Kinematics: Describing A One-Dimensional Motion

PHY406: A Physical Science Activity

Universiti Teknologi MARA
Fakulti Sains Gunaan

Name:______________________________ HP: ____________________ Lab # 3:

The goal of today's activity is to explore and describe the nature of horizontal motion or motion in one dimension pictorially, textually, graphically and mathematically.

At the end of the activity, students will be able to:

1. Draw a pictorial representation after observing an object moving along the horizontal.
2. Describe, verbally and in writing, the motion observed and the motion shown by the pictorial representation.
3. Discuss the appropriateness of the planned investigation methods, including the physical quantities investigated and manipulated and the devices chosen to perform the investigation on observing the one-dimensional motion.
4. Organize the collected data (perhaps by tabulating the data) and use MS EXCEL to construct a graph of position vs. time.
5. Describe the features of the graph, the indirect quantities derived from the graph, the inferred relationship deduced from it and a possible mathematical model representing the inferred relationship.
6. Compare and contrast the velocity vs. time graph and the position vs. time graph for a particular horizontal motion.

Background Information

Motion of coconut or durian or any other objects that fall down from a certain height is different from motion of the same objects that roll horizontally on the ground. The same tennis ball that you threw onto a wall in laboratory #1 may have a different motion than if the ball was hit by a racket or if it was left drifting on water.

Describing motion of an object to another person depends on whether this person is a science illiterate man-on-the-street or a science-literate person or graduates with a physics-related degree. Hence, students doing science or physics-related degrees must be able to describe motion using various methods such as pictorial representation and textual approaches. In addition, they must also be able to describe motion that are represented by graphs and be able to deduce physical quantities and mathematical modeling from the features on the graphs.

STUDENT ACTIVITIES

INVESTIGATION 1-PICTORIAL REPRESENTATION OF A GLIDER ON A FRICTIONLESS AIR TRACK

This section will let you locate and draw the center of a glider as it glides on a frictionless air track. You will be moving the glider and identify the position of its center at intervals of 2 seconds. No predictions will be made for this activity.

Activity 1:

Materials:

Air track with gliders and its accessories (with magnets, rubber bands, fan attachments)
1 digital stopwatch

1.1.0 METHOD

- This activity is best done in groups of 3 or 4.
- You will need to adjust the screws underneath the air track to ensure it is leveled. Be sure to test that it is leveled before beginning your investigation.
- Plan your investigation to enable you to reasonably locate the position of the glider every intervals of 2 seconds. You will need to locate at least 5 positions while the glider is in motion.
- Repeat your investigation with the glider moving faster and slower than before.
- Repeat all the above but this time you must allow the glider to rebound from the end of the air track. You need to design ways to make it rebound.

1.1.1 DATA

Record your data in a table.

1.1.2 RESULTS

Draw the positions of the glider for all the six cases.

	Picture of motion
Slow	
Fast	
Fastest	

	Picture of motion with rebound
Slow	
Fast	
Fastest	

Describe the motion you observed in each of the six cases.

How are the gliders’ motion the same in each case?

How are the gliders’ motion different in each case?

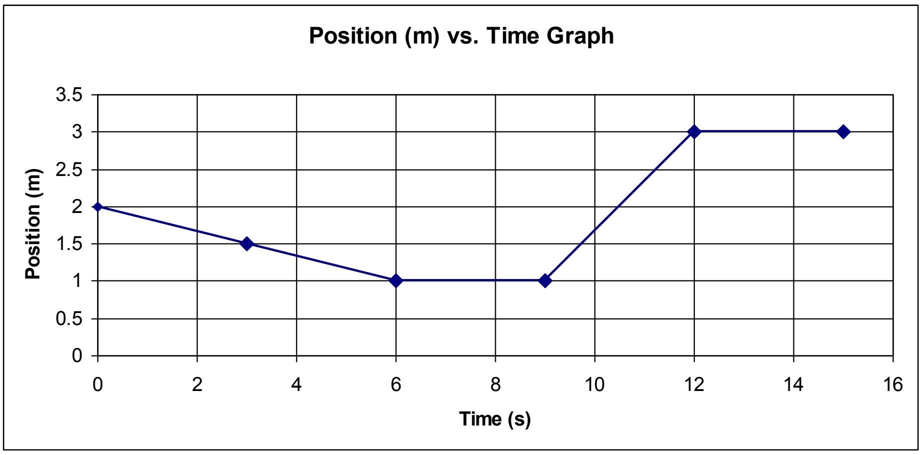
Activity 2: **<u>Position vs. Time Graphs Of Motion</u>**

Using the data you collected in activity 1 and MS EXCEL, construct graphs for cases 1-3 on the same graph and graphs for cases 4-6 on another graph.

