Worksheet 16: Momentum and Impulse Name:_____
Do work in smooth form

1. a Car of mass 1200. Kg is moving west at 20.0 m/s. The brakes are applied and the car stops.
   a. How much momentum did the car have before stopping?

   b. What was the change in momentum? (make west positive)

   c. What is the impulse?

   d. If the braking time was 5.00s, what was the average force?

In Problems 2 and 3 there are no unbalanced forces except those of the 'collisions.' Therefore the momentum is conserved. The process is to calculate the total momentum before collision and to assume the total final momentum is the same. (remember, momentum is a vector!) i.e. write:

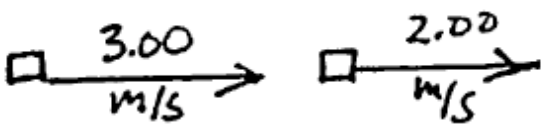
$$\Sigma \overrightarrow{P_o} = \Sigma \overrightarrow{P_f} \Rightarrow \overrightarrow{M_1V_{1o}} + \overrightarrow{M_2V_{2o}} = \overrightarrow{M_1V_{1f}} + \overrightarrow{M_2V_{2f}}$$

2. A PSSC cart (Mass 4.00 kg, speed 6.00 m/s) heading east collides with another cart (Mass 6.00 kg, speed 4.00 m/s) heading west. They rebound along their original paths.
   a. What is the initial (before collision) *total* momentum of the 2 cart system?

   b. What is the *total* momentum of the system after the collision?

   c. The lighter car has a speed of 5.00 m/s after the collision: What is the velocity of the other cart?
   d. What was the impulse acting on the cart with m = 4.00 kg?

3. 2 bodies of equal mass (2.00 kg each) move to the right as shown:



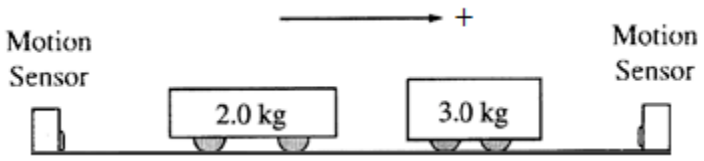
   a. What is the total Momentum of the "system?"

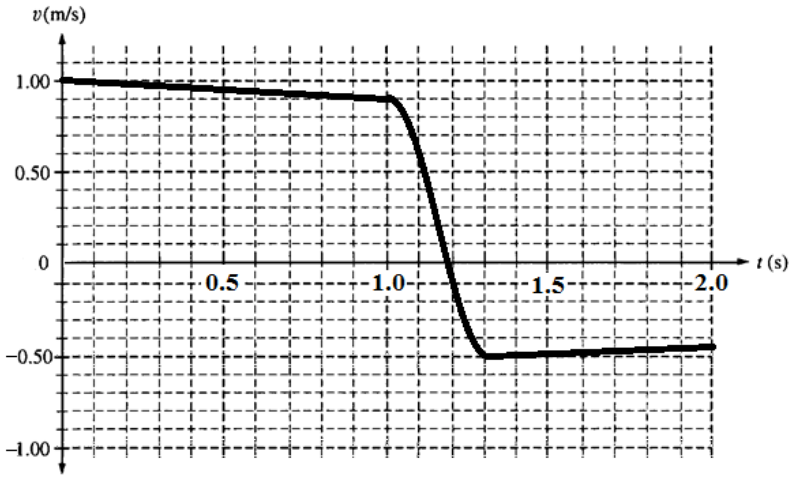
   b. After the left-hand object catches up with the right-hand object and hits it, the right-hand object moves with a speed of 2.90 m/s. What was the impulse on it?

   c. What is the velocity of the left-hand object after the collision?

4. A piece of high explosive hanging from a thread suspended from a tree limb explodes, breaking into three pieces. Two pieces go off at right angles to each other, a 1.00 kg piece at 100. m/s and a 2.00 kg piece at 80.0 m/s. if the mass of the third piece is 3.00 kg, determine its speed and direction. (Hint: What is conserved here? Draw a diagram showing the pieces. Remember that momentum is a vector.)

