Name: _____

Lesson 1.4. Measuring Position

Date: _____ Period: _____

Objectives

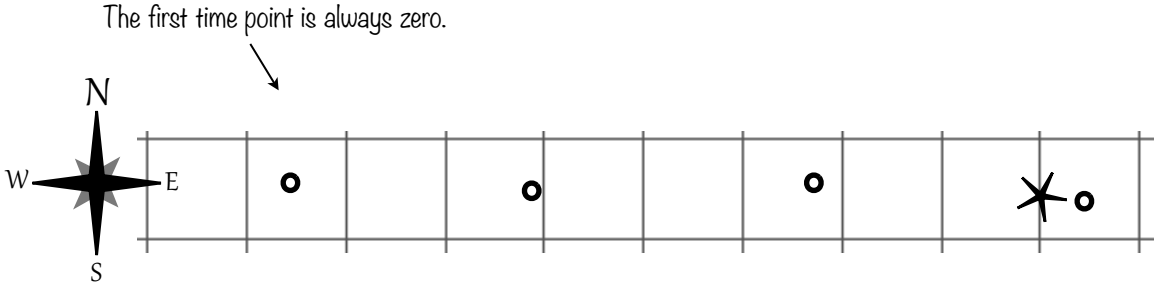
1) Compare two ways to measure the progress of the dune buggy as it travels along the floor.
2) Identify which method is preferable and why.

A Comparison

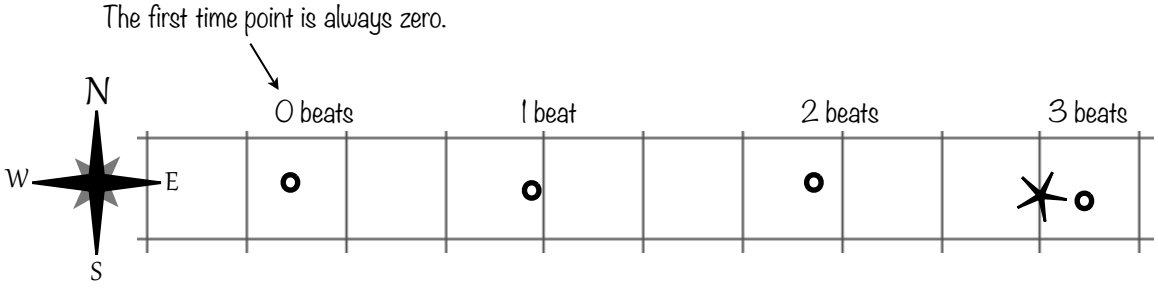
During the Dune Buggy paradigm lab, you will place washers on the floor beside the buggy as it travels along. So, the first question is, "We know *where* to place each washer (beside the buggy), but how will we know *when* to place each washer?"

Well, here's the thing. While you place the washers, your eyes will be busy watching the buggy, so you can't watch the clock. Therefore, we'll use an online metronome to sound out "beats" at evenly-spaced time points. While your eyes are busy watching the buggy, your ears will be busy listening for the next "beat", and your body will be busy getting the washer placed. That's *multitasking* for sure!

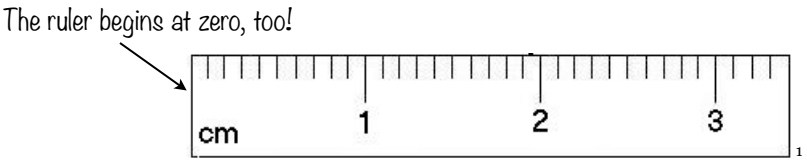
The resulting pattern of washers on the floor will look something like this …



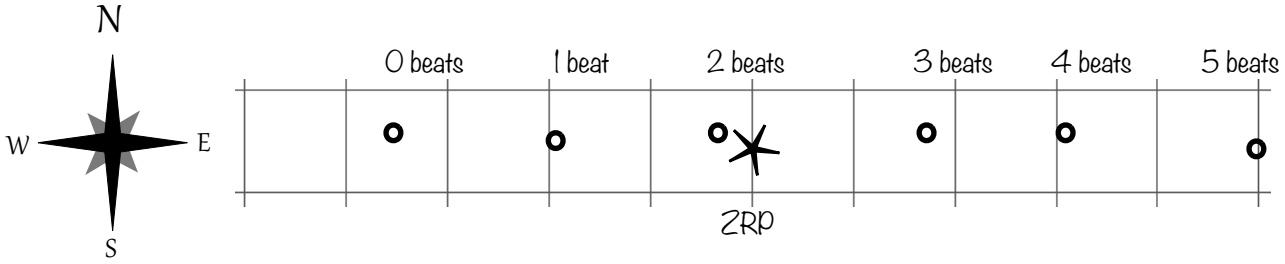
… and the time point labels will look something like this:



The very first washer you place is always labeled "0 beats" because that is when you begin counting time. For a similar reason, the left end of a ruler is always labeled "0 units" because that is where you begin measuring length.


