

Lesson 1.5. Position in Space & Time

Hey! What's the Big Idea Here?

- 1) In order to study the motion of something that moves continuously, one must observe its position over and over, spread out over an extended interval of time.
- 2) Something in continuous motion does not spend any time at any position; rather, it *passes by* positions in space. Therefore, one must devise a way to mark the passing of the object, then perform measurements on the marks.
- 3) The direction of motion is determined by the *order in time* in which the ball passed by the marked positions because time only “flows” forward.

Just Passin' Thru¹

George Thorogood and The Destroyers

*She asked me how long
I'd be stayin' in town,
And did I have plans this time
For stickin' around?
She said it'd be so nice if I
Could spend a week or two;
But was I gonna stay,
Or was I just passin' thru?*

Chorus:

*Well, I'm just passin' thru this time;
I won't be stayin' here long,
Just like an outlaw
In a Willie Nelson song.
So, I guess I'll be rollin' on,
Say goodbye to you;
Sorry I can't stay,
You know, I'm just passin' thru.*

*It's hard to figure out just why
I can't keep still;
But somethin's always callin' me
From over the hill.
So, I guess I'll be rollin' on,
Adios to you;
Sorry I can't stay,
You know, I'm just passin' through.*

Chorus:

*Yes, I'm just passin' thru this time;
I won't be stayin' here long,
Just like an outlaw
In a Willie Nelson song.
So, I guess I'll be rollin' on,
Bye-bye to you;
Honey, I can't stay,
You know, I'm just passin' thru.*

*Well, it's hard to figure out just why
That I've got to be free;²
Stayin' in just one place
Don't appeal to me.
So, I guess I'll be rollin' on,
Bye-bye to you;
Sorry I can't stay,
You know, I'm just passin' through.*

Chorus

*Well, I'm just passin' thru this time;
I won't be stayin' here long,
Just like an outlaw
In a Willie Nelson song.
I'd like to stick around awhile
And have some fun with you;
Sorry I can't stay,
You know, I'm just passin' thru.*

