Name: _____

Lesson 1.12 Blue Arrows

Date: _____ Period: _____

Once we've established that,on average, an object travels equal displacements during equal time intervals, then we can begin to answer questions and make predictions about future time points and positions of the object. All of this depends upon the object continuing to travel in the same manner, of course.

That is the awesome power of a pattern!

Now, introductory physics students must master eight (well, really it's nine) quantities in order to analyze motion along a straight line. In this class, we use graphs as visual tools to help master these quantities. We use colored pencils to draw arrows and to shade in certain regions on graphs of position, velocity, momentum, acceleration, and net force. These colored "decorations" enable us to answer any question asked in the mechanics part of the introductory physics curriculum ***and*** they have the added advantage of making clear the interconnections and relations between the eight (well, really nine) physics quantities:

position
displacement
velocity
(*average and instantaneous*)
change-of-velocity
acceleration
momentum
impulse
net force

It is important that you approach your work with a positive attitude! You will learn a symbolic "language" in which each color and shape represents a particular physical quantity. Any symbol loses all meaning when it's used incorrectly and the same is true here; in order to be at all useful, the colored shapes must be drawn and labeled neatly and correctly. Furthermore, sometimes students find the work deceptively simple at first and do not apply their best effort to the lessons. *Do not be fooled! The work isn't difficult, but it must be done correctly. Each step builds on what came before!*

As you know, every journey begins with a single step and proceeds one step at a time. You will be amazed how well your brain associates each quantity with its color. The first step in our journey is **blue** arrows to represent position.

A word about choosing a good medium for artwork in Physics 1: I prefer that you use colored pencils and I refer to colored pencils throughout the lessons. However, they suffer from the disadvantage of not erasing cleanly, if at all. Therefore, you may choose another medium if you prefer, but it must meet the following criteria. *These criteria pretty much eliminate most highlighters, marker pens, and permanent markers!*

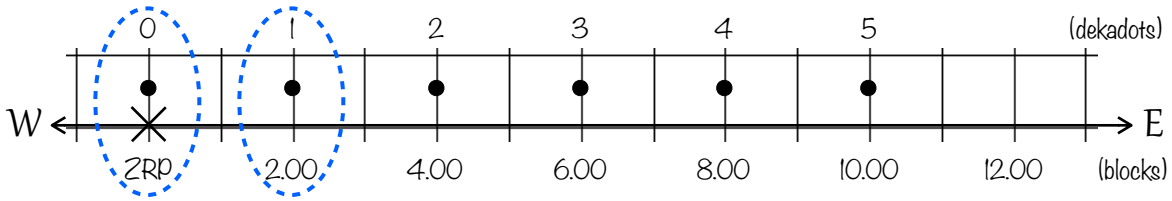
- You must be able to draw thin, neat lines and the colors must be as specified (*i.e., pink is not red).*
- Your marks must not "bleed" through to be visible on the other side of the paper.