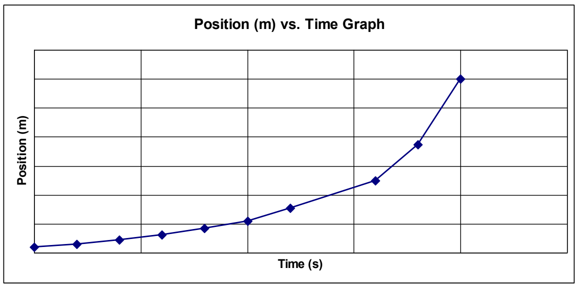
Describe the differences you observed between cases 1, 2 and 3.

Describe the similarities and differences you observed between cases 4, 5 and 6.

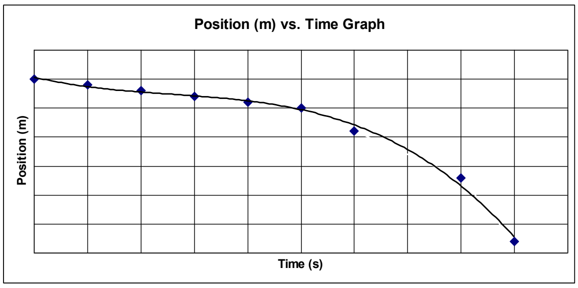
Describe the motion of the glider displayed in the position-time graph shown below.



Describe the motion of the glider displayed in the position-time graphs shown below.



Graph 2a

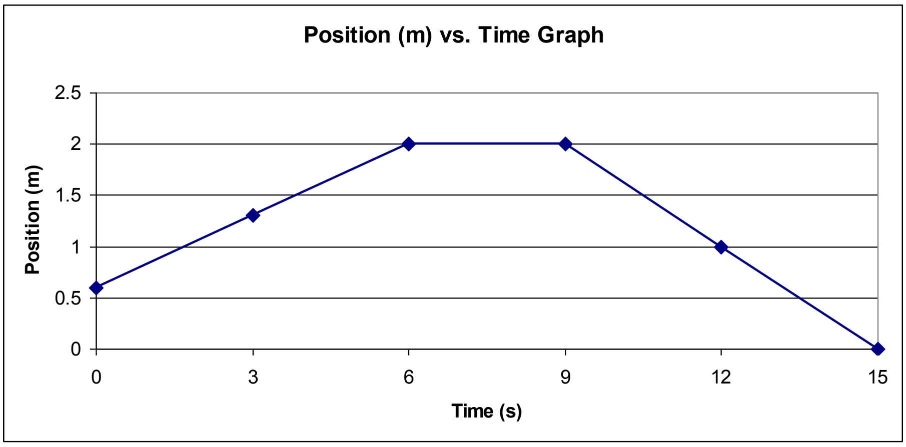


Graph 2b

INVESTIGATION 2-DESCRIBING VELOCITY WITH WORDS AND GRAPHS

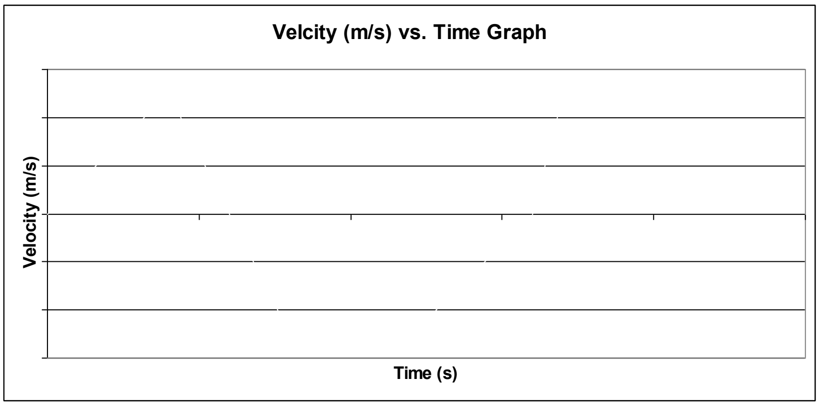
This section will allow you to describe velocity of an object using words and graph.

- Suppose that you want to know the direction of motion and your speed from the position-time graph that you had constructed.
- Use the graph below to answer the following questions and then devise a way to graphically represent speed and direction vs. time.



a) What is your speed between 0-6 seconds?	
b) What is your speed between 6-9 seconds?	
c) What is your speed between 9-15 seconds?	

- Devise a method to represent your speed and direction vs. time graphically. Sketch the graph in the graph frame below.



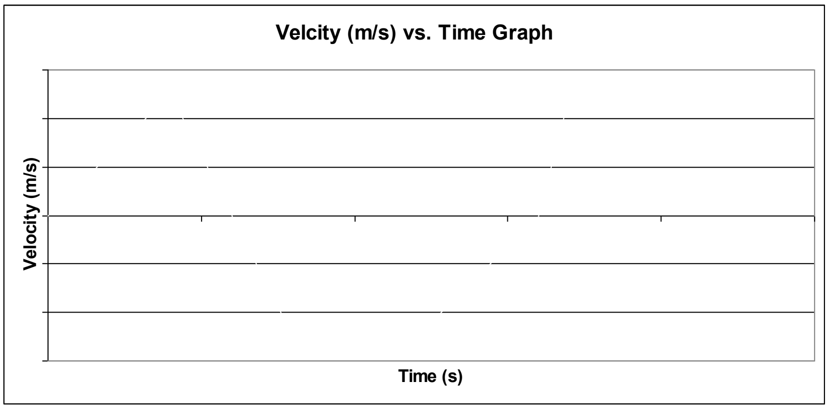
- Explain the reasons for your methods. What rules did you apply?