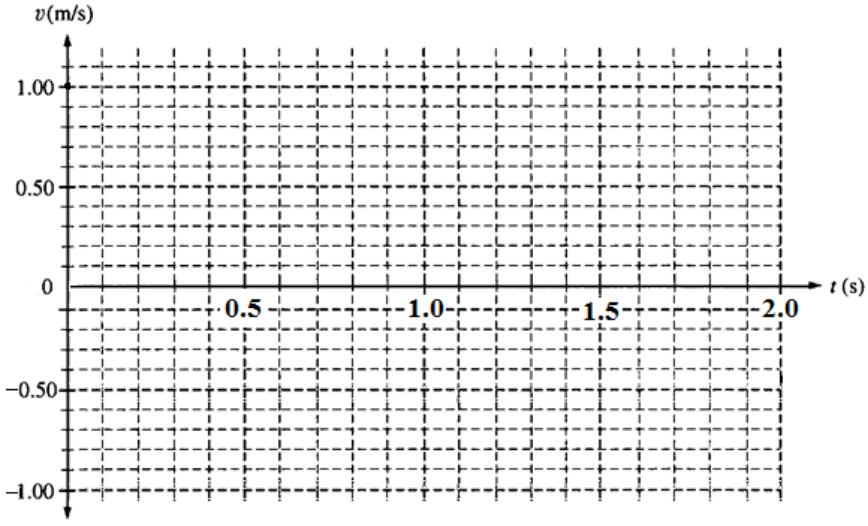
The figure to the right represents two carts on a lab track with magnets attached to repel when they collide. The 3.0 kg cart is initially at rest. The motion sensor on the left picks up the following data on the 2.0 kg cart: (12 points)





a. Use the data to calculate the velocity of the 3.0kg cart immediately after the collision.

b. On the axes below, sketch a graph of the velocity of the 3.0 kg cart as a function of time t.



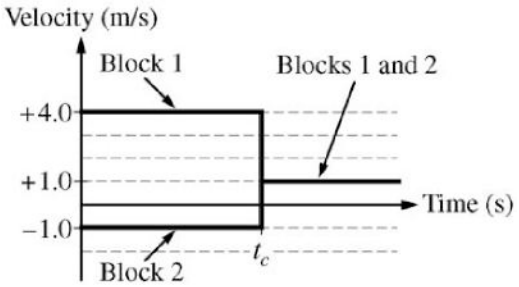
c. Draw a free body diagram of each of the carts as they collide.

2.0 kg cart

3.0 kg cart

d. Is the impulse on the 2 kg cart greater than, less than or equal to the impulse on the 3 kg cart. Explain.

e. Is this collision elastic? Demonstrate with a calculation.



Block 1 of mass m_1 and block 2 of mass m_2 are sliding along the same line on a horizontal frictionless surface when they collide at time t_c. The graph above shows the velocities of the blocks as a function of time.

1. Which block has the greater mass, and what information indicates this?
   (A) Block 1, because it had a greater speed before the collision.
   (B) Block 1, because the velocity after the collision is in the same direction as its velocity before the collision.
   (C) Block 2, because it had a smaller speed before the collision.
   (D) Block 2, because the final velocity is closer to the initial velocity of block 2 than it is to the initial velocity of block 1.
2. Which of the following is true of the motion of the center of mass of the two-block system during the time shown?
   (A) The center of mass does not move because the blocks are moving in opposite directions before the collision.
   (B) The center of mass moves at a constant velocity because there is no friction acting on the system.
   (C) The center-of-mass velocity starts out greater than but decreases during the collision because the collision is inelastic.
   (D) The center-of-mass velocity increases as the blocks get closer together, and then becomes constant after the collision.
3. Two football players with mass 75 kg and 100 kg run directly toward each other with speeds of 6 m/s and 8 m/s respectively. If they grab each other as they collide, the combined speed of the two players just after the collision would be:
   (A) Greater than 8m/s
   (B)Greater than 6 m/s but less than 8 m/s
   (C) Less than 6 m/s
   (D) Impossible to tell