

Name: _____

Pd. _____

Date: _____

Momentum Experiment: The Marble and The Cup

Objective:

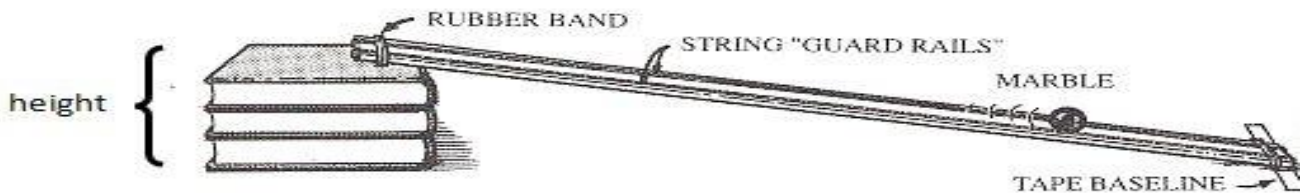
Your objective for this experiment is to determine how momentum can be affected by changing variables such as height and mass.

Materials:

- | | | |
|--------------------|---|----------|
| 1. Textbooks (6) | 4. Rubber band (1) | 7. Timer |
| 2. Meter stick (1) | 5. 2 pieces of string (1 meter long each) | |
| 3. Masking Tape | 6. Marble or ball bearing | |

Set-Up:

Create the set-up seen in the picture below:



Notice the following:

1. The string is held to the meter stick at the top by using a rubber band.
2. Stretch the string on both sides to the lower end of the meter stick and tape down. You have now created "guardrails" to keep the marble/ball bearing from rolling off the meter stick.

Task 1: Manipulating the height of the ramp

2 Books

1. Get the mass of your marble/ball bearing using the triple beam balance. Record under Data Collection.
2. Record the distance the ball travels under Data Collection.
3. Measure the height of the ramp for 2 books and record in the data table
4. Conduct trial 1 by allowing the marble/ball bearing to roll down the ramp
5. Using the timer, measure the time it takes for the marble/ball bearing to get to the end of the ramp
6. Repeat for trials 2 – 5

4 Books

1. Change the height of your ramp to 4 books.
2. Measure the height of the ramp for 4 books and record in the data table.
3. Conduct trials 1-5 by following the same procedures you used for 2 books.

6 Books

1. Change the height of your ramp to 6 books
2. Measure the height of the ramp for 6 books and record in the data table
3. Conduct trials 1-5 by following the same procedures you used for 2 and 4 books.

Data Collection:

Mass of marble/ball bearing: _____

Distance marble/ball bearing travels: _____

	Height of Ramp (2 books)	Height of Ramp (4 books)	Height of Ramp (6 books)
Time it takes the marble/ball bearing to reach the bottom (in seconds)			
Trial 1:			
Trial 2:			
Trial 3:			
Trial 4:			
Trial 5:			
Average Time			

Analysis:

1. Calculate the velocity of the marble/ball bearing using the average time. **SHOW YOUR WORK!** ($v=d/t$)
 - a. Velocity at 2 books:

 - b. Velocity at 4 books:

 - c. Velocity at 6 books:

2. Calculate the momentum of the marble/ball bearing at each ramp height. **SHOW YOUR WORK!** ($p = mv$)
 - a. Momentum at 2 books:

 - b. Momentum at 4 books:

 - c. Momentum at 6 books:

3. Looking at your calculations for velocity, what conclusions can you make about height's effect on velocity?

4. Looking at your calculations for momentum, what conclusions can you make on how velocity affects momentum?

Task 2: Manipulating the mass of the marble/ball bearing

Mass 1

1. Using 3 books, measure the height of the ramp in meters. Record under Data Collection.
2. Record the distance the ball travels under Data Collection.
3. Get the mass of your marble/ball bearing using the triple beam balance. Record in the data table.
4. Conduct trial 1 by allowing the marble/ball bearing to roll down the ramp
5. Using the timer, measure the time it takes for the marble/ball bearing to get to the end of the ramp
6. Repeat for trials 2 – 5

Mass 2

1. Change the mass of your marble/ball bearing.
2. Get the mass of your new marble/ball bearing using the triple beam balance. Record in the data table.
3. Conduct trials 1-5 by following the same procedures you used for mass 1.

Mass 3

1. Change the mass of your marble/ball bearing.
2. Get the mass of your new marble/ball bearing using the triple beam balance. Record in the data table.
3. Conduct trials 1-5 by following the same procedures you used for mass 1 and 2.

Data Collection:

Height of the books: _____ Distance the marble/ball bearing travels: _____

	Mass of marble/ball bearing 1	Mass of marble/ball bearing 2	Mass of marble/ball bearing 3
Time it takes the marble/ball bearing to reach the bottom (in seconds)			
Trial 1:			
Trial 2:			
Trial 3:			
Trial 4			
Trial 5:			
Average Time			

Task 3: Additional Analysis

1. Looking at all of your data, what is the relationship between the following variables? Be sure to explain how you know.
 - a. Mass and momentum

 - b. Velocity and momentum

2. Based on your new found knowledge of momentum, what would happen in the following situations? Be sure to explain how you know!
 - a. The mass is doubled, what happens to momentum?

 - b. The velocity is tripled, what happens to momentum?

 - c. The momentum is changed to zero, what has happened?