WEIGHT DROP LAUNCH

How does mass affect the velocity of a //code.Node cart using a weight drop launch system?

According to Newton's Laws of Motion, an unbalanced force is one that causes a change in the motion of the object to which the force is applied. An object at rest or an object in steady motion continues at rest or in unchanged motion unless it is subjected to an unbalanced force. In that case, the object accelerates in the direction of the force according to the equation: force equals mass times acceleration (F = ma). An unbalanced force continues to accelerate an object until a new balance of forces is established.
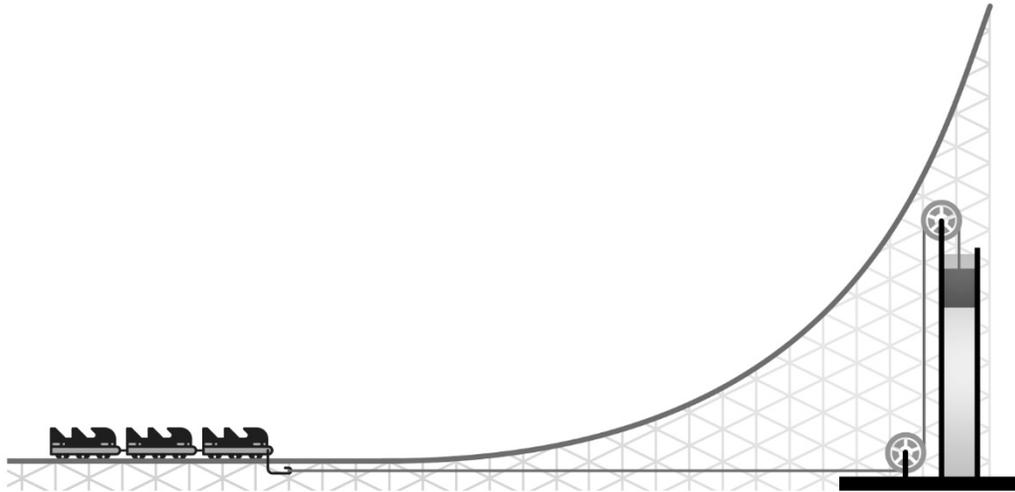
A roller coaster with a weight drop launch stores potential energy in a heavy weight that is pulled to a height. The coaster is then launched using the spike in energy provided by letting the weight fall to the ground. The weight drop launch is thought to be the first ever launch system and was introduced in the 1970's. Speeds of around 60 mph could be achieved using this type of system.

Objectives

• Investigate how unbalanced forces affect motion.

• Create a coding program that includes a break loop option to end data collection at a determined time.

Materials and Equipment

- Data collection system
- //code.Node
- Mass (4), 50 g
- Textbook
- //code.Node cart
- Spring
- String
- Measuring tape

Safety

Follow regular laboratory safety precautions.

Procedure

Part 1 – Blockly Coding Challenge: Impact Alert System

In this experiment you will be modeling a weight drop launch system used in the past on roller coasters. Your data collection on Cart Velocity will be quick and will require you to stop collecting data on impact, that is when the cart hits the textbook and weight reaches the floor. Your challenge is to create a Blockly program that will stop data collection for you. Create a program that stops collecting data after impact. You will notice that velocity will record as a negative number when the cart bounces back in reverse after impact.

Tips for your program:

- Utilize the Cart Velocity Hardware block.

- Use your knowledge of how the data changes after impact to help you.

- Use the "break out of loop" block in your program for success.

Part 2 – Weight Drop Launch

1. Clear off an area to be your track for the //code.Node cart. Use a measuring tape to mark about 1 meter of clear space.

2. Place a textbook at the end of the table with the spine aligned to the edge. This will allow the string to move freely.

3. Cut about 1.5 m of string and attach one end to the front of the //code.Node cart.

4. Attach the spring to the front of the cart. This will help protect the cart upon impact.

5. Place three of the 50 g masses into the cart and tie one to the other end of the string. See Figure 1 as to how to set up for the experiment.

Figure 1: Set up for experiment
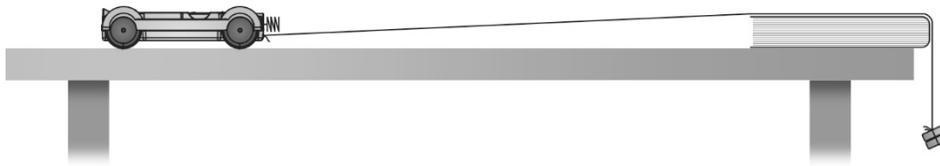
6. Select Sensor Data in SPARKvue.

7. Put the //code.Node into the Cart and connect the //code.Node to your device.

8. Select only Cart Velocity under Motion Sensor and disable all other sensors.
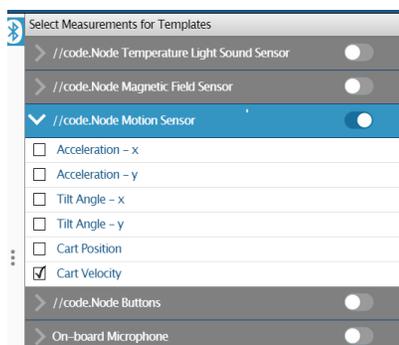
5. Select the Line Graph display. You should now have a graph of Cart velocity vs. Time.

6. Pull your cart back so that the hanging mass is just below the top of the table. Note: Your string should be long enough so that the mass will reach the floor after release. This ensures you will not launch your cart over the textbook.

7. Start collecting data and release the cart. Note: Data collection will not start the second you press start. This is ok and will not affect your data.

8. Stop collecting data upon impact or use Blockly to create a program that will stop data collection for you.

9. Repeat the release two more times. Use the coordinates tool ⊡ to get your max velocity and record this data into Table 1 and calculate the average velocity. See Figure 2 as to how your data may look.

Figure 2: Sample data collection using the Coordinates tool.

8. Take another 50 g mass from the cart and add it to the end of the string for a total of 100 g hanging mass.

9. Repeat steps 6 - 9 and record this data into Table 2 and calculate the average velocity.

10. Take a third 50 g mass from the Cart and add it to the end of the string for a total of 150 g hanging mass.

11. Repeat steps 6 - 9 and record this data into Table 3 and calculate the average velocity.

12. Save your experiment as Weight Drop or according to your teacher's directions in case you need to refer to it later.

Data Collection

Table 1: Maximum cart velocity with 50 g weight drop

Trial	Max Cart Velocity
1	
2	
3	

Average velocity _____

Table 2: Maximum cart velocity with 100 g weight drop

Trial	Max Cart Velocity
1	
2	
3	

Average velocity _____

Table 3: Maximum cart velocity with 150 g weight drop

Trial	Max Cart Velocity
1	
2	
3	

Average velocity _____

Questions and Analysis

Part 1 – Blockly Coding Challenge: Impact Alert System

1. Did you face any challenges creating this program? If so, what were they and how did you work them out?

2. Looking at other group's programs, were there any differences? If so, what was different?

3. What was the purpose of the "break out of loop" block in your program.

Part 2 – Weight Drop Launch

4.   Looking at your data, how was the cart's average velocity affected as you added more weight to the launch system?

5.   Explain the motion of the cart and the forces that were acting upon it once it was released.

6.   How do you think your data would be affected if you kept all four masses, for a total of 200 g, in your cart during each release? How could you test this?