

LAB**The Momentum of Colliding Objects****LAB B****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

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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LAB B**Data Table**

Action	Time	Velocity	Mass	Momentum	Distance softball moved
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 (kg · 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.

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LAB B**Challenge**

1. **Evaluate** A friend says, “See that plate resting on the table? It’s not moving because no forces are acting on it.” Is the friend right? Explain.

2. **Distinguish** “When a car slows down,” a friend says, “it has a positive acceleration in the opposite direction to its motion.” Explain the mistake your friend is making.

3. **Write** a short story about a walk to school in which you describe the motions your characters go through in terms of their accelerations, speeds, and velocities. Use other sheets of paper if necessary.

Extension

Research how momentum influences passengers within a car during a crash. Explain the importance of wearing a seatbelt.

Communicate Your Data

Make a Graph As a class, 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.