Name _____ Date _____ Hour _____

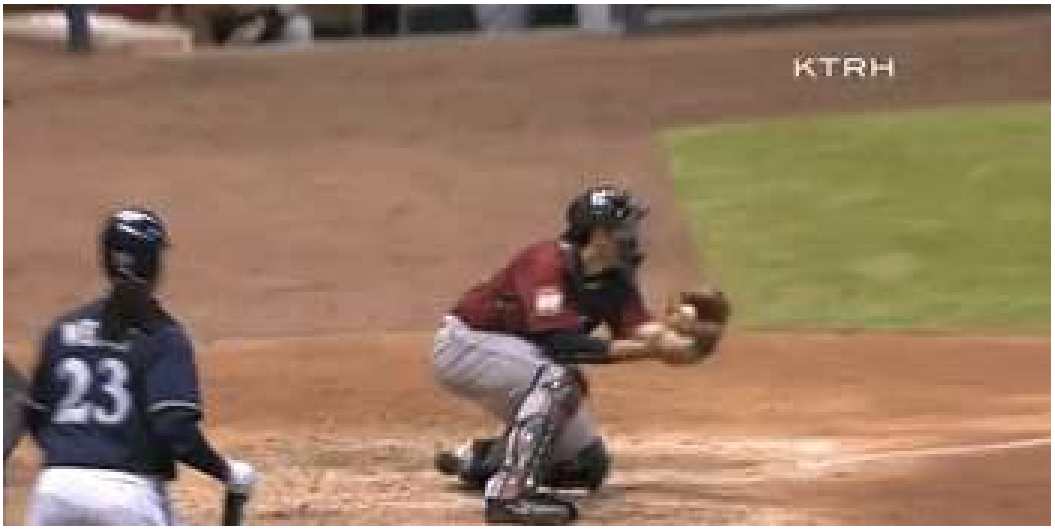
Part 1: Momentum and Impulse

1. Calculate the momentum of a 4000 kg car moving at 30 m/s.
2. Calculate the momentum of a 730 gram newspaper tossed by a newspaper boy at 5 m/s.
3. A freight train engine of 9933 kg is traveling at a speed of 0.0001 m/s. How fast does a bee with a mass of 17 grams have to fly in order to have the same momentum as the freight train?
4. Calculate the total momentum of the system:
    a. A 55 kg person sits on a 135 kg boat at rest in the middle of the lake.
    b. A 55 kg person jumps off the boat with a speed of 3 m/s and the 135 kg boat goes backwards with a velocity of 1.22 m/s.
    c. A 55 kg person runs at 4 m/s towards a docked 135 kg boat.
    d. After jumping onto the boat, the 55 kg person and the 135 kg boat both drift away with a speed of 1.16 m/s.
5. The driver accelerates a 260.0 kg snowmobile, which results in a force being exerted that speeds up the snowmobile from 6.00 m/s to 25.0 m/s over a time interval of 60.0 s.
    a. What is the snowmobile's change in momentum?
    b. What is the impulse on the snowmobile?
    c. What is the magnitude of the average force that is exerted on the snowmobile?
6. In order to slow down a 1500 kg car from a velocity of 20 m/s to a velocity of 0 m/s, the brakes were applied over a time interval of 30 seconds.
    a. What is the car’s change in momentum?
    b. What is the impulse on the snowmobile?
    c. What is the magnitude of the average force that is exerted on the snowmobile?
7. A 0.144 kg baseball is pitched horizontally at 32.0 m/s. After it is hit by the bat, it moves at the same speed, but in the opposite direction.
    a. What was the change in momentum of the ball?
    b. B. What was the impulse delivered by the bat?
    c. If the bat and ball were in contact for 6.5×10^{-5} s, what was the average force the bat exerted on the ball?

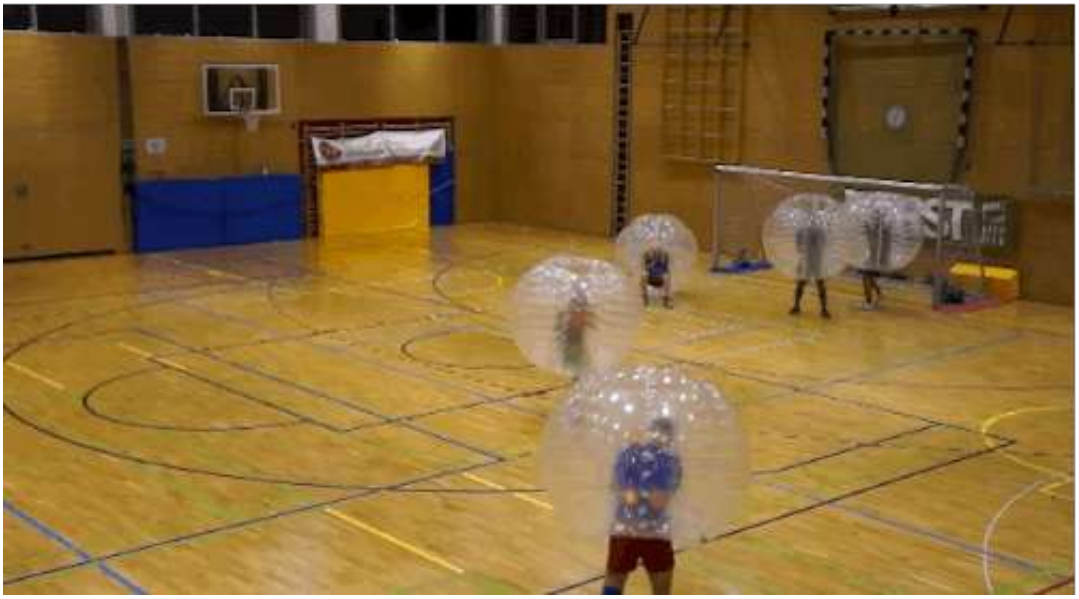
Part 2: Inelastic Collisions

1. Two freight cars, each with a mass of 2.0×10^5 kg, collide and stick together. One was initially moving at 2.0 m/s and the other was at rest. What is their final speed?
2. A 0.105-kg hockey puck moving at 18 m/s is caught and held by a 62-kg goalie at rest. With what speed does the goalie slide on the ice?
3. A 35.0-g bullet strikes a 3.5-kg stationary piece of lumber and embeds itself in the wood. The piece of lumber and bullet fly off together at 7.1 m/s. What was the original speed of the bullet?
4. A 0.50-kg ball that is traveling at 6.0 m/s collides head-on with a 1.00-kg ball moving in the opposite direction at a speed of 12.0 m/s. The balls stick together. Find their final velocity.

Part 3: Predictions in Collisions



1. Describe the type of collision.
2. Model the before, middle and after of the collision and note the velocities and masses.
3. Describe why the collision ended this way.



1. Describe the type of collision.
2. Model the before, middle and after of the collision and note the velocities and masses.
3. Describe why the collision ended this way.

1. before collision

2. before collision

3. before collision

Determine the “after” for the collision and why. Feel free to use the simulations to help you!