The ruler begins at zero, too!
cm
1
2
3

Here, again, is the set of washers showing the places that a Groovy Dune Buggy passed at evenly-spaced time points as it traveled along the floor of the physics classroom.



Notice that I have added the time point labels. These show the *order in time* in which the washers were placed. The first washer placed is always labeled *zero* because we count the passing of time from that moment; that moment is the beginning of our time scale.

Now, please compare two types of measurements that can be taken on the pattern of washers. Carefully read the instructions printed above each data table.

To complete Table A, measure the distance *from* each washer *to* the next washer. In other words, directly measure the distance *between* the washers. Record your measurements in Table A below.

Table A. Distance and direction from each washer to the next washer.

Time Points (beats)	Distance and Direction Between Washers (tiles, direction)
0 beat→ 1 beat	1.7 tiles, E
1 beat → 2 beats	
2 beats → 3 beats	
3 beats → 4 beats	
4 beats → 5 beats	

To complete Table B, measure the distance *from* the zero reference point (ZRP) *to* each of the washers, in turn. Record your measurements in Table B below.

Table B. Distance and direction from the ZRP to each washer

Time Points (beats)	Distance and Direction Between ZRP and Washer (tiles, direction)
0 beats	3.6 tiles, W
1 beat	
2 beats	
3 beats	1.8 tiles, E
4 beats	
5 beats	

You have just measured two different lengths in the pattern of washers on the floor.

- Describe how you performed the measurements that are recorded in Table A.

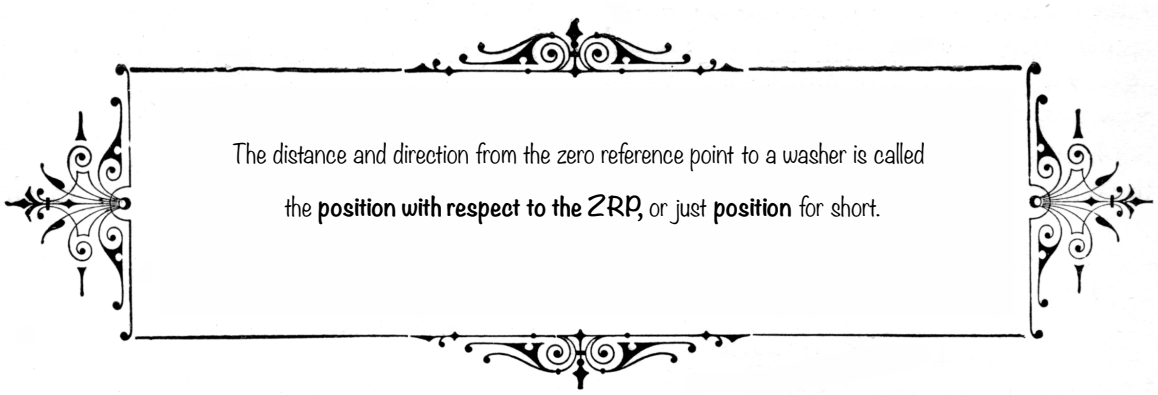
- Describe how you performed the measurements that are recorded in Table B.

- Which method of measurement was *easier* to perform: A, or B? Carefully explain your reasoning.

Both types of measurement are equally *precise* because they both contain one decimal place. However, the results are still not of equal quality. Which method of measurement do you think gives the more *reliable* result? Carefully explain your thinking.

A physicist would say that measuring from a single reference point to each washer gives the more reliable result for three reasons.

- *Superior measurement technique.* The edges of the tiles form the "marks" on the floor tile "ruler." The ZRP lies right on an edge; therefore, it lies directly on a "mark" on the ruler. It is visually easier to estimate that no "parts of a tile" remain at the left end of each distance that is measured from the ZRP. Thus, instead of estimating parts of a tile at both ends of the measurement, you must estimate only the part of a tile remaining at the right end.
- The distance from the ZRP to each washer is measured without regard to any other washer. Each data point is thus independent of every other data point.
- The positions of all washers are measured relative to the same reference point. Motion must be described relative to a reference point that is at rest within a reference frame. For each description of a single motion, all of the observations must be made relative to the same reference point.



[2]

There are three rules about the zero reference point (ZRP).

1) The ZRP is chosen *after* the washers have been placed on the floor.
2) The ZRP is located *at the edge of a tile*.
3) The same ZRP is used to measure the positions of *all of the washers* in a given set.

