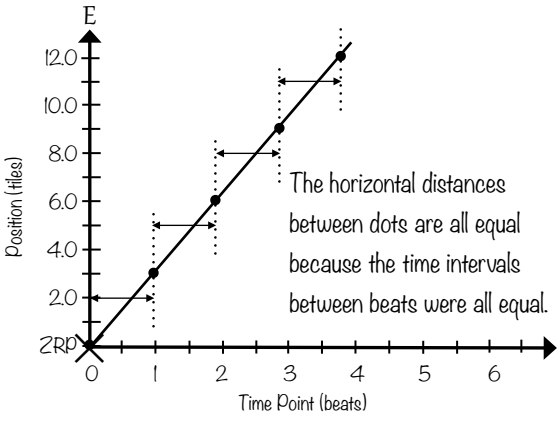
Name: _____

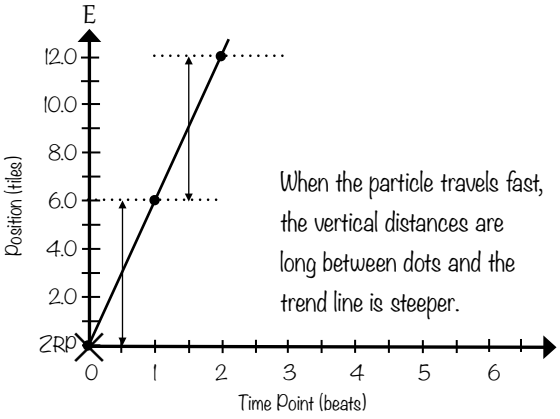
Lesson 1.14. Blue & Red Arrows

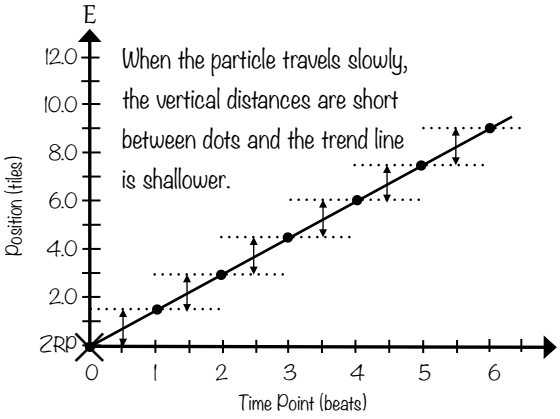
Date: _____ Period: _____





When a particle travels at a constant velocity, the trend line on its position graph is a straight line. This is because the particle travels equal distances during equal time intervals.





When the particle travels quickly, the displacement during each time interval is long and the slope of the trend line is steeper; when it travels slowly, the displacement during each time interval is short and and the slope is shallower.

Bearing these ideas in mind, we are now ready to state a formal definition of *average velocity*:

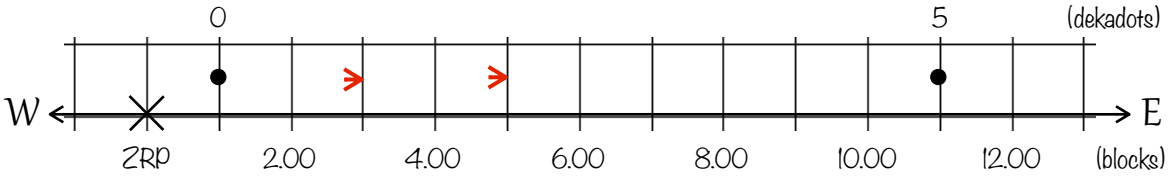
- The *average velocity* of a particle in uniform motion is defined as the slope of the trend line on the graph of position *vs.* time point.
- A particle's *average velocity* is equal to the average displacement per time interval of one count.

