Physics 230 Lab #9 – Collision in Two dimensions

There are only two air tables available. We will have to have different starting times. Each group has 30 minutes to work on the air table. If your group is not done in 30 minutes, you will have to wait until other group finishes, but the time will keep clocking. You only have to take two good pictures – perfectly elastic collision and partially elastic collision. Once you produce two pictures, you can go back to your station to finish the lab. To keep the record, do not forget to bring a memory stick or a floppy disk (kidding).

Prior to the lab

Lab stations 1 and 4 are equipped with cameras. Open "VP Capture" program and you should see the table on the screen. You don't need to set an air-table. Learn how to use the program, crop the video, and save the clip to your memory stick.

Actual lab

Set the air-table on the lab table. Open "VP Capture" program so that you can set the air-table at the center of the screen. Also, you might want to check the focus (on the camera) and angle so that the picture you are going to take is perpendicular to the table. Level the table (it will not be possible to make the entire surface level. So, only important locations need to be leveled.) – If a puck at the center hovers in a small circle, it is leveled.

First use magnetic pucks to simulate "perfectly elastic collision". In this case, magnetic force will repel when they approach so that they can "collide" without physically colliding. Hence, kinetic energy conserves. It takes practices to achieve the perfect speed and angle. One of the members starts the camera and the other starts the puck. The first member stops the camera when one of the pucks hits the edge of the table. Once your group is satisfied with the picture (no actual hitting), crop and save the picture to your flash drive. Repeat the same procedure, but this time, use non-magnetic pucks so that they physically collide. Since this is easier than "perfectly elastic collision", you can do this first (but make sure you know which picture is which when you store them.). Each collision should have no more than 20 pictures. (There are 10 frames per second and make sure there is at least 5 or 6 flames BEFORE the collision so that you can calculate an accurate v_i.)

Once two clips (perfectly elastic and partially elastic) are saved to your memory stick (do not close the program until it completely saves the data, otherwise the computer will crash – I really mean it. So, be patient.), you can go back to your station and open "Video Point" program to trace those pucks' movements. It will ask how many objects (to be traced), type "2". Trace the movements of the pucks for each flame. After you finish, hit an icon (I think it is the second from the bottom on the left-hand side on your screen) to show all the dots you have traced. Copy this and use either Photoshop or Word to make the background as light as possible, but traces (dots) and an image of one puck are still visible. Make the picture as large as possible when print out. Repeat the same for the other collision.

Conservation of Momentum

You are going to test if the momentum of the system was conserved. Since a momentum is a vector, you need to break them into X and Y components. Use the print out to establish X and Y components. You can use a scale to find their masses and use a protractor to find angles. How can you calculate real speeds of the pucks before and after? (Hint: You can measure real diameter of a puck and scaled down diameter of the same puck on the print out you produced.) You can measure the distances that the pucks moved before and after and their corresponding time intervals, you can calculate real speeds. When you calculate errors, use the original momentum of the collider as theoretical so that you can express % errors in X and Y directions.

Energy

Perfect elastic collision: Compare kinetic energies of the system before and after the collision. They should be close.

Partially elastic collision: Calculate % energy lost upon the collision.

Conclusion

Discuss about the conservation of momentum and energy for both types of collisions.

The next page is an example and you can use this to practice beforehand.

Puck 1	452.66 g	9.49 cm
Puck 2	409.34 g	9.46 cm