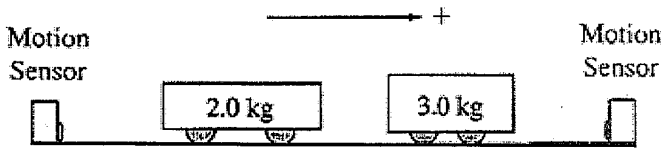
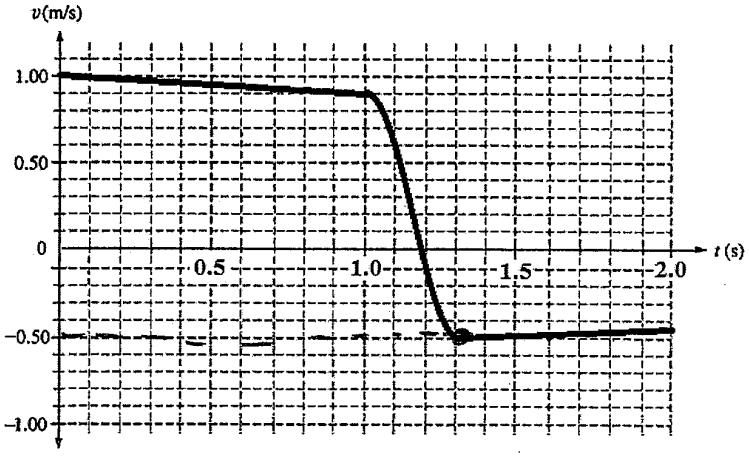
The figure to the right represents two carts on a lab track with magnets attached to repel when they collide. The 3.0 kg cart is initially at rest. The motion sensor on the left picks up the following data on the 2.0 kg cart: (12 points)





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

$V_{o2} = 0.9\ m/s$

$V_{f2} = -0.5\ m/s$

$V_{o3} = 0$

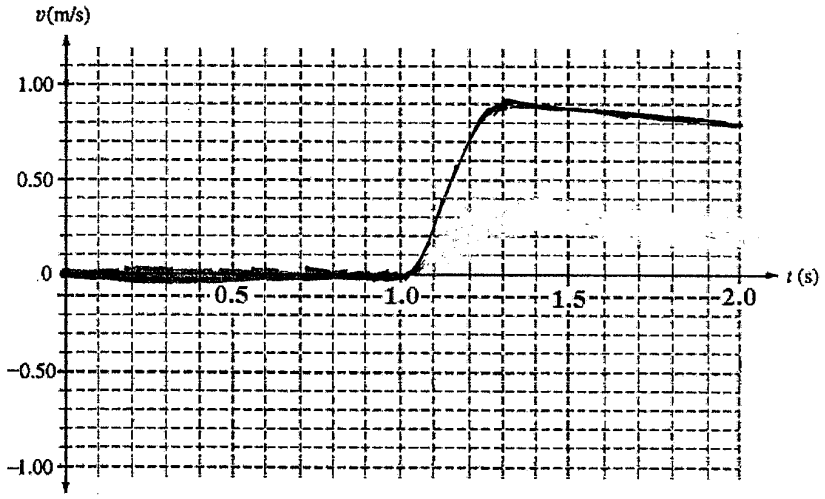
$V_{f3} = ?$

$\Sigma P_i = \Sigma P_f$

$m_2 V_{o2} = m_2 V_{f2} + m_3 V_{f3}$

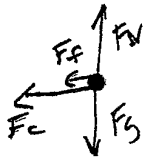
$V_{f3} = \dfrac{m_2 V_{o2} - m_2 V_{f2}}{m_3} = \dfrac{2(0.9 - 0.5)}{3} = 0.9333\ m/s$

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

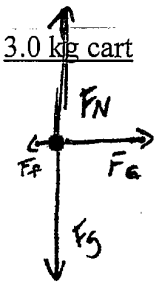


c. Draw a free body diagram of each of the carts as they collide.

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. Forces are = and opposite, time is same.
or
Both have same Δp

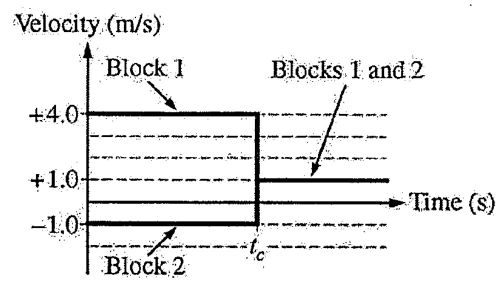
e. Is this collision elastic? Demonstrate with a calculation.

$K_o \stackrel{?}{=} K_f$

$\frac{1}{2}m_2 v_2^2 \stackrel{?}{=} \frac{1}{2}m_2 v_{2f}^2 + \frac{1}{2}m_3 v_{f3}^2$

$(2)(0.9)^2 \stackrel{?}{=} (2)(0.5)^2 + (3)(0.933)^2$

$1.62 \stackrel{?}{\neq} 3.11$



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

before +←
75kg → −6 m/s; ← 8 m/s 100kg
After +←
175kg ← V_f

$\Sigma P_o = \Sigma P_f$

$m_1v_1 + m_2v_2 = (m_1+m_2)V_f$

$V_f = \frac{m_1v_1 + m_2v_2}{m_1+m_2}$

$V_f = \frac{(75)(-6) + (100)(8)}{(75+100)}$

$V_f = 2$ m/s