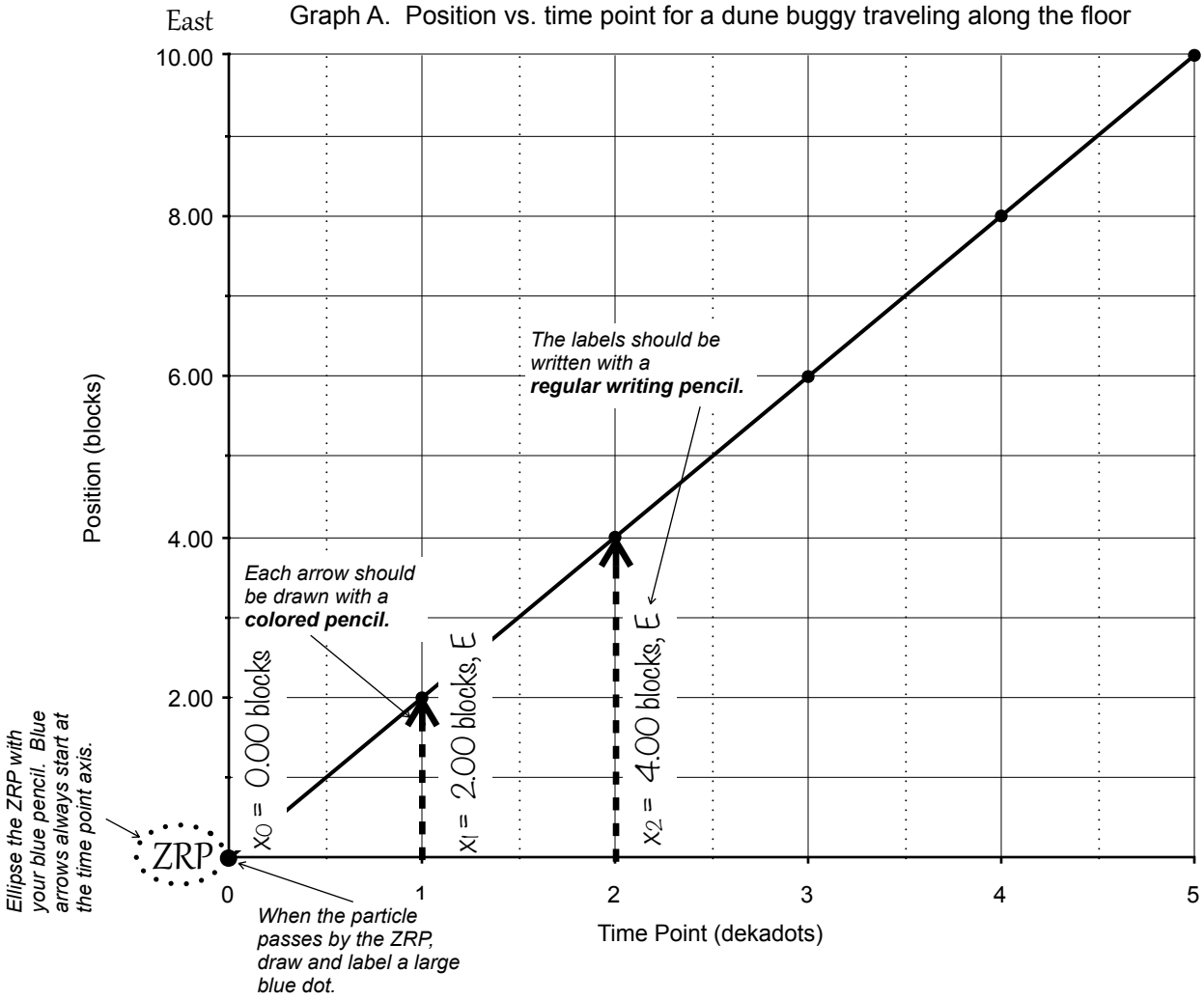
So, sharpen your **blue** colored pencil (or whatever) and let the adventure begin!

Before you turn the page …

What's all this about a "particle"?

When you observed the dune buggy in the lab, you paid attention to the motion of the whole buggy without even thinking about the spinning motor, turning wheels and gears, or even the electrical current flowing from the battery. Lots of stuff was moving, but you observed only the motion of the buggy *as a whole*, as if the buggy were a large "particle". The motion of most physical objects is quite complex and we're just not ready to tackle such motion, yet. When we observe the motion of a complex object in the lab, we think about the object *as a whole*, without paying attention to what's going on within the object. We call this a "particle model" because we analyze the motion of objects as if they have nothing going on inside (no *internal structure*); that is, we consider things to be "particles".





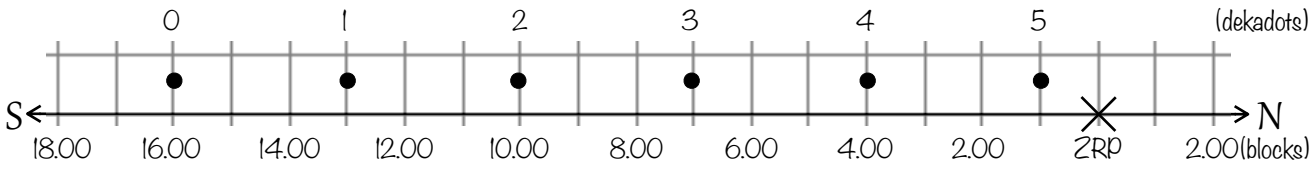
A) The motion map!

- ☐ With **blue** colored pencil, draw an ellipse around the position dot at each time point.