*Honey, I can't stay,
You know I'm just passin' thru.
Yep!*

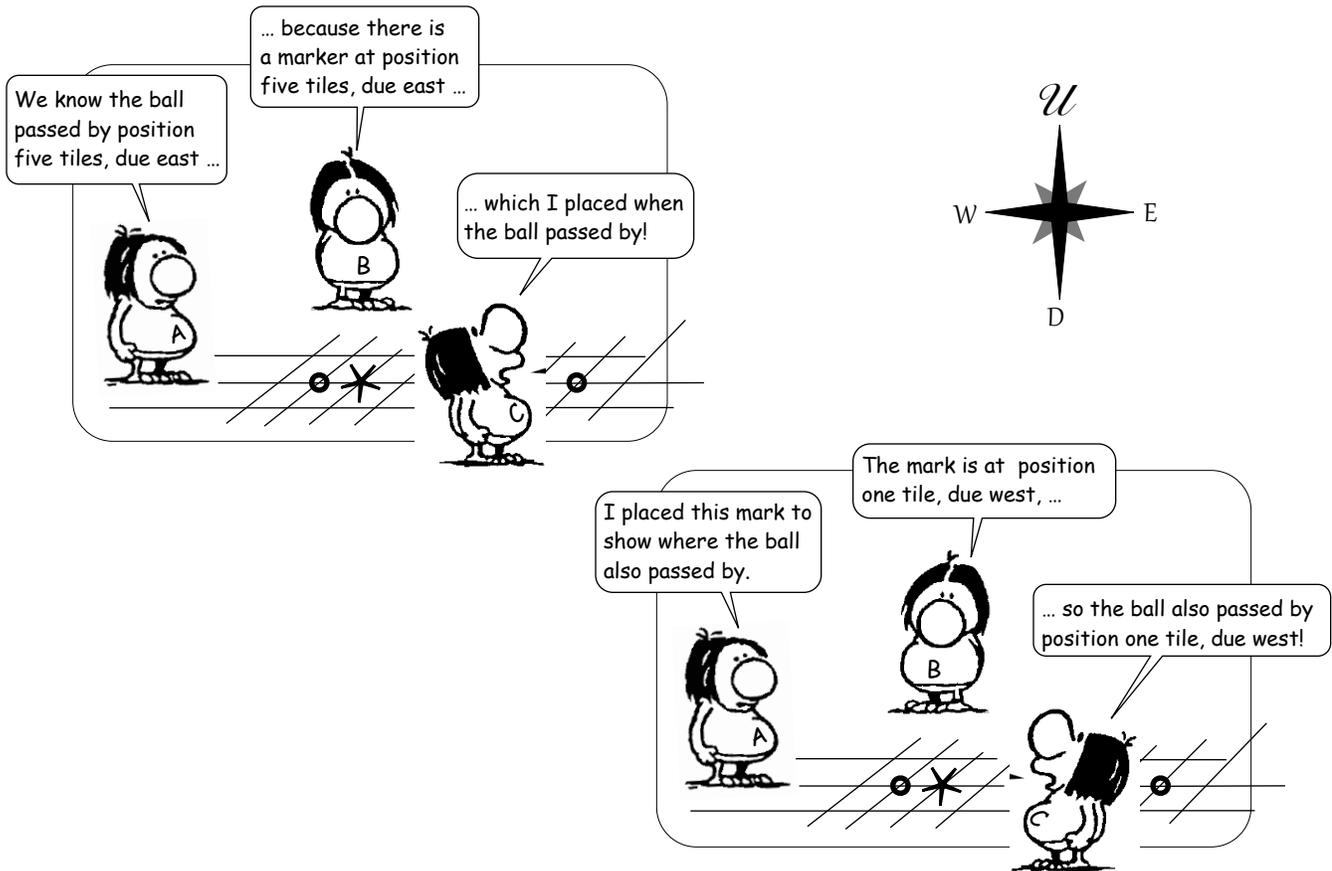
A Big Difference

Both the lady and her beloved understand that there is a big difference between *stickin' around* and *just passin' thru*. *Stickin' around* means *spending time in one place*. *Just passin' thru* means you keep going, spending *no time* in any one place. A rolling bowling ball is another example of something that is *just passin' thru*; its motion is *continuous*; it spends *no time* in any one place.

To study the continuous motion of a bowling ball rolling along the floor, one must observe its position over and over, spread out over an extended interval of time. However, observing the position, even once, of a *moving* object is not at all the same as observing the position of a *stationary* object. An observer trying to measure the position of a moving object finds himself in the same position as the lady in the song, “Just Passin' Thru”. The observer wishes to study something that does not stay in one place for any time; that is, something that just *keeps rollin' on*.

The only way to study something that spends no time in any one place is to devise a way to mark the *passing* of the object. Once the object has passed by and the motion is over and done, there is a lasting record of its passing. For example, the lady might take a photograph of her beloved to remind herself of his “passin’ through” once he is gone. She is left with a photograph to admire: a sorry substitute for her beloved himself.

In a similar fashion, the students might leave markers on the floor showing where the bowling ball passed by at certain points in time. This leaves them in the curious position of having to perform measurements, not on the bowling ball itself, but on the *markers*, which provide a record of places the bowling ball *passed by*, **not** places where the bowling ball spent any time!



Hmmm. This is very nice. Please explain how we know that the ball moved. (*Hint: you may have to review Lessons 1 and 2!*)

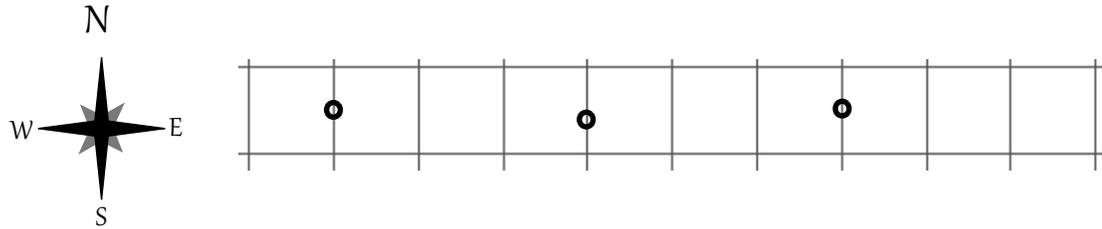
Nevertheless, we do not have enough information to answer any questions about the ball’s motion. For example:

- 1) In what direction did the ball travel?
- 2) How fast did the ball travel?

