



The Momentum of Colliding Objects

Lab Preview

Directions: Answer these questions before you begin the Lab.

1. What is Newton's third law of motion?

2. What remains constant in this experiment?

Many scientists hypothesize that dinosaurs became extinct 65 million years ago when an asteroid collided with Earth. The asteroid's diameter was probably no more than 10 km. Earth's diameter is more than 12,700 km. How could an object that size change Earth's climate enough to cause the extinction of animals that had dominated life on Earth for 140 million years? The asteroid could have caused such damage because it may have been traveling at a velocity of 50 m/s, and had a huge amount of momentum. The combination of an object's velocity and mass will determine how much force it can exert.

Real-World Problem

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

Materials

meterstick	softball
racquetball	tennis ball
baseball	stopwatch
masking tape	balance

Goals

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

Safety Precautions

Procedure

1. Copy the data table on the following page onto a separate piece of paper.
2. Use the balance to measure the mass of the racquetball, tennis ball, and baseball. Record these masses in your data table.

3. Measure a 2-m distance on the floor and mark it with two pieces of masking tape.
4. Place the softball on one piece of tape. Starting from the other piece of tape, slowly roll the racquetball toward the center of the softball.
5. Use a stopwatch to time how long it takes the racquetball to roll the 2-m distance and hit the soft ball. Record this time in your data table.
6. Measure and record the distance the racquetball moved the softball.
7. Repeat steps 4–6, rolling the racquetball quickly.
8. Repeat steps 4–6, rolling the tennis ball slowly, then quickly.
9. Repeat steps 4–6, rolling the baseball slowly, then quickly.

LAB (continued)

Data and Observations

Momentum of Colliding Balls					
Action	Time	Velocity	Mass	Momentum	Distance Softball Moved
1. Racquetball rolled slowly					
2. Racquetball rolled quickly					
3. Tennis ball rolled slowly					
4. Tennis ball rolled quickly					
5. Baseball rolled slowly					
6. Baseball rolled quickly					

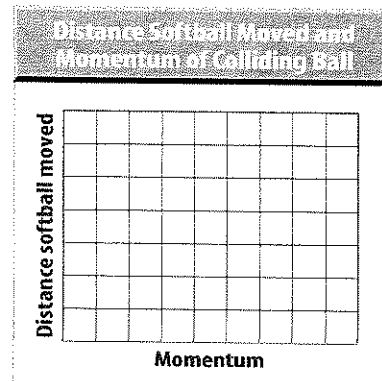
Analyze Your Data

- Calculate the momentum of each type of ball and action using the formula $p = mv$. Record your calculations in the data table.
- Graph the relationship between the momentum of each ball and the distance the softball was moved, using a graph like the one shown.

Conclude and Apply

- Infer from your graph how the distance the softball moves after each collision depends on the momentum of the ball that hits it.
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- Explain how the motion of the balls after they collide can be determined by Newton's laws of motion.
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Communicating Your Data

Compare your graph with the graphs made by other students in your class. Discuss why the graphs might look different.