PHYS 1210 Worksheet 7. Conservation of Momentum

1. 1. A 0.455-kg hockey stick[†] rests on the frictionless ice while its owner fights. A 0.175-kg puck moving at a speed of 25.0 m/s collides with the stick, and rebounds from the stick at a speed of 11.0 m/s and an angle of 60° from its original path. For consistency of notation, let us say that the initial direction of the puck is the $+x$ direction, or 0°. After the collision, the direction of the puck's velocity is therefore 60°. Let's analyze this collision.[‡]

   A. What is the total momentum of the puck and stick before the collision? Don't neglect to specify magnitude, direction, and units. Or, it's may be easier to keep track of x and y components.

   B. Is momentum conserved in this collision? yes no

   C. What is the total momentum of the puck and stick after the collision?

   D. What is the momentum of the puck after the collision? Specify the full vector, not just its magnitude.

   E. What is the momentum of the stick after the collision?

   F. What is the velocity of the stick after the collision?

   G. Is kinetic energy conserved in this collision? yes no

   H. Is total mechanical energy conserved in this collision? yes no

   I. What kind of collision is this? Choose one.

   Elastic inelastic totally inelastic

2. The contact between the stick and puck lasts 0.045 seconds.

   A. What is the magnitude and direction of the impulse acting on the puck during the collision?

   B. Approximating that the force between them was constant over that time, what was the magnitude of the force acting on the puck?

3. The brightest star in the night sky, Sirius, is actually a double star system. The system consists of a bright star with a mass 2.063 times that of the Sun,[*] and a much dimmer "white dwarf" star with a mass 1.018 times that of the Sun. The average distance between these stars is 2.409×10^{12} m. How far from the bright star is the center of mass of the system?

[†] Did you realize that hockey sticks were that light? I was surprised.
[‡] Follow along in the worksheet on the back.
[*] How do we know that? Astronomers are clever.

Collision Problem Worksheet

Mass of puck m_p = 0.175 kg Mass of stick m_s = 0.455 kg

What	***x***	***y***
Initial velocity of puck v_{pi}	25.0 m/s	0 m/s
Initial velocity of stick v_{si}	0 m/s	0 m/s
Initial momentum of puck p_{pi}		
Initial momentum of stick p_{si}		
Initial total momentum Σp_i		
Final total momentum Σp_f		
Final velocity of puck v_{pf}	11.0 m/s cos(60°) =	11.0 m/s sin(60°) =
Final momentum of puck p_{pf}		
Final momentum of stick p_{sf}		
Final velocity of stick v_{sf}		
Initial kinetic energy of puck K_{pi}		
Initial kinetic energy of stick K_{si}		
Initial total kinetic energy ΣK_i		
Final kinetic energy of puck Kp_f		
Final kinetic energy of stick Ks_f		
Final total kinetic energy ΣK_f		