What do we need to know in order to answer these questions? Can you tell? If so, please explain below. If not, then read on! However, it would be best if you tried to answer by yourself, first!

Example 1

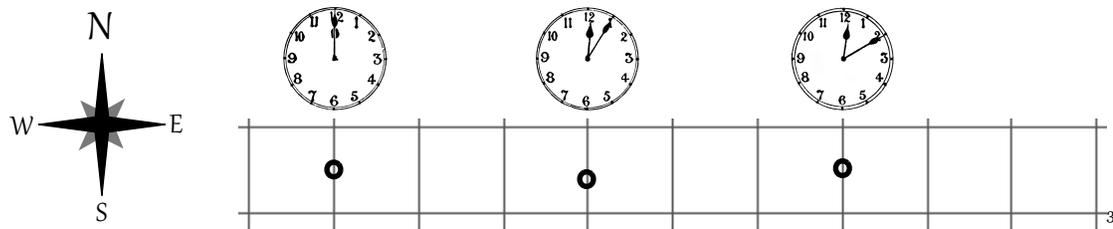
The picture below shows three markers that a student placed to mark the positions passed by a bowling ball as it rolled along the floor of the physics classroom.



Can you tell what direction the ball traveled? yes no

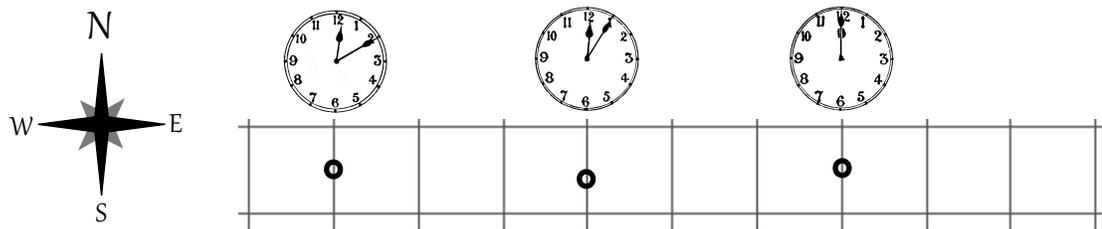
Please carefully explain your thinking. _____

Example 2



How about now? Can you tell what direction the ball traveled now? yes no

Example 3

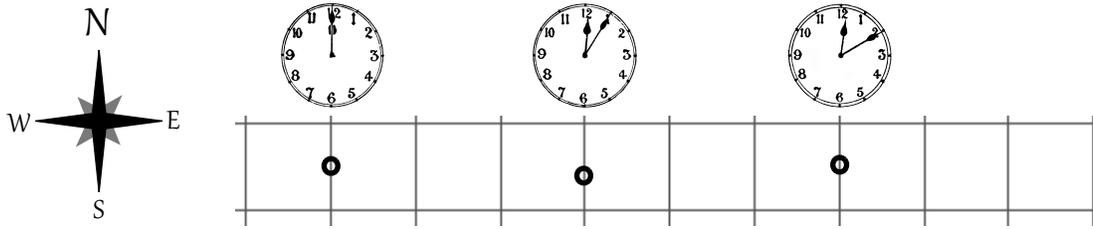


How about now? Can you tell what direction the ball traveled now? yes no

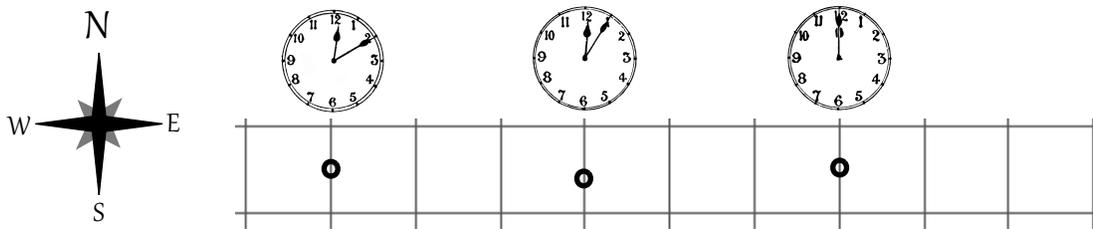
What is the difference? Why was it impossible to tell the direction of travel in Example 1, but easy to tell in Examples 2 and 3?

