

Newton's First Law—No Net Force

Mechanics: Newton's First Law of Motion, inertia, net force	
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Qty	Equipment and Materials	Part Number
1	PASPORT Xplorer GLX	PS-2002
1	PASPORT Motion Sensor	PS-2103
1	1.2 m PASCO Track	
1	GOcar	ME-6951
1	Fan Accessory	ME-9491
1	Friction Block	ME-9807
0.5 m	Braided Physics String	SE-8050

Purpose

The purpose of this activity is to investigate the motion of an object when there is no net force applied compared to the motion when there is a net force applied.

Background

After doing experiments with balls rolling down ramps, Galileo proposed that an object in motion would continue in motion forever if the floor it rolls on were perfectly smooth and continued to infinity. Galileo used the word *inertia* as the label for this tendency of an object to continue its state of motion.

Isaac Newton developed Galileo's ideas. What condition must exist for an object to maintain its state of motion? Newton said that an object at rest tends to stay at rest and an object in motion tends to stay in motion if there is no net force acting on the object. In other words, if the net force on an object is zero, its acceleration (change in motion) is also zero.



Galileo (1564–1642)

Safety Precautions

- Follow all directions for using the equipment.

Preview

Use the Motion Sensor to measure the motion of a cart as it experiences different applied forces. Use the Xplorer GLX to record, display, and analyze the position and velocity of the cart.

Prediction

1. What will happen to an object at rest if *no* force is applied?
2. What will happen to an object at rest if it is pushed, but there is a large frictional force acting on the object?
3. What will happen to the motion of an object that is pushed, and there is very little frictional force acting on the object?
4. What will happen to the motion of an object if there is a constant net force applied to it?

Procedure

GLX Setup

1. Connect the Motion Sensor to one of the sensor ports on the top end of the GLX. Put the range switch on the top end of the Motion Sensor to the ‘near’ (cart) setting.
1. Turn on the GLX (⏻).
- The Graph screen opens with a graph of Position (m) versus Time (s).



Fig. 1: Motion Sensor setting

Equipment Setup

1. Place the track on a horizontal surface and level the track. (Place the GOcar on the track. If the cart rolls one way or the other, adjust the track to raise or lower one end.)
2. Attach the Motion Sensor to one end of the track. Place the cart about 20 cm from the sensor. Aim the sensor at the cart.



Fig. 2: Equipment setup

Record Data

Part 1: No Net Force Applied

1. Press Start (▶) to start recording data. Do not touch the cart
2. After 3 seconds, press (▶) to stop recording data.

Part 2: Friction Block

1. Tie a string to one end of the cart.
2. Place the friction block, with felt side up, in the tray of the cart. Turn the cart over and place it 20 cm in front of the Motion Sensor with the string end facing away from the sensor.

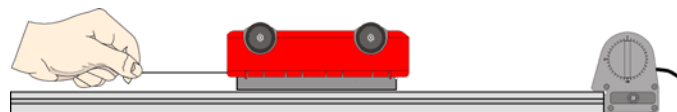

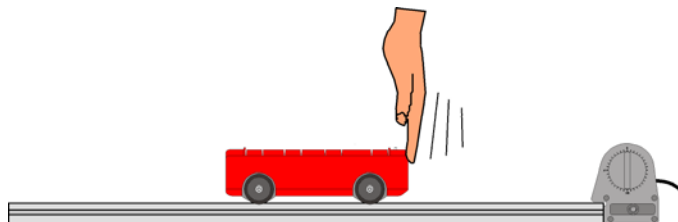


Fig. 3: Friction Block setup

3. Press Start (▶) to start recording data. Wait one second and then give the cart and block a brief pull away from the sensor.
4. After 3 seconds, press (▶) to stop recording data.

Part 3: Low Friction Cart

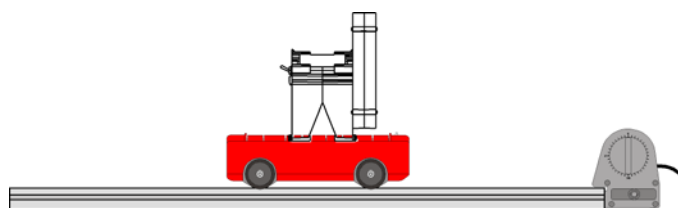
1. Turn the cart over and remove the string and friction block.
2. Place the cart 20 cm in front of the Motion Sensor.
3. Press Start  to start recording data. Wait one second and then give the cart a gentle push away from the sensor.

**Fig. 4: Low Friction Cart**



4. After 3 seconds, press  to stop recording data.

Part 4: Fan Cart

1. Finally, clip a Fan Accessory to the cart and place the cart 20 cm front of the sensor.
2. Start the fan, but hold the cart in place. Make sure the fan is arranged so it will push the cart away from the sensor.








**Fig. 5: Fan setup**

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3. Press Start  to start recording data. Wait one second and then release the cart.
 4. After 3 seconds, press  to stop recording data.
- NOTE: Don't let the fan cart hit the end of the track or it might be damaged.

Analysis

Use the Graph screen to examine both the position and the velocity for each data run.

1. To change the Graph screen to show a specific run of data, press  to activate the vertical axis menu. Press the up-arrow key () to move to 'Run #_' in the upper right corner. Press  to open the menu, select the data run in the menu, and press  to activate your choice.
2. To change the Graph screen from Position (m) versus Time (s) to Velocity (m/s) versus Time (s), press  to activate the vertical axis menu. Press  again to open the menu. Select 'Other' and then select 'Velocity'. Press  to activate your choice.
3. Record the value of the slope in the Data Table. This is the value for the acceleration due to gravity on the falling object.

Record your results and answer the questions in the Lab Report section.

Lab Report – Activity 6: Newton’s First Law–No Net Force**Name** _____ **Date** _____**Predict**

1. What will happen to an object at rest if no force is applied?
2. What will happen to an object at rest if it is pushed, but there is a large frictional force acting on the object?
3. What will happen to the motion of an object that is pushed, and there is very little frictional force acting on the object?
4. What will happen to the motion of an object if there is a constant net force applied to it?

Data

Sketch your graphs of position versus time for the cart for all four runs. Include labels and units for your y-axes and x-axes.



Sketch your graphs for velocity versus time for the cart for all four runs. Include labels and units for your y-axes and x-axes.



Questions

1. What do your graphs show for the car in Run #1 (no force applied)?
2. What does your velocity graph show for the cart in Run #2 (friction cart – cart is pushed, but has a large frictional force)?

3. Why does the cart keep moving in Run #3 (low friction cart – cart is pushed, and has little frictional force)?

4. Which data run represents constantly accelerated motion?

5. Why does the cart sliding on the friction block (Run #2) come to a stop so quickly?

6. What happens to an object at rest if no force is applied?

7. What happens to an object in motion if no force is applied?

8. Do your results support your predictions?