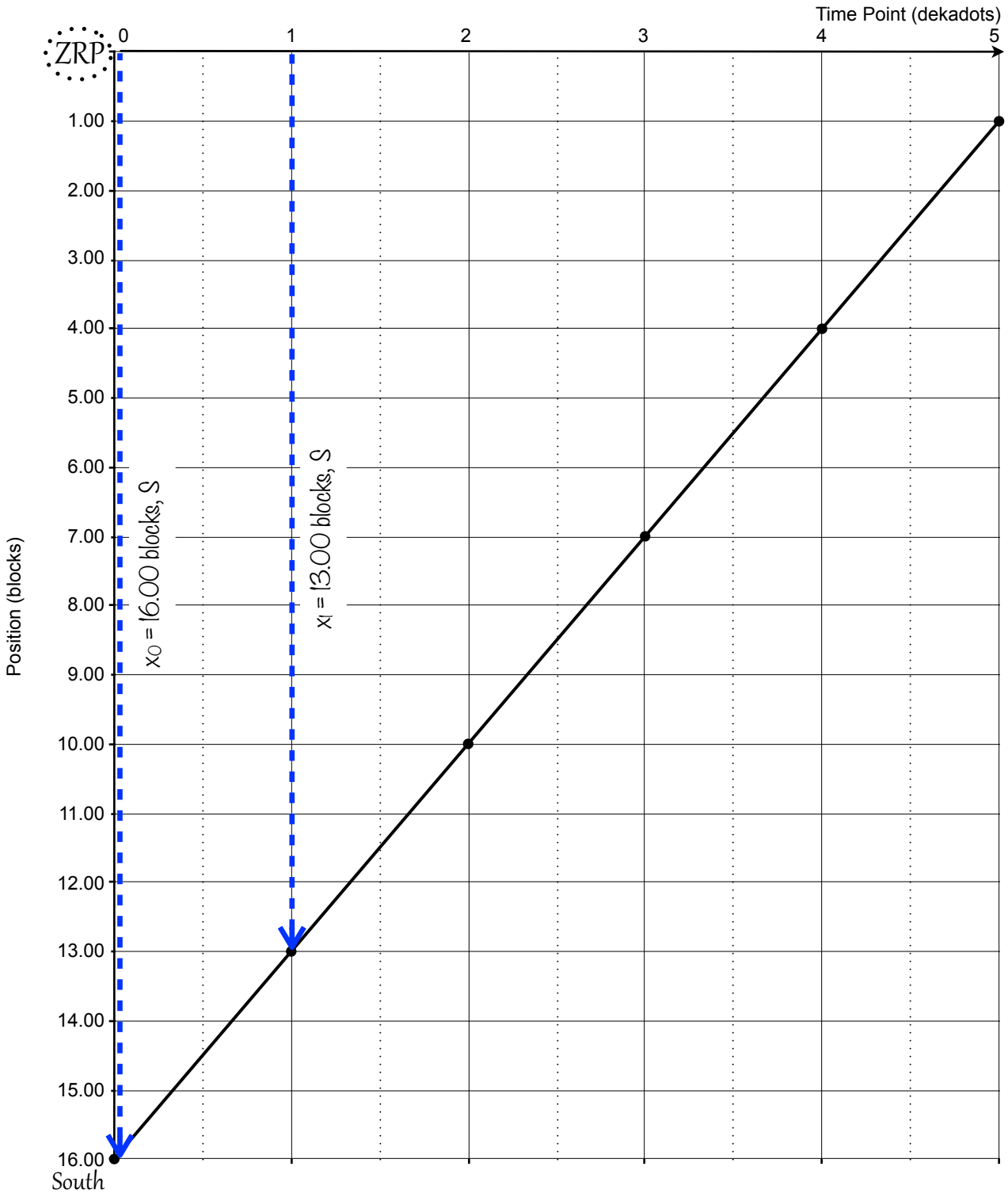
B) The position graph!!

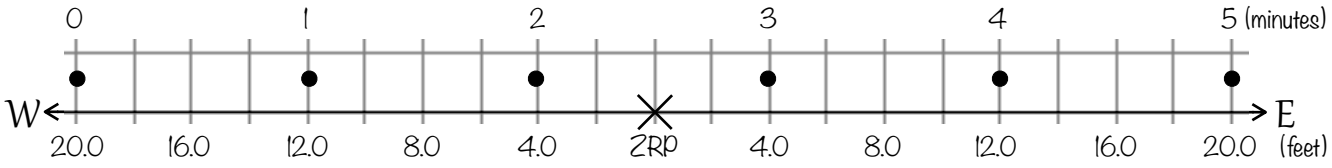
- ☐ With **blue** colored pencil, draw an ellipse around the ZRP.
- ☐ Now, pay close attention. The order in which you perform the following is important.
  - ☐ Always remember that position is measured *from the ZRP!*
  - ☐ Touch your **blue** colored pencil to the paper *on the time point axis* at the first time point.
  - ☐ Draw a **blue arrow** (or a dot) along the gridline to the initial position value.
  - ☐ Repeat these steps for the positions at the remaining time points.
- ☐ With regular writing pencil, draw a trend line connecting the points of the position arrows.
- ☐ With your regular writing pencil, label each blue arrow with the position including the direction. Make sure you get the unit right!

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.