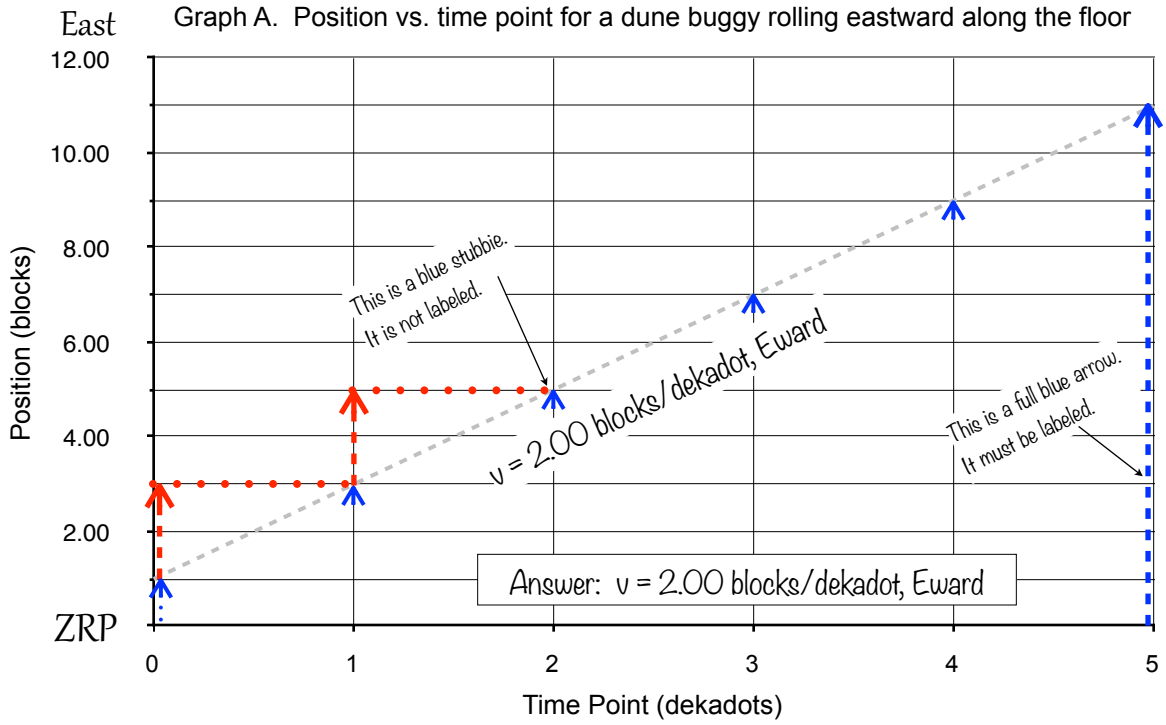
Velocity combines motion in space *and* motion in time, therefore the symbol we use to represent *average velocity* must also show motion in space *and* motion in time. In this lesson, you will learn to draw **red arrows** to represent *average velocity*. As with the **green** *total displacement* arrows, each red *average velocity* arrow is accompanied by a **red dotted line**.

Here are some helpful strategies:

1) As you read a scenario, underline important given information with the corresponding color.
2) Starting with what you know, draw the story in a logical order.
3) **Blue arrows** always start at the time point axis.
4) **Green arrows** are always drawn at the *beginning* of a time interval, and always start at the tip of the *initial* blue arrow.
5) **Red arrows** are drawn at the *beginning* of each time interval of 1 count, and always start at the tip of a blue arrow (or stubby).

Now, sharpen your **red** colored pencil (or whatever) and turn the page!





*A buggy was just passing **1.00 block, east** of the reference point when the timer made the first dot on the ticker tape. At 5 dekadots, the buggy passed **11.00 blocks, also east** of the reference point. Determine the buggy's <u>average velocity</u> during this time interval.*

A) Helpful strategies.

- ☐ We know the initial and final positions, so draw them first. Then, draw the story in the correct order.
- ☐ **Blue arrows** always start at the time point axis.
- ☐ **Red arrows** are always drawn at the *beginning* of a time interval.

B) The position graph!!

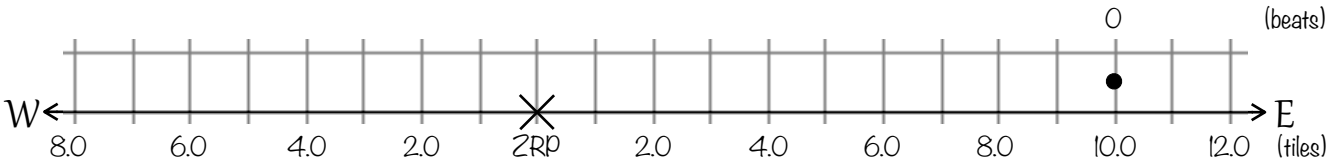
- ☐ With **blue** colored pencil, draw an ellipse around the ZRP.
- ☐ With **blue** colored pencil, draw position arrows (or a dot) at the initial and final positions.
- ☐ With regular writing pencil, label the position arrows and draw a trend line between the points of the position arrows.
- ☐ With **blue** colored pencil, draw a stubby arrow at every time point.
- ☐ Now, pay close attention. The order in which you perform the following is important.
  - ☐ Touch your **red** colored pencil to the paper at the point where the trend line crosses the grid line *at the end* of a time interval.
  - ☐ Draw a **red dotted line** straight back *from* the end of the time interval *to* the beginning of the time interval.
  - ☐ Touch the **red** colored pencil to the paper at the point of the *initial position arrow* (or stubby).
  - ☐ Draw a **red arrow** straight to where you ended the red dotted line.
- ☐ Draw a **red arrow and its dotted line** for each time interval of travel. These show you the average velocity of the buggy! With regular writing pencil, label the *trend line* with the average velocity and write your answer.

