Name_____

Physics 120 Quiz #2, April 13, 2007

$x_f = x_i + v_{i,x}t + \frac{1}{2}a_x t^2$

$v_f = v_i + a_x t$

$v_{fx}^2 = v_{ix}^2 + 2a_x \Delta x$

$\vec{F} = m\vec{a} = m\dfrac{d\vec{v}}{dt}$

$g = 9.8\,\frac{m}{s^2}$

$1hr = 3600s$

$1mi = 1600m$

Solutions to $Ax^2 + Bx + C$

are given as $x = \dfrac{-B \pm \sqrt{B^2 - 4AC}}{2A}$

Please show all work in order to receive partial credit. The quiz is worth 10 points total.

1. Two students who are late for exams are running to their respective classes in opposite directions as fast as they can. They turn a corner and run into each other head-on, and crumple into a pile on the floor as shown below. In this problem, we will find the force that one student exerts on the other, and to do this we'll focus on the student on the left.

    a. Draw a free body diagram for the student on the left, making sure to label all of the forces and define your coordinate system. Then write expressions for Newton's 2nd Law for your coordinate system. You may ignore friction and air resistance in this problem.
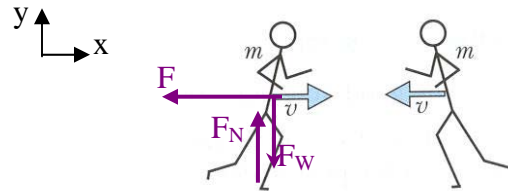
    $\sum F_x: \quad -F = ma_x$

    $\sum F_y: \quad F_N - F_w = ma_y = 0$

    b. Suppose that the mass of the student is 60kg and that the student is traveling with a velocity of 6m/s, what is the acceleration of the student if the collision lasts for a time of 0.017s?

    $v_{fx} = v_{ix} + a_x t \rightarrow a_x = \dfrac{v_{fx} - v_{ix}}{t} = \dfrac{(0-6)\frac{m}{s}}{0.017s} = -352.9\,\frac{m}{s^2}$

    c. What is the magnitude of the force exerted on the student on the left? How many times larger is this force compared to the weight of the student?

    $-F = ma_x \rightarrow F = -ma_x = -60kg \times \left(-359.2\,\frac{m}{s^2}\right) = 21177N$

    $F_W = mg = 60kg \times 9.8\,\frac{m}{s^2} = 588N \rightarrow \dfrac{F}{F_W} = \dfrac{21177N}{588N} = 36$

2. You observe three carts moving to the left.
   Cart A moves with constant speed.
   Cart B is speeding up.
   Cart C is slowing down.
   Which cart or carts are experiencing a net force to the left?

   a. Cart A   b. Cart B   c. Cart C   d. Carts B and C