[1] <http://schools.ednet.ns.ca/avrsb/712/routlejo/Chemistry/images/ruler.jpg> 16 August, 2015

[2] <http://etc.usf.edu/clipart/3700/3715/filigree-banner_42.htm> October 18, 2012

 Name: _____

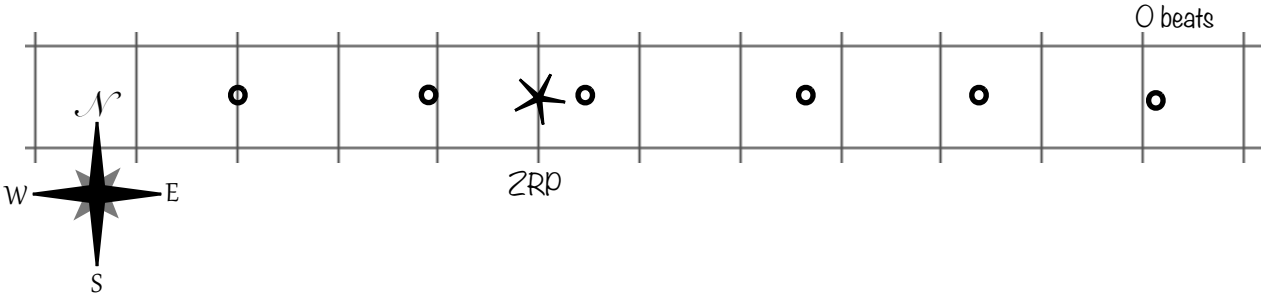
Homework 1.4. Measuring Position

Date: _____ Period: _____

Please answer the following questions neatly, in pencil, on a nice, clean sheet of lined notebook paper.

1) Here is a picture of the washers placed by a student to mark the positions passed by a Groovy Dune Buggy at time points separated by equal intervals as it traveled along the floor of the physics classroom.

   The buggy traveled ***westward***.



a) Assign a *time point* value to each washer beginning with *zero beats* and increasing evenly by one beat. I have already labeled time point *zero* for you. (*You're welcome*.)

a) On the *second blue line from the top* of your notebook paper, write out the title of the data table shown below. Then, draw the table below the title. ***Please remember to include the column headings.***

b) Measure the *position* (***including the direction)*** of each washer.

c) Record your results in your data table.

Table 1. Position vs. time point for a Groovy Dune Buggy traveling along the floor of the physics classroom in order to determine whether it traveled at a constant speed.

Time Point (beats)	Position (tiles, direction)

Name: _____

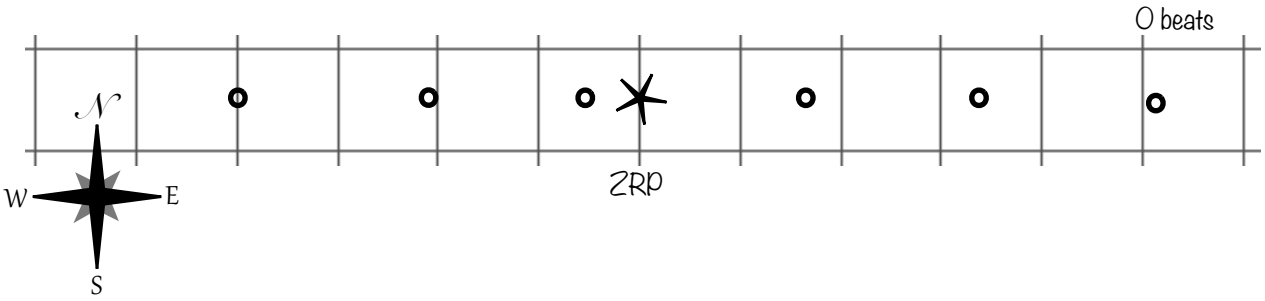
Homework 1.4. Measuring Position

Date: _____ Period: _____

Please answer the following questions neatly, in pencil, on a nice, clean sheet of lined notebook paper.

1) Here is a picture of the washers placed by a student to mark the positions passed by a Groovy Dune Buggy at time points separated by equal intervals as it traveled along the floor of the physics classroom.

   The buggy traveled ***westward***.



b) Assign a *time point* value to each washer beginning with *zero beats* and increasing evenly by one beat. I have already labeled time point *zero* for you. (*You're welcome*.)

a) On the *second blue line from the top* of your notebook paper, write out the title of the data table shown below. Then, draw the table below the title. ***Please remember to include the column headings.***

b) Measure the *position* (***including the direction)*** of each washer.

c) Record your results in your data table.

