Name Federico Tatur Date 10/25/2023

CRN 88847 GTA Name Merritt

Lab 8: Collisions in 2D

PHYS 2305

Pre-lab Assignment

Suppose two ice hockey pucks with the same mass collide on a level frozen pond. There is approximately no friction between the pucks and the surface. (System: Both pucks).

$\vec{P}_{sys,i}$ is the momentum of the system immediately before the collision.

$\vec{P}_{sys,f}$ is the momentum of the system immediately after the collision

Question Pre-1a: Will the total momentum of the system $\vec{P}_{sys}$ change as a result of the collision? In other words, is $\vec{P}_{sys,f}$ the same as or different from $\vec{P}_{sys,i}$. If they're different, how does $\vec{P}_{sys,f}$ differ from $\vec{P}_{sys,i}$? Explain your reasoning.

* the momentum will stay the same, this is because in a collision of an isolated system, the momentum will remain conserved. Since the friction on the ice surface is negligable, this system can be treated as free from external forces.

Suppose you choose a coordinate system such that the XY plane is parallel to the plane of the frozen pond.

Question Pre-1b: How does the x-component of $\vec{P}_{sys,i}$ compare to the x-component of $\vec{P}_{sys,f}$? Why?

the x-component of the initial momentum vector must be equal to the x-component of the final momentum vector of the system, since momentum is conserved, the x-components should be equal.

Question Pre-1c: How does the y-component of $\vec{P}_{sys,i}$ compare to the y-component of $\vec{P}_{sys,f}$? Why?

the y-component of the initial momentum vector must be equal to the y-component of the final momentum vector of the system, this is because momentum is conserved, so the y-components should stay equal and the same

The graph in **Figure 8. 1** shows the velocity components for one of the pucks near the time of the collision. The puck's velocity in the x-direction (v_x) is shown in green, the puck's velocity in the y-direction (v_y) is shown in purple, and the time of collision is shown in grey. The puck has a mass of 150 g.

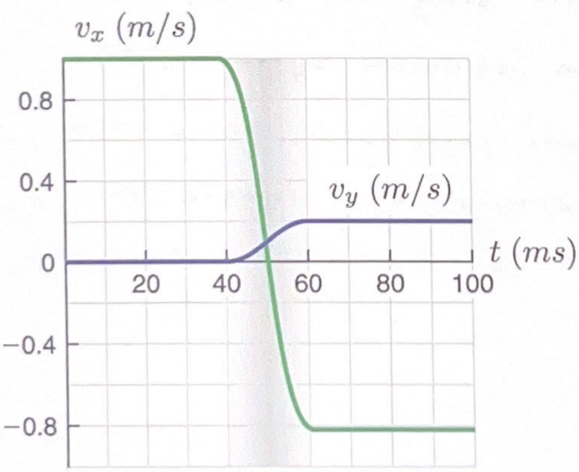

Figure 8. 1: Time-series graph of the puck's x- and y-velocity components.

Question Pre-1d: What is the change in the puck's momentum from t = 0 ms to t = 100 ms? Is the "change in the puck's momentum" a vector or a scalar? If this quantity is a vector, write it in component form (i.e., use $\hat{\imath}$ and $\hat{\jmath}$)

$m = 0.15\ kg$

$v_{xi} = 1\ m/s$

$v_{xf} = -0.8\ m/s$

$v_{yi} = 0\ m/s$

$v_{yf} = 0.2\ m/s$

$\Delta P_x = P_{fx} - P_{ix}$

$= mv_{fx} - mv_{ix}$

$= 0.15(-0.8) - (0.15)(1)$

$= -0.27\hat{\imath}\ kg\,ms^{-1}$

$\Delta P_y = P_{yf} - P_{yi}$

$= mv_{fy} - mv_{iy}$

$= (0.15)(0.2) - 0$

$= 0.03\hat{\jmath}\ kg\,ms^{-1}$

$\Delta P = [-0.27\hat{\imath} + 0.03\hat{\jmath}]\ kg\,ms^{-1}$

Question Pre-1e: What is the change in the puck's kinetic energy from t = 0ms to t = 100ms? Is the "change in the puck's kinetic energy" a vector or a scalar? If this quantity is a vector, write it in component form (i.e., use $\hat{\imath}$ and $\hat{\jmath}$)

$v_i = \sqrt{v_{ix}^2 + v_{iy}^2}$

$= \sqrt{1^2 + 0}$

$v_i = 1\ m/s$

$v_f = \sqrt{v_{fx}^2 + v_{ix}^2}$

$= \sqrt{(0.8)^2 + (0.2)^2}$

$v_f = 0.824\ m/s$

$\Delta K = K_f - K_i$

$\Delta K = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$

$\Delta K = \frac{1}{2}(0.15)(0.824)^2 - \frac{1}{2}(0.15)(1)^2$

$\Delta K = -0.024$ Joules

* there's a loss in kinetic energy in the system