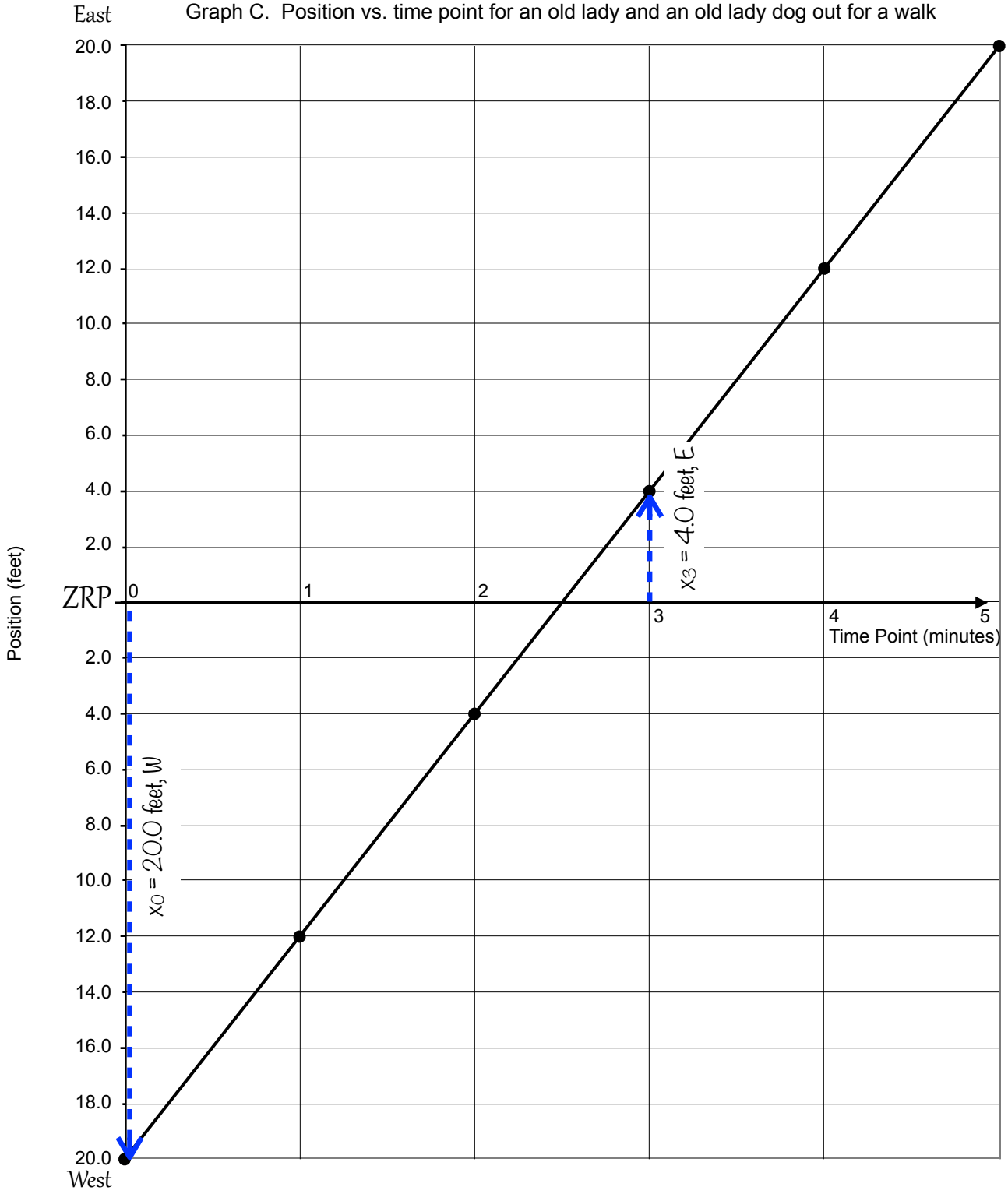


Graph B. Position vs. time point for a dune buggy traveling northward along the floor





Graph C. Position vs. time point for an old lady and an old lady dog out for a walk



Name: _____

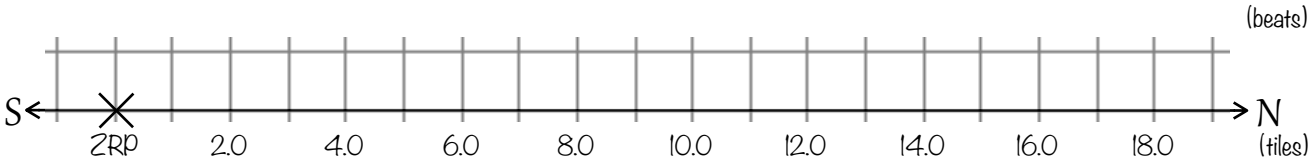
HW 1.12. Blue Arrows on the Position Graph

