DIRECTIONS: Answer the following in the space provided, or circle the best answer. All problem answers MUST include the formula work and answers (with correct units and significant figures) for full credit. Be sure to check the units in the problems first!

1. You are sitting at a baseball game and prepare to catch a foul ball coming your way. In order to catch the ball safely in your hands you should:
   a. move your hands toward the ball  b. hold your hands still  c. pull them away from the ball

2. Mr. Reed and Mr. Bergh are driving identical cars on the freeway. Mr. Reed is driving twice as fast as is Mr. Bergh. Who has more momentum?
   a. Mr. Bergh  b. Mr. Reed  c. neither, it's the same  d. principals don't drive

3. A freight train rolls along a track with considerable momentum. If it were to roll at the same speed but had twice as much mass, its momentum would be?
   a. zero  b. doubled  c. halved  d. the same  e. what's the freight

4. Little Debbie and her sister, Betty Crocker, are in the hall outside of physics class one day. Debbie runs into her sister while moving at 3 m/s, and grabs onto her (tackling her). After, the two then move together at 2 m/s down the hall. If Betty was initially standing still, then her mass must be:
   a. the same as Debbie's  b. larger than Debbie's  c. smaller than Debbie's

Suppose you are traveling in a bus at highway speed on a nice summer day and the momentum of an unlucky bug is suddenly changed as it splatters onto your windshield.

5. Compared to the force that acts on the bug, how much is the force that acts on the bus?
   a. more  b. the same  c. less

6. The time of impact is the same for both the bug and the bus. Compared to the impulse on the bug, the impulse on the bus is
   a. more  b. the same  c. less

7. Although the momentum of the bus is very large compared to the momentum of the bug, the change in momentum of the bus compared to the change in momentum of the bug is,
   a. more  b. the same  c. less

8. Define – a) types of collisions (2 pt)

   b) Law of Momentum Conservation (1 pt)
9. Explain how it is possible for a motorcycle (mass = 250 kg) to have the same momentum as a locomotive engine (mass = 2,500 kg). (4)

10. Hitting a stationary hockey puck having a mass of 0.18 kg, Sven gives the puck an impulse of 60.0 N·s. At what speed will the puck move toward the goal? (4)

11. A snowball (mass = 85 g) hits an icicle and sticks to it. The icicle and the snowball, with a combined mass of 220 g, move together at 8.0 m/s. How fast was the snowball moving before impact? (4)

12. A $2.5 \times 10^{-2}$ kg dart moving horizontally at 15.0 m/s makes impact and sticks in a non-moving block of wood with a mass of 0.50 kg. Both objects then slide across the table. How fast are the dart and wood moving together afterward? (4)

13. A ball (mass 12 kg) moving at 15 m/s in the +x-direction collides with a ball (mass 36 kg) moving at 5.0 m/s in the +y direction. After colliding, the 12-kg ball moves at 6.0 m/s at an angle of 30° above the +x direction. Afterward, what is the speed and direction of the 36-kg ball? Be sure to include a diagram of the situation. (5)