**8. Momentum (linear) homework problems**

Name and date submitted (3 pts):

Create space in the Word document below, and write or type your answers. Turn in your completed work as an email attachment. YOU MUST SHOW ALL YOUR WORK to get credit.

(7 questions; 100 points)

Equations: p = mv, ∆p = m∆v linear momentum formulas

∆p = ∑F · ∆t impulse formula

1. Conservation of momentum: Two figure skaters, one weighing 625 N and the other 725 N, push off against each other on frictionless ice.
2. If the heavier skater travels at 1.50 m/s, how fast will the lighter one travel?
3. How much kinetic energy is “created” during the skaters’ maneuver, and where does this energy come from?
4. Baseball: A regulation 145 g baseball can be hit at speeds of 100 mph. If a line drive is hit essentially horizontally at this speed and is caught by a 65 kg player who has leapt directly upward into the air, what horizontal speed in cm/s does he acquire by catching the ball?
5. Inelastic collision: On a highly polished, essentially frictionless lunch counter, a 0.500 kg submarine sandwich moving 3.00 m/s to the left collides with a 0.250 kg grilled cheese sandwich moving 1.20 m/s to the right.
6. If the two sandwiches stick together, what is their final velocity?
7. How much mechanical energy dissipates in the collision? Where did this energy go?
8. Accident analysis: Two cars collide at an intersection. Car *A*, with a mass of 2000 kg, is going from west to east, while car *B*, of mass 1500 kg, is going from north to south at 15 m/s. As a result of this collision, the two cars become enmeshed and move as one afterwards. In your role as an expert witness, you inspect the scene and determine that, after the collision, the enmeshed cars moved at an angle of 65° south of east from the point of impact.
9. How fast were the enmeshed cars moving just after the collision?
10. How fast was car *A* going just before the collision?
11. Impulse: A catcher catches a 145 g baseball traveling horizontally at 36.0 m/s.
12. How large an impulse does the ball give to the catcher?
13. If the ball takes 20 ms to stop once it is in contact with the catcher’s glove, what average force did the ball exert on the catcher?
14. Bone fracture: Experimental tests have shown that bone will rupture if it is subjected to a force density of 1.0 x 108 N/m2. Supposed a 70.0 kg (154 lb) person carelessly roller-skates into an overhead metal beam that hits his forehead and completely stops his forward motion. If the area of contact with the person’s forehead is 1.5 cm2, what is the greatest speed with which he can hit the wall without breaking any bone if his head is in contact with the beam for 10.0 ms?
15. In a common physics demonstration, two identical carts having rigid metal surfaces and equal speeds collide with each other. Each cart has a piece of Velcro at one end and a spring at the other end.
16. Indicate which collision is *elastic* and which is *inelastic*.
17. For collision ‘a’, find the magnitude and direction of the velocity of each cart after the collision.
18. Now do the same for collision ‘b’.
19. What happened to the ‘lost energy’ in the *inelastic* case?

