**Conservation of Momentum – elastic and inelastic collisions**

*Directions: on a separate sheet of paper, show all necessary work.*

**Elastic: mv + mv = mv + mv**

1. A 0.25-kg cue ball hits the 0.25-kg 8-ball in a perfectly elastic collision. If the cue ball was going 22 m/s and stops at the collision, how fast does the 8-ball go after the collision?  ***(****22 m/s)*
2. A 4-kg medicine ball is thrown at 15 m/s and hits a 55-kg boy who is on his skateboard. If the medicine ball continues with a speed of 4 m/s, how fast will the boy and skateboard be going after the collision? *(0.8 m/s)*
3. A bullet that has mass of 0.1-kg has a velocity of 420-m/s just before it hits the 1.5-kg target. If the bullet continues with a speed of 300 m/s, how fast will the target be going after the collision? *(8 m/s)*
4. A toy truck, with mass 0.02 kg, travels along a level tabletop at 0.50 m/s. A miniature car, with mass 0.005 kg, speeds headlong toward the toy truck at 0.75 m/s. After the collision, the toy truck continues in its original direction at 0.10 m/s. What is the velocity of the miniature car? *(0.85 m/s)*
5. An 8.5 kg cart traveling at 9.54 m/s has a head on elastic collision with a 36.8 kg cart at rest. If the final velocity of the first cart is 3.57 m/s, what was the final velocity of the second cart? *(1.38 m/s)*

**Inelastic: (m+m)v = mv + mv**

1. A boy, mass 70.0 kg, riding a skateboard, mass 2.0 kg, is traveling 3.0 m/s east when he attempts to jump forward from his skateboard. If his velocity immediately after leaving the skateboard is 3.1 m/s, what is the velocity of the skateboard? (-0.5 m/s)
2. A rifle has a mass of 7 kg and the bullet inside has a mass of 0.7 kg. If the velocity of the bullet is 350-m/s after the rifle is fired, what is the recoil velocity of the rifle? *(-35 m/s)*
3. A 60 kg 10th grader jumps off a 7 kg ladder into his swimming pool. If the ladder flies off at 15 m/s, how fast will the 10th grader go? *(-1.75 m/s, yes)*
4. Two people, one of mass 72.8kg and the other of mass 52.4kg, sit in a stationary rowboat of mass 81.6 kg.
   1. If the lighter person jumps EAST out of the boat at 7 m/s, how fast will the heavier person and boat move, and in what direction? *(-2.38 m/s west)*
   2. If the heavier person jumps into the water at 4 m/s to rescue the lighter person, how fast will the rowboat move? *(-8.07 m/s)*
5. A child in a boat throws a 6.4 kg package out horizontally with a speed of 10 m/s. Calculate the velocity of the boat immediately after, assuming it was initially at rest. The mass of the child is 26 kg and that of the boat is 45 kg. *(-0.90 m/s)*

**Inelastic: mv + mv = (m+m)v**

1. A girl, mass 70.0 kg, is running 3.0 m/s east when she jumps onto a stationary skateboard, mass 2.0 kg. What is the velocity of the girl and skateboard assuming they move off together? *(2.92 m/s)*
2. A wrestler is standing at rest. Another wrestler, running at 5.0 m/s, grabs him and holds onto him, and the two continue with a velocity of 2.7 m/s. If the mass of the second wrestler is 100 kg, what is the mass of the first wrestler? *(85.19 kg)*
3. A 1 kg glider and a 3 kg glider both slide toward each other at 1 m/s on an air track. They collide and stick. What will be the speed of the combined mass? (-0.5 m/s)
4. A 0.006 k**g** bullet is fired horizontally at 250 m/s into a 1.50 kg wooden block resting on a horizontal surface. What is the speed of the bullet and wood when the bullet is stuck in the wood? (0.996 m/s)
5. Find the speed at which a 76 kg super hero must fly into a 19,537 kg train traveling at 35 m/s to stop it. (-8997 m/s)