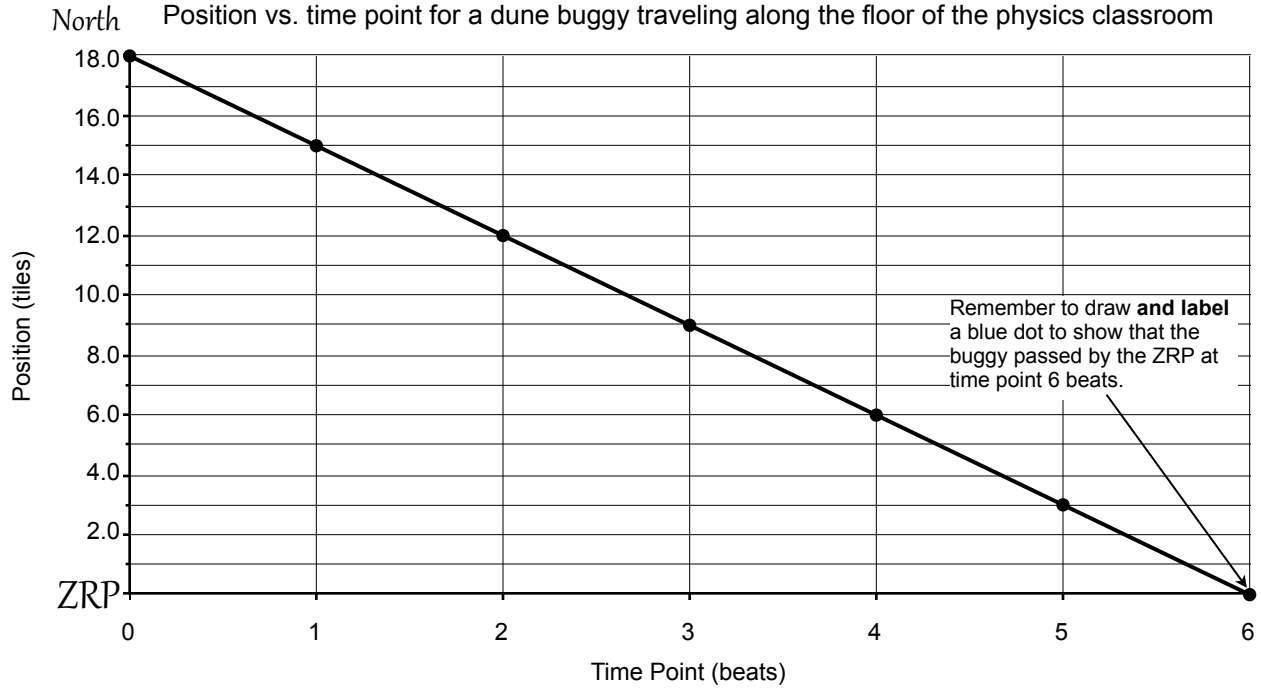
Date: _____ Period: _____

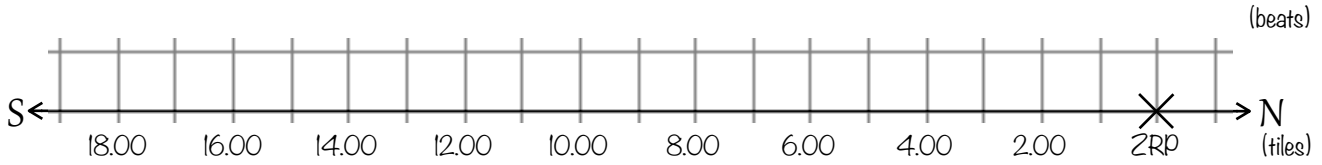
Please answer all of the parts of Question 1 neatly, in pencil, on a nice, clean sheet of lined notebook paper. Express your ideas as complete thoughts written in clear, declarative English sentences. Make every pronoun refer unmistakably to a definite antecedent.