Trust me on this one. You will spare yourself multiple "Try Again Alerts" (70% credit) not to mention much un-compensated mental anguish if you get in the habit of drawing these correctly.

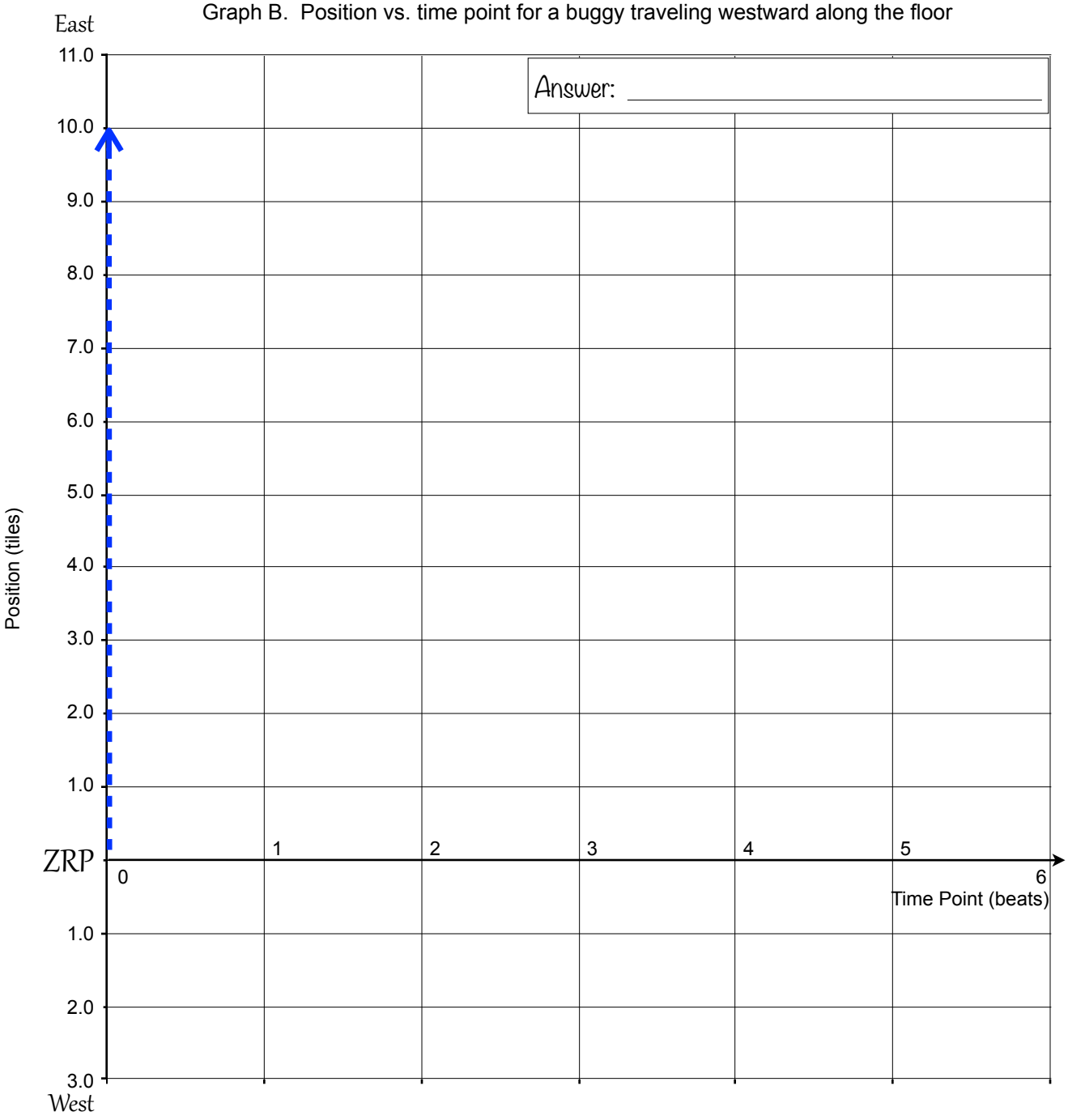
C) The motion map!

