Unit: Momentum

I. Impulse: \( \Sigma F \cdot t = I = \Delta p \)

II. Conservation of Momentum: if \( \Sigma F = 0 \), then \( \Delta p_{\text{total}} = 0 \)

III. Collisions: \( \Delta p_{\text{total}} = 0 \)
   
   A. Elastic: \( \Delta K = 0 \)

   B. Inelastic

   C. Perfectly Inelastic

IV. 2D Collisions: \( \Delta p_x = 0 \) and \( \Delta p_y = 0 \)
A truck and a car are moving along the road with equal momentum. Each driver hits the brakes. If both vehicles stop in the same time, which brakes applied the greater force?

a) The truck’s brakes.
b) The car’s brakes.
c) The forces were equal.
A ball is moving toward a non-ideal spring. When it hits the spring, it compresses it a certain distance, before it stops. Given the force vs. time graph below, determine the initial momentum of the ball.

![Force vs. Time Graph]

- Force (F) = 10 N
- Time (t) = 2 sec.
A table is set with all sorts of fine china. You grab hold of the tablecloth and pull it out from under the china very quickly. What happens?

a) The china does not move.

b) The china moves away from you a little.

c) The china moves toward you a little.

d) The china comes crashing off the table.
A rod is placed in the hole of a block of wood. If the rod is held vertical and hit from the top, which way does the wood move.

a) It moves up the rod.

b) It moves down the rod.

c) It does not move up or down the rod.
A stick hangs from a metal ball, which hangs from the ceiling. In the first experiment, the stick is pulled down quickly. In the second experiment, the stick is pulled down slowly. Which of the following is correct?

a) The top string breaks in both experiments.
b) The bottom string breaks in both experiments.
c) The top string breaks in the first and the bottom string breaks in the second.
d) The bottom string breaks in the first and the top string breaks in the second.
e) Both strings break.
You and your friend are ice skating. You throw a snowball at your friend, who then catches it. Assuming neither of you was moving before you threw the snowball, what is the result?

a) You are both moving toward each other.
b) You are moving toward your friend, who is moving away from you.
c) You are moving away from your friend, who is moving toward you.
d) You are both moving away from each other.
e) You are moving, but your friend is not.
f) Your friend is moving, but you are not.
g) Neither of you is moving.
You and your identical twin are ice skating. You both come to a stop right next to each other. Then, you shove your twin away. What is the result?

a) Your twin moves away and you remain still.
b) Your twin moves away and you move away at a slower speed.
c) Both of you move away at equal speeds.
d) You move away faster than your twin.
e) You move away and your twin remains still.
f) Neither of you move.
A 10 million kg asteroid is moving toward the earth at 100m/s. With an insane amount of dynamite, astronauts are able to break off a 1 million kg piece. They measure the velocity of the piece to be 1 km/s (toward the earth). How fast is the remaining chunk moving?
A 200g rubber ball is thrown at 15m/s at a bottle at the fair. If the ball bounces back with the same speed as it was initially moving, what is the change in momentum of the bottle?