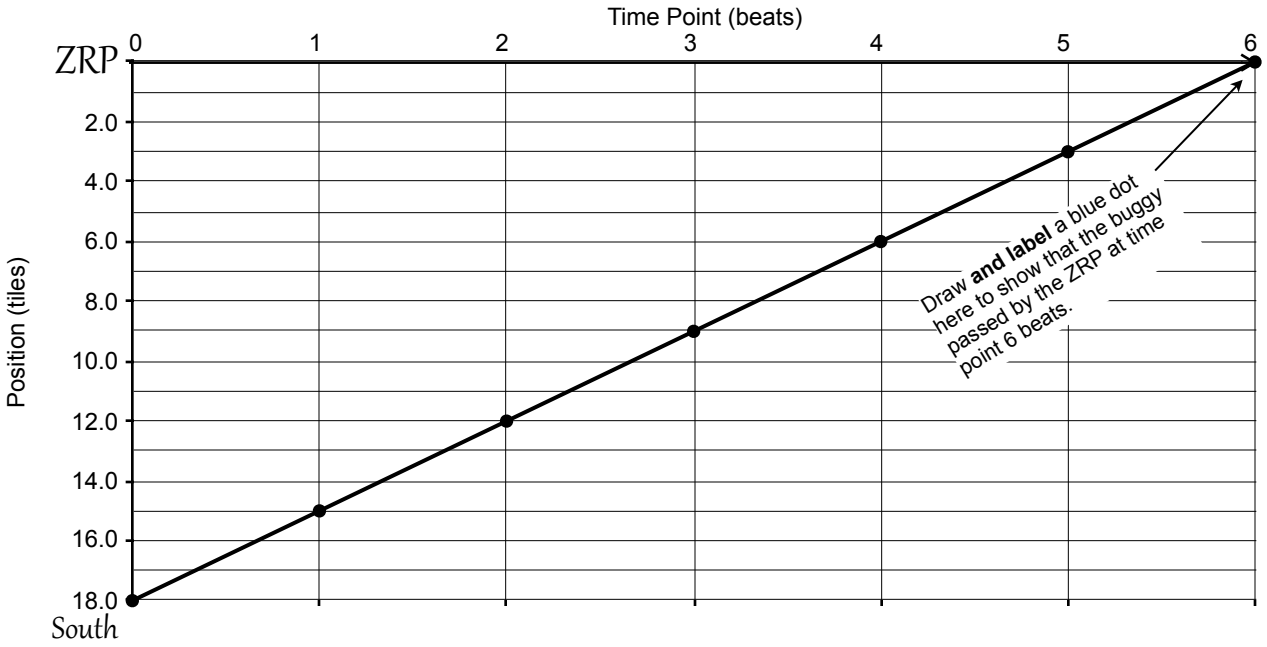
Please note: "Graphs A and B" and "In the 4th quadrant" and "Yes. Because it inclines upward" are neither careful explanations nor complete thoughts; responses such as these do not explain anything nor do they demonstrate that you understand anything at all. Eschew them!!

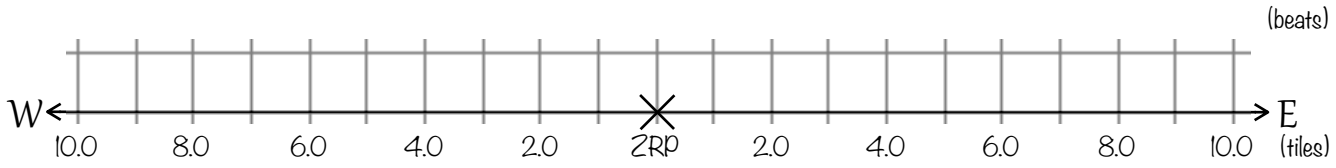
1) Consider Graphs A - C ***in the lesson*** (***NOT*** the homework graphs on the following pages!).
   a) Which graph(s) represent a particle that remained east or north of the ZRP as it traveled along? In which quadrant was the trend line in these graphs?
   b) Which way do the blue arrows point in the graph(s) you identified in part 1a above (upward, or downward)?
   c) Which graph(s) represent a particle that remained west or south of the ZRP as it traveled along? In which quadrant was the trend line in these graphs?
   d) Which way do the blue arrows point in the graph(s) you identified in question 1c above?
   e) Consider your answers to questions 1a, 1b, 1c, and 1d. Explain the connection between a particle's location, the quadrant of the trend line, and the direction the blue arrows point.
   f) Explain why the direction of the blue arrows flips from downward to upward on Graph C. What does this tell you about the motion of the particle?
   g) Explain why the lengths of the *position* arrows change as time passes. What does this tell you about the motion of the particle?
   h) Explain why the blue arrows first get shorter and then get longer as time passes on Graph C. What happens to the walkers' *position*?
2) Please decorate the motion maps and the position graphs on the following pages as you were instructed in the lesson. (*Please note: here, you will be required to draw the position dots on the motion maps yourself!*) Do your work ***right on the page***!