- ☐ With **blue** colored pencil, draw ellipses around the initial and final positions.
- ☐ With **red** colored pencil, draw a stubby arrow every 2.00 blocks.

A buggy was just passing 10.00 tiles, east of the reference point when a student placed the first washer, and it passed 2.00 tiles, west of the reference point when she placed the washer at time point 6 beats. Determine the average velocity of the buggy during this time interval.



Graph B. Position vs. time point for a buggy traveling westward along the floor



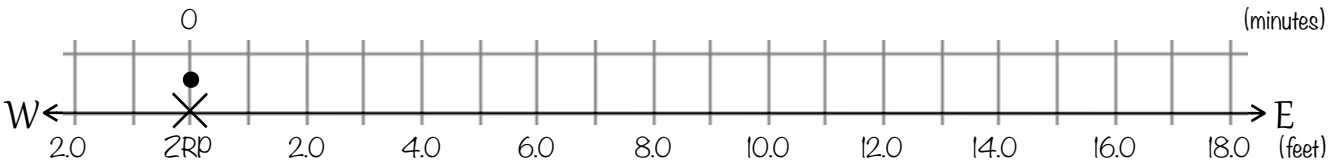
Answer: _____

Name: _____

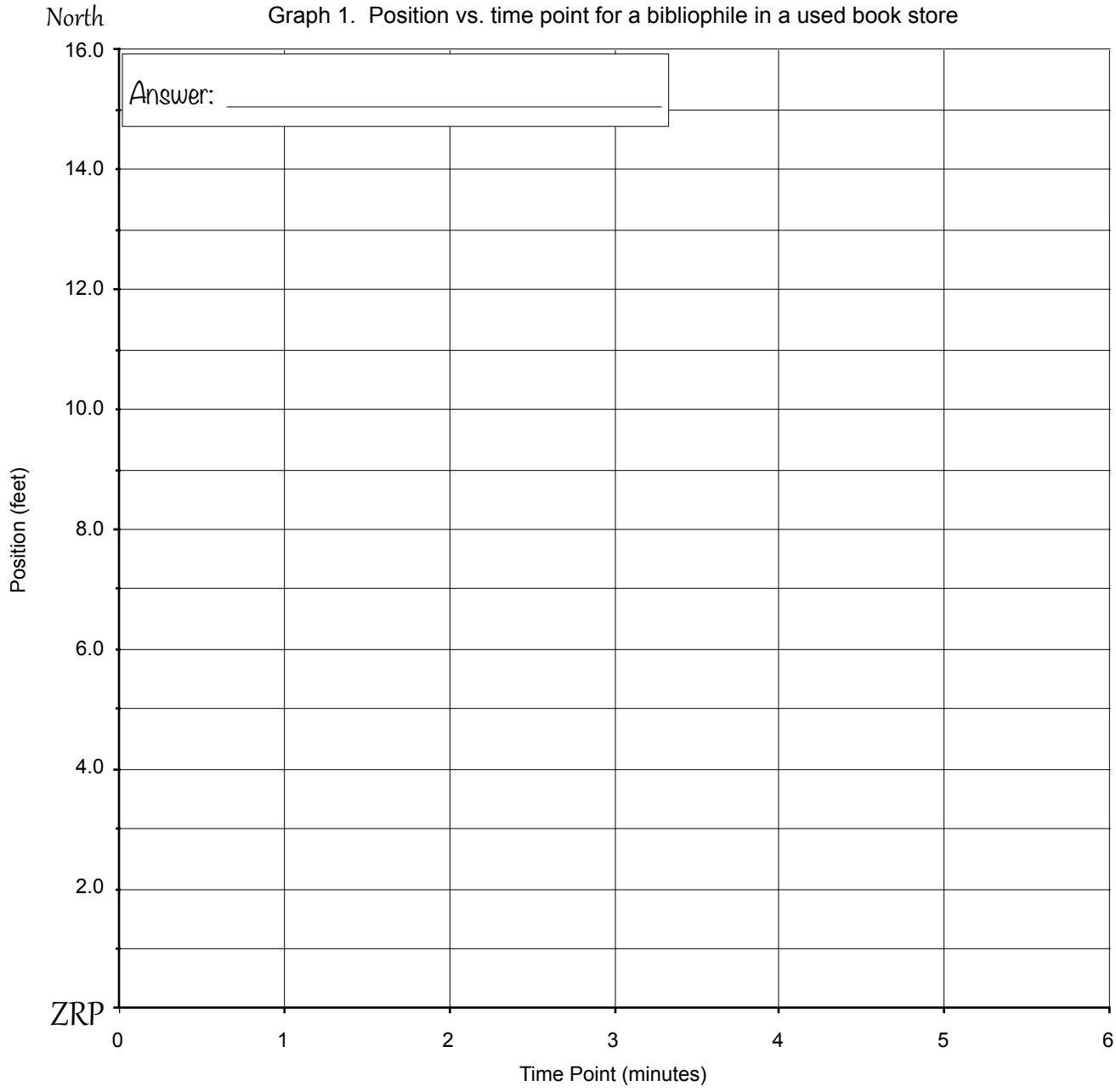
Homework 1.14. Blue & Red Arrows

Date: _____ Period: _____

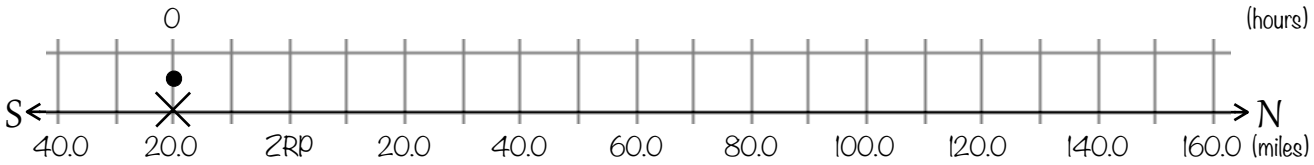
Someone (we won't say who) spent some time this past weekend attempting to remain financially responsible at a used book store (she didn't succeed). She began in the "Popular Physics" section, which we'll set as the reference point. Five minutes later, she was 15 feet, east of the reference point, having wandered into the "Humor" section. Please determine her average velocity during this five-minute interval.



