**Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Period\_\_\_\_\_Date\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Momentum and Impulse Lab**

**Important Formulas:**

p=m x Δv

I = Δp

I = F x t

**Purpose:**

Today you and a partner will be investigating the momentum & impulse experienced by a marble down a track. You will also look at the force exerted by the marbles.

**Materials:**

Foam pipe insulation

Masking tape

2 marbles

Stopwatch

Meter stick

Stack of 3 textbooks

**Procedure:**

* Your impulse station should be set up with 3 textbooks and your marble ramp with three textbooks each.
* Pieces of tape have been laid at the 0.5 meter mark (from where your track drops) and 1.5 meter mark.

Part I:

1. For the first part of the lab you will be working with 1 marble.
2. The lab member with the stopwatch needs to be sure they can work the stopwatch. Start timing when the marble is released down the hill and stop timing when the marble hits the book at the end of the track.
3. Release the marble by holding it at the top of the ramp where it starts to drop. Do NOT push your marble off.
4. Record the time needed to travel 1.5 meters in the chart below.
5. Repeat steps 2-4 two additional times.
6. Calculate the speed of each trial
7. Record the mass of the marble by using the scale

|  |  |  |  |
| --- | --- | --- | --- |
| **Trial #** | **Distance Traveled (m)** | **Time (s)** | **Speed (d÷t) (m/s)** |
| 1 |  |  |  |
| 2 |  |  |  |
| 3 |  |  |  |
| Average |  |  |  |

Mass of marble= \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_g

Part II:

1. Put a second marble on your track at the line marked 0.5 m
2. This time you will need to take time measurements 2 times during each trial, so you need to make sure you pay attention!
3. Again release a marble by holding it at the top of the ramp where it starts to drop. Do NOT push your marble off, just gently release.
4. Record the time when it hits the 2nd marble and when the 2nd marble hits the stack of books.
5. Repeat Steps 2-4 two additional times
6. Calculate the speeds in each trial.
7. Record the mass of each marble.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Trial**  **#** | **Distance traveled by 1st marble (m)** | **Time (s)** | **Speed of 1st marble upon collision** | **Distance traveled by 2nd marble (m)** | **Time on stopwatch when 2nd marble hit book** | **Total time 2nd marble traveled (subtract 2 times)** | **Speed of 2nd marble when hit book** |
| **1** | 0.5 |  |  | 1.0 |  |  |  |
| **2** | 0.5 |  |  | 1.0 |  |  |  |
| **3** | 0.5 |  |  | 1.0 |  |  |  |
| **Average** |  |  |  |  |  |  |  |

Mass of 1st marble: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_g Mass of 2nd marble: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_g

**Analysis Questions: Part I**

**(USE FORMULAS ON FRONT OF LAB &/OR TRIANGLES FROM NOTES)**

1. Determine the impulse experienced by the marble.(use average speed)
2. Determine what force was exerted by the marble on the book after the marble hit the book. (use average time)
3. Suppose you were to use a steel marble instead of glass. Since steel is heavier than glass, how would this have affected the impulse experienced by the marble?
4. Suppose you were to use a steel marble instead of glass. Since steel is heavier than glass, how would this have affected the force exerted on the book by the marble?

**Analysis Questions Part II**

1. Determine the impulse experienced by marble 1 when it hit marble 2. (use average speed of marble 1)
2. Determine the impulse experienced by marble 2 when it hit the book. (use average speed of marble 2)
3. Determine the force that was exerted on the 2nd marble by the 1st marble (use average time of marble 1)
4. Determine the force that was exerted on the book by the 2nd marble. (use average time of marble 2)
5. Was this an elastic or inelastic collision?
6. Suppose that the marbles would have stuck together for 5 seconds before separating after the collision, how would this have affected the force experienced by both marbles?
7. **HONORS ONLY**: Determine the speed the 1st marble traveled after the collision. (HINT: think conservation of momentum)