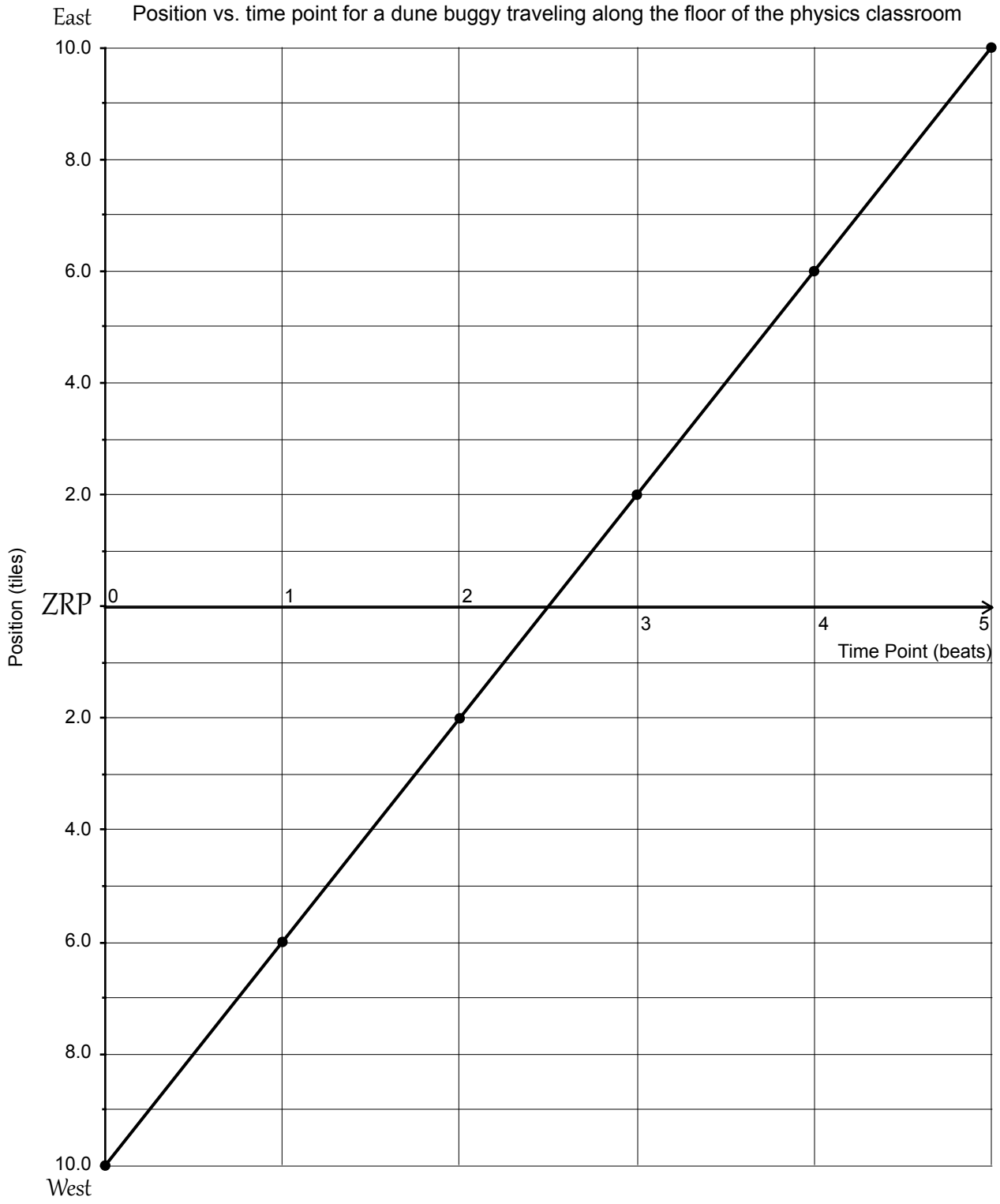

(beats)
S
N
ZRP
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
18.0
(tiles)

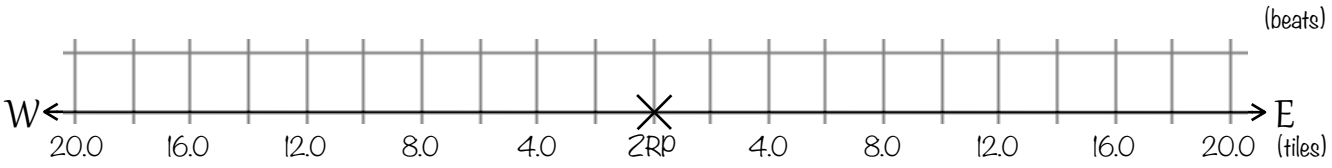

North
Position vs. time point for a dune buggy traveling along the floor of the physics classroom
Position (tiles)
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
ZRP
0
1
2
3
4
5
6
Time Point (beats)
Remember to draw **and label** a blue dot to show that the buggy passed by the ZRP at time point 6 beats.

