Conservation of momentum

A steel ball rolls along a level track at a known speed.

It collides with a neodymium magnet at the end of the track. The velocity of the attached masses is measured after the collision.

Question 1: Is the momentum before the collision equal to the momentum after the collision?

Prediction:

Question 2: Is the kinetic energy before the collision equal to the kinetic energy after the collision?

Prediction:

Note: Our initial state is the ball moving just before the collision. The final sate is the attached masses moves just after the collision. The purpose of letting the masses fall to the ground is simply a means of measuring velocity.

1. Measuring the initial velocity of the ball. Practice letting the ball roll down the track. If the ball is released too high on the track, it won't be able to stick to the magnet. Determine a height from where the ball has good speed but is still able to stick to the magnet upon collision.

Remove the magnet from the end of the track and release the ball from the determined height. Determine the velocity of the ball as it leaves the end of the track. This will be the initial velocity of the ball before the collision.

height from floor = forward distance =

air time =

initial velocity (at end of track) = v_o =

2. Measuring the final velocity of the combined masses. (By final velocity we mean the velocity immediately after the collision.)

Releasing the ball from the same position on the track, let it now collide with the magnet at the bottom. Measure the new forward velocity of the combined masses.

forward distance =

air time = (same as before) =

final velocity (immediately after collision) = v_f =

3. Comparing initial and final momentum.

mass of ball:

combined mass of ball and magnet:

Initial momentum: $m_o v_o =$

Final momentum: $m_f v_f =$

Conclusion: Are the initial and final momentum relatively equal? Is this what you expected?

4. Comparing initial and final kinetic energy.

Initial kinetic energy: $\frac{1}{2} m_o v^2_o =$

Final kinetic energy: $\frac{1}{2} m_f v^2_f =$

Conclusion: Are the initial and final kinetic energy relatively equal? Is this what you expected?

How much heat is produced in the collision? This heat is what percentage of the original kinetic energy?