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Collision Problem Solving

**Directions: Answer the following questions using the GUEiSS method. Make sure to watch out for direction and type of collision. Drawing a picture of the before and after scenario can be helpful.**

1. A 0.350 kg golf club moving at 40 m/s hits a stationary 0.05 kg golf ball. After the collision, the golf club is moving at 30 m/s.
	1. Calculate the momentum of the golf club *before* the collision.
	2. Calculate the momentum of the golf ball *before* the collision.
	3. What is the total momentum *before* the collision?
	4. What is the total momentum *after* the collision? How do you know?
	5. Calculate the momentum of the golf club after the collision.
	6. Calculate the momentum of the golf ball after the collision.
	7. Calculate the speed of the golf ball after it is hit by the golf club.
2. A 1 kg toy car is initially moving to the right with a speed of 4 m/s when it collides with another 2kg toy truck that is initially moving with a speed of 2 m/s to the left. After the collision, the toy car is now moving to the left with a speed of 1 m/s.
	1. Draw a picture showing the before and after of the scenario described above.
	2. Calculate the velocity of the toy truck after the collision.
3. An 800 kg runaway boxcar traveling at 30 m/s runs into a 400 kg boxcar at rest on the same track. If the two couple together after the collision, what is the final velocity of the pair?
4. In a collision, a 5 kg mass moving at 2 m/s transfers all of its momentum to a 1 kg mass at rest. What is the velocity of the 1 kg mass after the collision?
5. An 8 kg mass moving at 8 m/s collides with a 5 kg mass moving in the same direction at 4 m/s. If the 8 kg mass is moving at 3 m/s after the collision, what is the speed of the 5 kg mass?
6. Two train cars approach each other, one of mass 113,000 kg traveling at 10.2 m/s to the east, the other of mass 75,000 kg traveling at 20.3 m/s to the west. Upon collision, they lock together. What is the velocity of the cars after the collision?
7. An 0.1 kg bullet is shot at a 3.00 kg piece of wood at rest. If the bullet becomes embedded in the block, and the block proceeds to move at 5.0 m/s, what was the initial speed of the bullet?
8. A 65.0 kg ice skater is at rest in the middle of an ice rink with a 10 kg bowling ball in her hand. She throws the bowling ball to the right with a velocity of 4 m/s. Disregard the friction between the skates and the ice for this problem.
	1. Which direction will the ice skater be moving after the throwing the bowling ball? How do you know?
	2. What is the velocity of the ice skater after throwing the bowling ball?
	3. A second skater initially at rest with a mass of 40.0 kg catches the bowling ball. What is the velocity of the second skater after catching the bowling ball?
9. **Brain Teaser:** A small locomotive is moving forwards at 50 m/s when it collides with a large locomotive that is 4 times as massive that was initially at rest. After the collision, the small locomotive moves backwards with a speed of 10 m/s. What is the velocity of the large locomotive after the collision?