Physics 200 (Stapleton) Name: _____
Momentum and Impulse Test Practice Questions

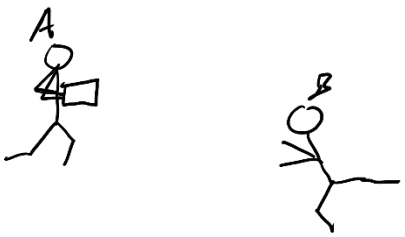
1. A monkey is trying to open a coconut by dropping it out of a tree onto the ground, but the coconut isn't breaking.

   a. Describe a different strategy that the monkey could use to break the coconut by dropping it from the same height. **Drop the coconut onto a rock**

   b. How does your strategy work?
   - Describe what happens to the coconut's momentum when it hits the ground. **Momentum decreases to zero.**
   - Then describe the relationship between impulse and momentum. **Impulse = change in momentum**

- Finally, explain how your strategy causes the coconut to break. **Dropping a coconut onto a rock (versus the ground) doesn't change the impulse, because impulse = change in momentum, and the coconut loses the same amount of momentum in both cases (hitting ground, hitting rock). However, since impulse = Ft, the rock impact can cause the same impulse but with a bigger force. It's the bigger force that breaks the rock. [When the coconut hits the ground, there's a smaller force and a longer impact time, but Ft is the same (i.e. impulse is the same)]**

2. Astronauts A and B are floating motionless in space. Astronaut A has a package, which she throws to Astronaut B, and which Astronaut B catches.



   a. Suppose that momentum is conserved in "the system" when B catches the package, but not when A throws it. If this is true, which items are part of "the system?"**System = B + package**

   b. Explain how you know that your answer to part a is correct.

Momentum is conserved when there is no outside force acting on the system. If there is an outside force, momentum is not conserved. If p is conserved when B is catching the package, then both B and the package must be part of the system, because both of them are exerting forces.

If p is not conserved when A throws the package, then A must be outside the system. We already know that the package is part of the system. If momentum is not conserved during the throw, there must be an outside force. That outside force must be the force exerted on the package by the thrower (A).

   c. If "the system" consists of both astronauts and the package, when is momentum conserved? When is it not conserved? **In this case, momentum is always conserved, because there can never be any outside forces. There is no gravity, air resistance, or anything else that can exert a force.**

   d. Suppose "the system" consists of both astronauts and the package. During which of the following moments does total KE remain constant? For each situation, explain how you know.

   - While A is in the process of pushing the package toward B. **Total KE is not constant. Neither object is moving in the beginning, and both would be moving (opposite directions) after the throw. Total KE increases.**
   - While the package is between A and B. **KE is constant. There are no collisions or any other forces acting on any of the objects. They will continue moving as they are moving.**
   - The time interval beginning when the package is between the astronauts and ending after B has caught the package. **Total KE is not constant. The coefficient of restitution is zero (since separation speed is zero and closing speed is some number), so this collision is inelastic.**

3. Students collected data on two identical sleds (A and B) that were released from the tops of identical snowy hills. The sled accelerated down the hills and crashed into obstacles at the same speed. The two obstacles had the same mass. The students' data table is below. Some of the information is missing.

Sled Letter	Impulse (Ns)	Average Impact Force (N)	Average Impact Time (s)
A	3	90	**0.03**
B	**3.5**	35	0.1

a. Describe how the obstacle that was hit by sled A probably differed from the obstacle that was hit by sled B.

Sled A hit a harder object.

b. Provide evidence and explain your reasoning for part A.

The impact time for sled A was much shorter, and the impulses were about the same. A shorter impact is consistent with a harder object.

c. Which sled had the highest speed after the collision?

Sled A had the highest speed after the collision

d. Provide evidence and explain your reasoning for part c.

Impulse is change in momentum. Since the sleds had the same mass and speed just before the collision, they also had the same momentum just before the collision. Sled B had a larger impulse (3.5Ns vs. 3Ns for sled A), which means its momentum (and therefore speed) changed more, so it slowed down more when it hit the obstacle. Sled A experienced a smaller impulse, so it slowed down less and had a higher speed after the collision.