

LAB

The Momentum of Colliding Objects

LAB A

Background

In bowling, the ball's momentum is very important. The bowler must ensure that the ball will travel towards the pins and not into the gutter. The size of the momentum also matters. If the momentum is too small, the ball will knock over very few pins.

Question

How do the mass and velocity of a moving object affect its momentum?

Materials

meterstick
softball
tennis ball
masking tape
trough
stopwatch
racquetball
baseball
balance

Wiffle ball

Objectives

- Observe and calculate the momentum of different balls.
- Compare the results of collisions involving different amounts of momentum.

Safety Precautions



Procedure

- ❑ 1. Read the procedure and safety information, and complete the lab form.
- ❑ 2. Use the data table on the next page.
- ❑ 3. Use the balance to measure the mass of the racquetball, tennis ball, and baseball. Record these masses in your data table.
- ❑ 4. Measure a 2-m distance on the floor, and mark it with two pieces of masking tape. Arrange the trough so that it begins at one line of tape and extends about a meter beyond the other line of tape.
- ❑ 5. Place the softball in the trough over the piece of tape. Starting from the other piece of tape, slowly roll the racquetball down the trough toward the softball.
- ❑ 6. Use a stopwatch to time how long it takes the racquetball to roll the 2-m distance and hit the softball. Record this time in your data table.
- ❑ 7. Measure and record the distance that the softball moved.
- ❑ 8. Repeat steps 5–7, rolling the racquetball quickly.
- ❑ 9. Repeat steps 5–7, rolling the tennis ball slowly and then quickly.
- ❑ 10. Repeat steps 5–7, rolling the baseball slowly and then quickly.

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(continued)

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Data Table

Action	Time	Velocity	Mass	Momentum	Distance softball moved
Wiffle ball					
Racquetball rolled slowly					
Racquetball rolled quickly					
Tennis ball rolled slowly					
Tennis ball rolled quickly					
Baseball rolled slowly					
Baseball rolled quickly					

Analyze Your Data

1. Calculate the momentum for each type of ball and action using the formula $p = mv$. Record your calculations in the data table.
2. Graph the relationship between the momentum of each ball and the distance that the softball moved. The x-axis should be momentum ($\text{kg} \cdot \text{m/s}$), and the y-axis should be distance (m).

Conclude and Apply

1. Infer from your graph how the distance that the softball moves after each collision depends on the momentum of the ball that hits it.

2. Describe How do an object's velocity and mass affect the amount of momentum that it has?

3. Explain why bowling balls have such a large mass. What would happen if you tried to bowl with a table tennis ball? Explain.

4. Infer When you bowl, should you roll the ball gently? Explain.

Communicate Your Data

Make a Graph

Make a momentum-distance graph using data from everyone in the class. Discuss how this graph is similar to and different from the graphs made by individual groups.