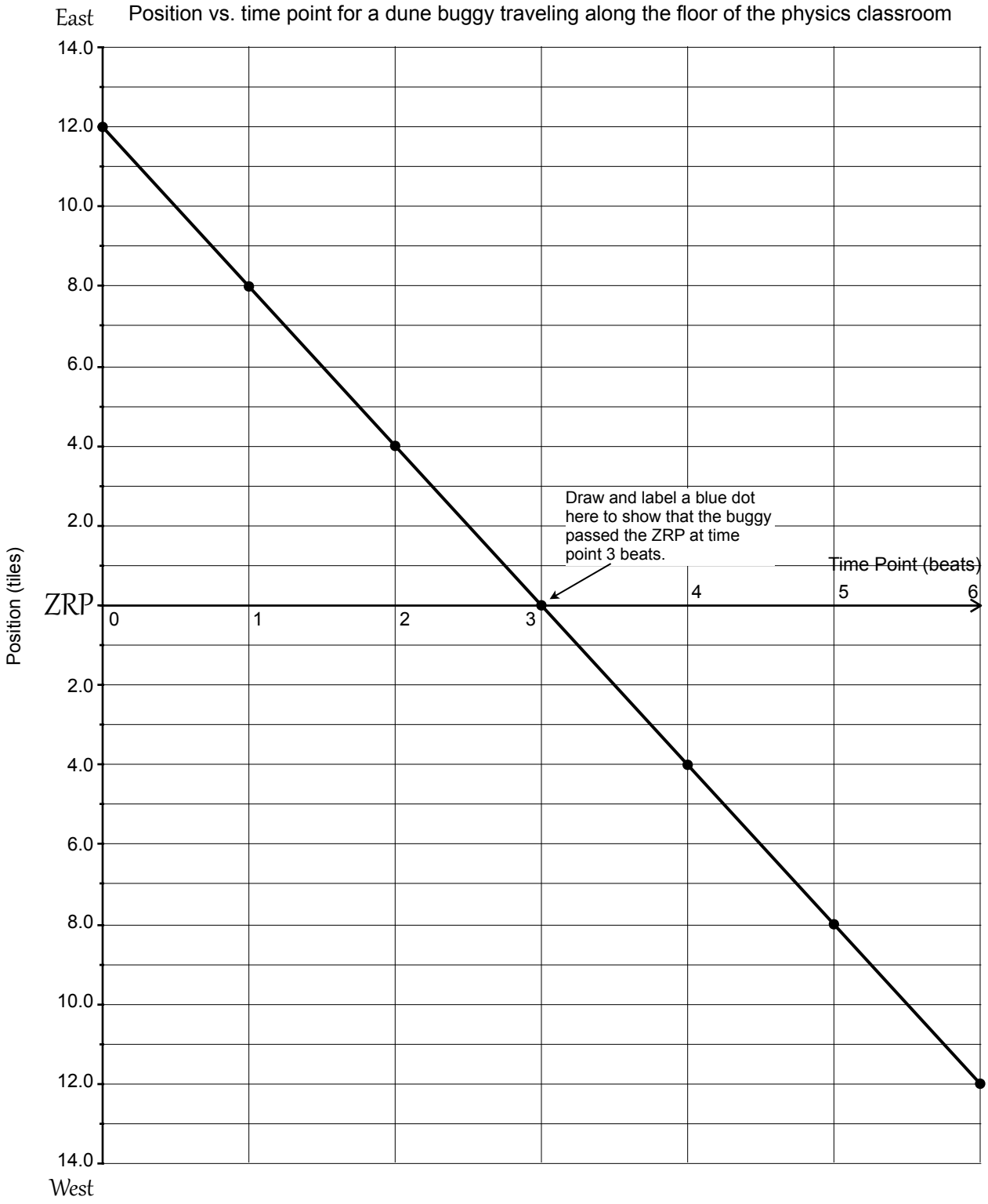

(beats)
S
N
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
ZRP
(tiles)


Position vs. time point for a dune buggy traveling along the floor of the physics classroom
Time Point (beats)
ZRP
0
1
2
3
4
5
6
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
18.0
South
Position (tiles)
Draw **and label** a blue dot here to show that the buggy passed by the ZRP at time point 6 beats.


(beats)
W
E
10.0
8.0
6.0
4.0
2.0
ZRP
2.0
4.0
6.0
8.0
10.0
(tiles)


East
Position vs. time point for a dune buggy traveling along the floor of the physics classroom
10.0
8.0
6.0
4.0
2.0
ZRP
0
1
2
3
4
5
Time Point (beats)
Position (tiles)
2.0
4.0
6.0
8.0
10.0
West


(beats)
W
E
20.0
16.0
12.0
8.0
4.0
ZRP
4.0
8.0
12.0
16.0
20.0
(tiles)


East
Position vs. time point for a dune buggy traveling along the floor of the physics classroom
14.0
12.0
10.0
8.0
6.0
4.0
2.0
ZRP
2.0
4.0
6.0
8.0
10.0
12.0
14.0
West
Position (tiles)
Draw and label a blue dot here to show that the buggy passed the ZRP at time point 3 beats.
Time Point (beats)
0
1
2
3
4
5
6