PHY 211 Recitation 20

March 27, 2020

1

A 90.0 kg ice hockey player hits a 0.150 kg puck, giving the puck a velocity of 45.0 m/s. If both are initially at rest and if the ice is frictionless, how far does the player recoil in the time it takes the puck to reach the goal 15.0 m away? Solve as follows:

(a) Draw a picture of the scenario before and after the hit. Indicate the direction of the velocities or write that $v = 0$ for each object.

(b) Is momentum conserved in the "collision" between the player (including the stick) and the puck? Why or why not?

(c) Is energy conserved in the collision? Why or why not?

(d) Write down the initial and final momenta and kinetic energies.

(e) Are there any sources of potential energy in this problem?

(f) Write down the relevant conservation laws and solve to find the velocity of the player after shooting the puck.

(g) How long does the puck take to reach the goal? How far does the player move in that time?

2

In an elastic collision, a 400 kg bumper car collides directly from behind with a second, identical bumper car that is traveling in the same direction. The initial speed of the leading bumper car is 5.60 m/s and that of the trailing car is 6.00 m/s. Assuming that the mass of the drivers is much, much less than that of the bumper cars, what are their final speeds?

(a) Is momentum conserved during the collision? Why or why not?

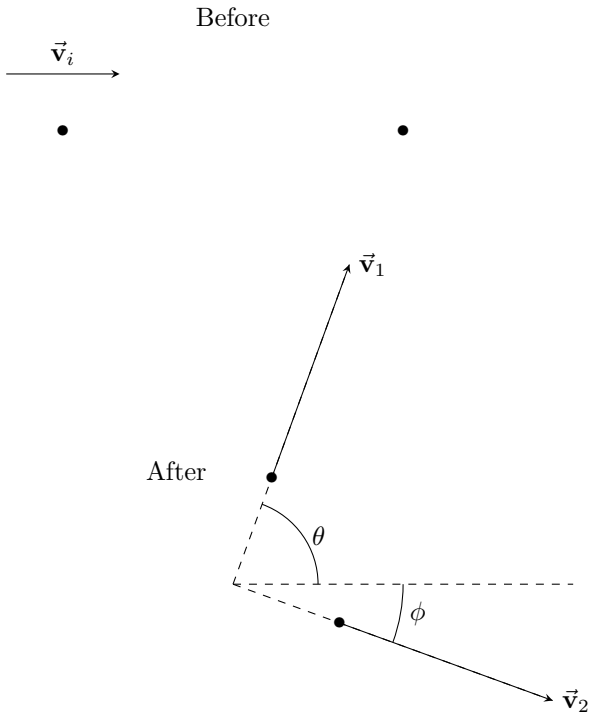
(b) Is energy conserved? Why or why not?

(c) Write down expressions for the initial and final momentum of the two cars.

(d) Write down expressions for the initial and final kinetic energies of the two cars.

(e) Calculate the final speeds.

3



A proton traveling with a speed of $|\vec{\mathbf{v}}_i|$ towards another proton which is at rest. They collide elastically, and the incoming proton is deflected at an angle θ with respect to the incoming direction. The other proton emerges at some other angle ϕ. You can ignore gravity in this problem.

(a) Is momentum conserved during the collision? Why or why not?

(b) Is energy conserved? Why or why not?

(c) Write down expressions for the conserved quantities, equating before and after.

(d) From your number of equations and unknowns, is this problem solvable?

(e) Solving this is actually difficult, and I don't suggest you try the algebra. If you want to try to solve for the angle ϕ, you could think of it graphically: Think about how the expressions you wrote down relate the three velocity vectors. *Hint: draw the graphical vector addition that corresponds to your momentum equations. Then, if you cancel common factors, does the energy equation look like a formula you know from geometry?*