Activity 2: PHeT Activities

Since speed and velocity can only be measured and graphed using sound or light sensitive devices, you will not be able to make direct measurements. Hence, you will be using the PHeT activities. You will need to obtain the Java applets from the Colorado University by visiting the following website:*http://phet.colorado.edu/en/simulation/moving-man*
You will then be prompted to ***Download*** or ***Run Now***. Choose the ***Run Now*** and you will be asked to save the following file: ***moving-man_en.jnlp***. Save it to a folder on your desktop or anywhere on your hard drive. (Place it in the PHY406 folder in a subfolder called PHeT. If the subfolder has not been created, then create it.). Be sure that your laptop had already been installed with Java.

- Explore the activities by moving the man left or right. You can imagine the man to be you. Minimize both the velocity-time graph and the acceleration-time graphs as you move the man to the right and to the left. You can move him as many times as you wish and you may clear the graph as many times as you wish.

- Predict the velocity-time graph now by drawing it in the graph frame below after you decide how you are going to walk.

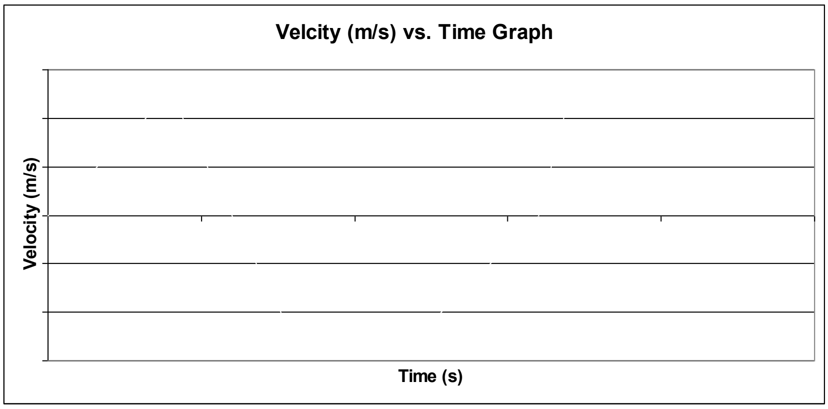


Show both the position-time and the velocity-time graph now. Compare the predicted velocity-time graph you made and the real velocity-time graph. Was it the same or different? What preconception you had that did not match the real motion? Explain.

Velocity Vector

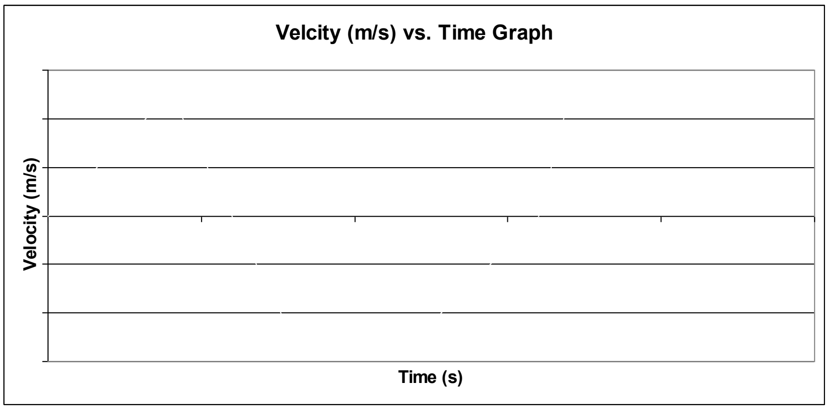
When you describe motion in one dimension, you must ensure that both the displacement and the velocity is described in terms of its magnitude and its direction. The common way is to denote motion along the +ve x-axis as being positive. So, if you walk heading EAST, your final displacement will be positive and your velocity is positive. On the other hand, if you walk to the WEST, then the displacement and velocity is negative. In addition, when drawing displacement and velocity vectors, the magnitude is indicated by its length. The longer the vector is, the further is the displacement or the faster is the velocity.

- Make another prediction on the velocity-time graph now by drawing it in the graph frame below after you decide how you are going to walk. Make sure your walk is different from the one you walked before.



Show both the position-time and the velocity-time graph now. Compare both the predicted motion and the real motion for both the position-time and the velocity-time graph. Explain the differences and similarities you observed from each of the graphs.

- Make the last prediction on the velocity-time graph now by drawing it in the graph frame below after you decide how you are going to walk. Make sure your walk is different from the one you walked before.



Show both the position-time and the velocity-time graph now. Compare both the predicted motion and the real motion for both the position-time and the velocity-time graph. Explain the differences and similarities you observed from each of the graphs.