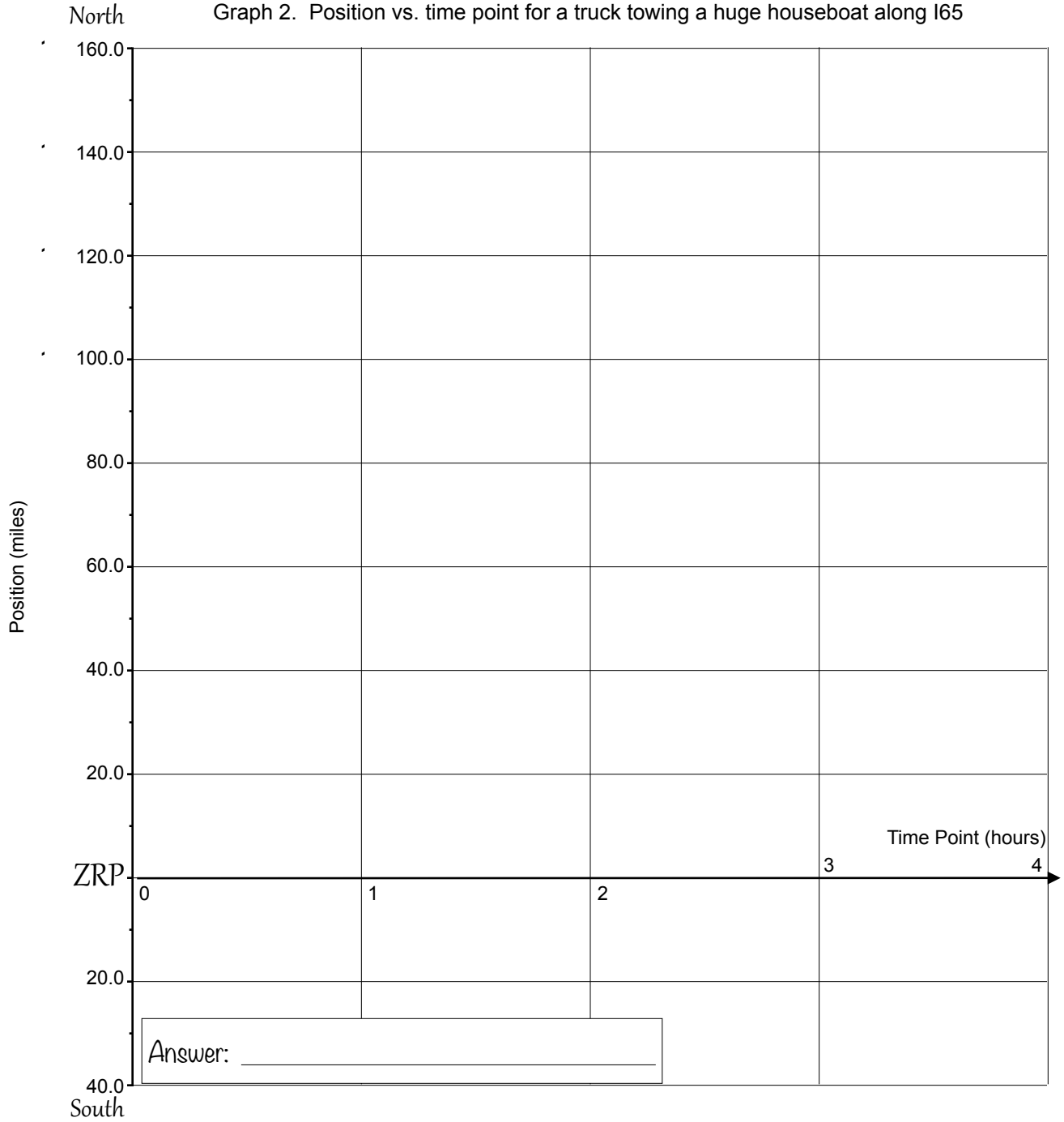
Graph 1. Position vs. time point for a bibliophile in a used book store



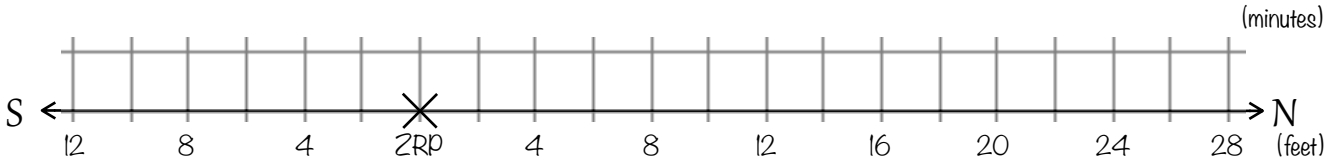
A truck, towing a huge houseboat on a trailer, was traveling southward in Kentucky, along I65. It entered the freeway at 130 miles, north of the border with Tennessee, which is the reference point. Three hours later it took the exit 20 miles south of the border in order to stop for fuel. Please determine its average velocity as it traveled along the freeway.