Table 1. Position vs. time point for a Groovy Dune Buggy traveling along the floor of the physics classroom in order to determine whether it traveled at a constant speed.

Time Point (beats)	Position (tiles, direction)

Name: _____

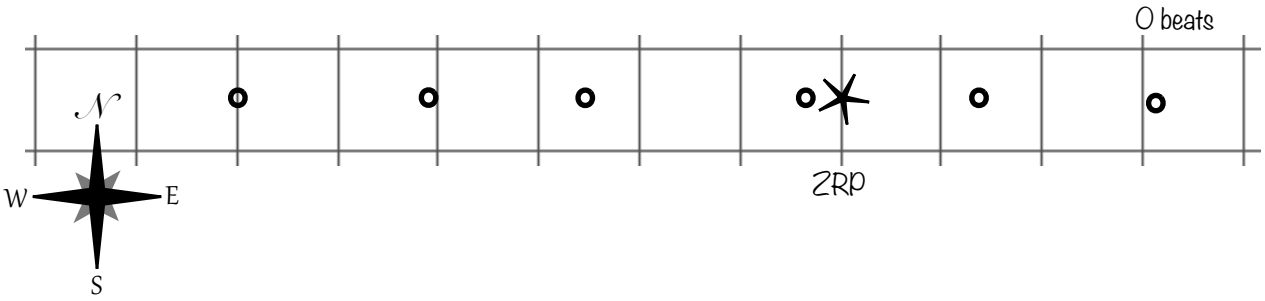
Homework 1.4. Measuring Position

Date: _____ Period: _____

Please answer the following questions neatly, in pencil, on a nice, clean sheet of lined notebook paper.

1) Here is a picture of the washers placed by a student to mark the positions passed by a Groovy Dune Buggy at time points separated by equal intervals as it traveled along the floor of the physics classroom.

   The buggy traveled ***westward***.



c) Assign a *time point* value to each washer beginning with *zero beats* and increasing evenly by one beat. I have already labeled time point *zero* for you. (*You're welcome*.)

a) On the *second blue line from the top* of your notebook paper, write out the title of the data table shown below. Then, draw the table below the title. ***Please remember to include the column headings.***

b) Measure the *position* (***including the direction)*** of each washer.

c) Record your results in your data table.

Table 1. Position vs. time point for a Groovy Dune Buggy traveling along the floor of the physics classroom in order to determine whether it traveled at a constant speed.

Time Point (beats)	Position (tiles, direction)

Name: _____

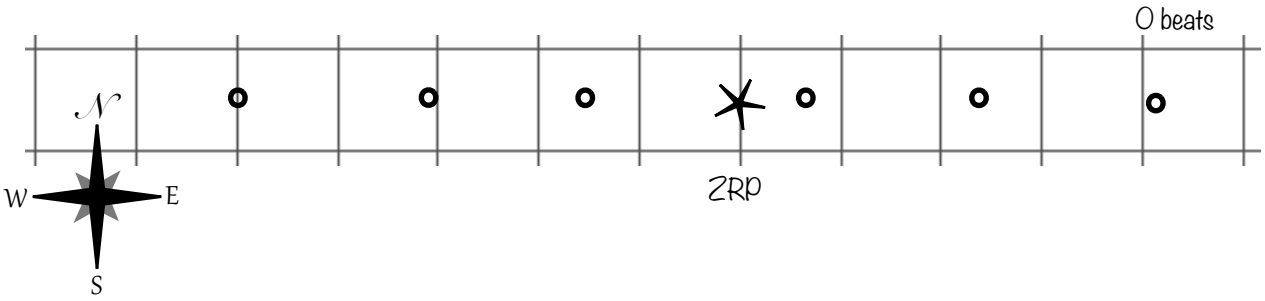
Homework 1.4. Measuring Position

Date: _____ Period: _____

Please answer the following questions neatly, in pencil, on a nice, clean sheet of lined notebook paper.

1) Here is a picture of the washers placed by a student to mark the positions passed by a Groovy Dune Buggy at time points separated by equal intervals as it traveled along the floor of the physics classroom.

   The buggy traveled ***westward***.



d) Assign a *time point* value to each washer beginning with *zero beats* and increasing evenly by one beat. I have already labeled time point *zero* for you. (*You're welcome*.)

a) On the *second blue line from the top* of your notebook paper, write out the title of the data table shown below. Then, draw the table below the title. ***Please remember to include the column headings.***

b) Measure the *position* (***including the direction)*** of each washer.

c) Record your results in your data table.

Table 1. Position vs. time point for a Groovy Dune Buggy traveling along the floor of the physics classroom in order to determine whether it traveled at a constant speed.

Time Point (beats)	Position (tiles, direction)