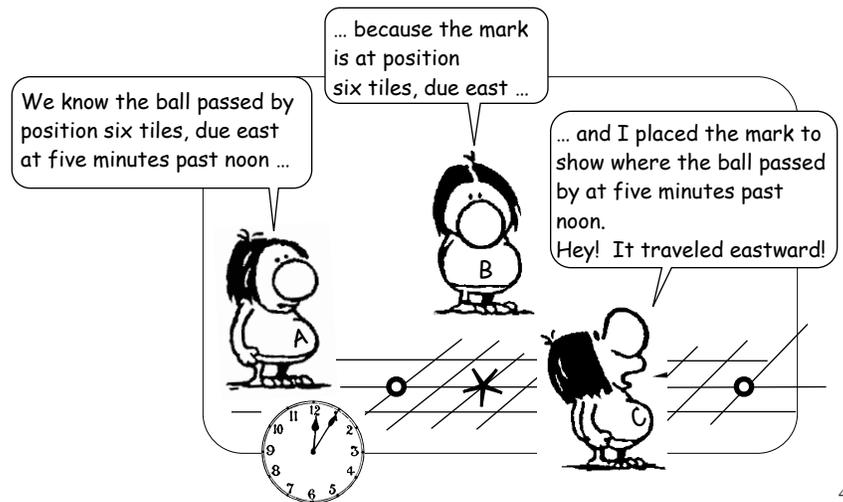
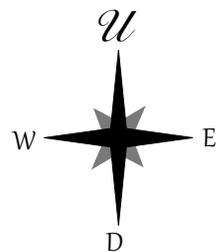
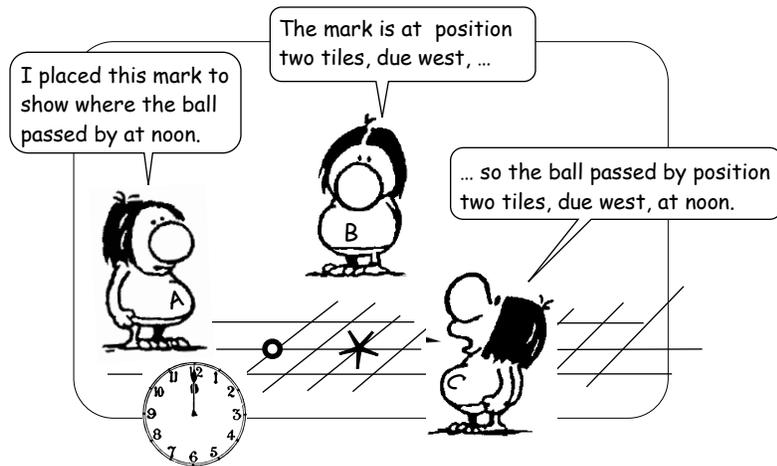
The direction of motion is the direction in which the clocks show time progressing *forward*. We may travel in any direction in space, but we travel only forward in time. Even when we remain at rest in space, we travel forward in time!

* If the clocks show that time progresses forward as the marks progress eastward, then the ball traveled eastward.



* If the clocks show that time progresses forward as the marks progress westward, then the ball traveled westward.





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¹ <<http://www.sing365.com>> November 4, 2012

² All cartoon characters are from:
 Buffler, Andy; Saalih, Allie; et al. *Introduction to Measurement in the Physics Laboratory: A Probabilistic Approach*.
 University of Cape Town Department of Physics. Cape Town, South Africa. Version 3.5, 2009.
 Downloaded from <www.phy.uct.ac.za/people/buffler/labmanual.html>

³ <http://etc.usf.edu/clipart/17400/17495/1205_17495.htm> 27 December, 2014