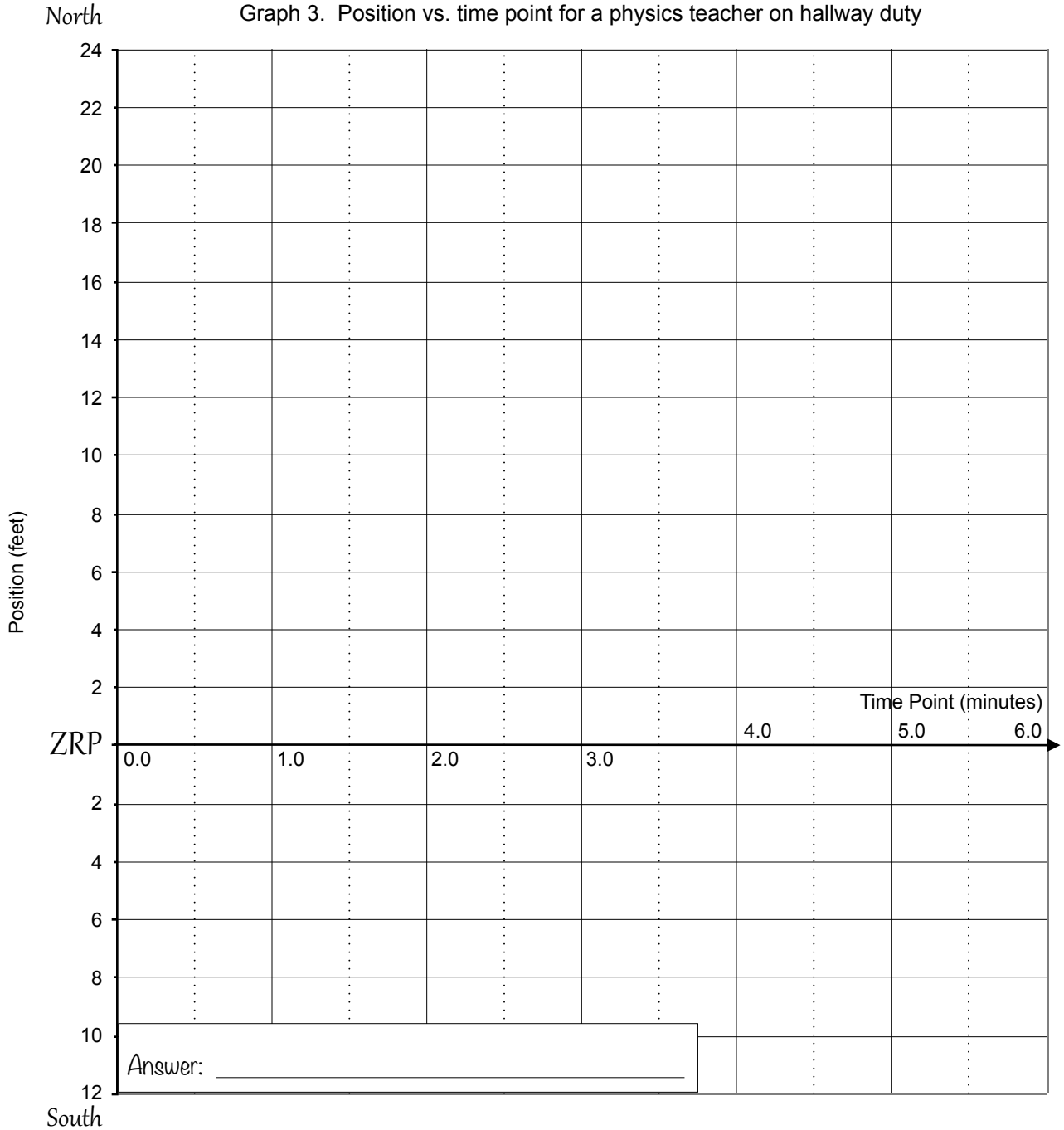
Graph 2. Position vs. time point for a truck towing a huge houseboat along I65



The motion map and position graph below represent the motion of your beloved physics teacher on hallway duty. When eager physics students began taking data, she was located 26 feet, north of the door of the physics classroom (which is the reference point, of course). After walking at a slow, steady pace for 5 minutes, she was 6 feet south of her door. Please determine her average velocity while on duty.

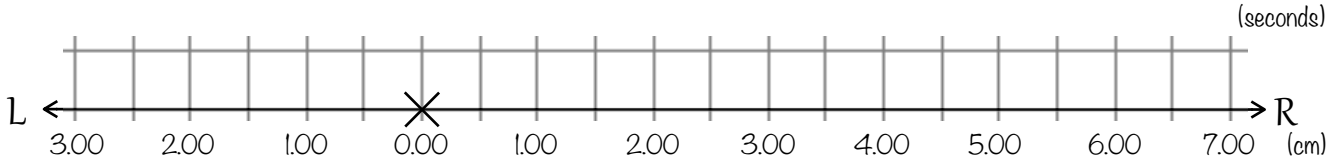


Graph 3. Position vs. time point for a physics teacher on hallway duty



Answer: _____

Students in Ms. Gigante's Physics 2 class were using an online laboratory simulation to study the speed of a wave traveling along a string. After setting the frequency of the wave at a desired value, Ismael (there is no "sh" in "Ismael") clicked the "play" button and watched as successive crests of a wave proceeded rightward along the string. His partner, Daniel, started the timer (t = 0.00 s) when a particular crest was right over the 2.00 cm mark on the online ruler. When the crest reached the 5.00 cm mark on the ruler, the timer read 6.00 s. Please determine the average velocity of the wave crest.



Right

Graph 4. Position vs. time point for a wave crest traveling along a string

Answer: _____