

Collisions and Momentum

Lab Procedure – Answer questions in red.

Download and run the Java application “collision-lab_en”. The screen should look like what is shown below.

The screenshot shows the PhET Collision Lab 2.01 simulation interface. The browser window title is "Collision Lab 2.01" and the address bar shows the file path: `file:///C:/Users/TIMPOR~1/AppData/Local/Temp/phet-collision-lab/collision-lab_en.html`. The interface includes a navigation bar with "Introduction" and "Advanced" tabs, and a "PhET" logo. The main simulation area features two balls, labeled 1 (red) and 2 (green), with a green arrow indicating the velocity of ball 1. A control panel on the right includes checkboxes for "Velocity Vectors" (checked), "Momentum Vectors", "Center of Mass", "Momenta Diagram", "Kinetic Energy", and "Show Values". Below these is a slider for "Elasticity 100%" and a "Reset All" button. The bottom control panel includes "Restart", "Back", "Play", and "Step" buttons, a "Sim Speed" slider, and a "Time = 0.00 s" display. A data table at the bottom left shows the mass of each ball:

Ball	Mass
1	0.5 kg
2	1.5 kg

A "More Data" button is located below the table.

1. Go to the “advanced” screen. Select 1-Dimensional collisions, and make the collisions 100% elastic to begin. Experiment with one-dimension elastic collisions. Note that you can click “play” to begin a new simulation. After two masses collide, just press pause to stop all action before the masses hit the walls.

2. Select “Show Values” from the right-hand column. You may also want to select “velocity vectors” from the right column as well. Make sure that the ball masses are 0.5 kg (red) and 1.5 kg (green).

a) Calculate the momenta of the two balls, and the total momentum of the system before you start the collision. Use the convention of velocity vectors pointing right as positive, and vectors pointing left as negative. Explain the formula used, and give your results.

Now start the collision by pressing the play button. Stop the collision before any of the balls leaves the screen after they collide.

b) Calculate the momenta of the two balls, and the total momentum of the system after the collision. Use the convention of velocity vectors pointing right as positive, and vectors pointing left as negative. Explain the formula used, and give your results.

c) Was momentum conserved in this collision? Explain your result.

- d) Repeat the same collision if necessary. Calculate the kinetic energy of each of the two balls and the total kinetic energy of the two ball “system” before they collide. Explain any equations that you used, and give the results.

- e) Calculate the kinetic energy of each of the two balls and the total kinetic energy of the two ball “system” after they collide. Explain any equations that you used.

- f) Was kinetic energy conserved in the collision? Explain your answer.

3. Set up the same collision again. This time, though, set the collision “elasticity” to the far left, to full “inelastic”. You will repeat the same calculations as above.....

- a) Calculate the momenta of the two balls, and the total momentum of the system before you start the collision. Use the convention of velocity vectors pointing right as positive, and vectors pointing left as negative. Explain the formula used, and give your results.

Now start the collision by pressing the play button. Stop the collision before any of the balls leaves the screen after they collide.

- b) Calculate the momenta of the two balls, and the total momentum of the system after the collision. Use the convention of velocity vectors pointing right as positive, and vectors pointing left as negative. Explain the formula used, and give your results.

- c) Was momentum conserved in this collision? Explain your result.

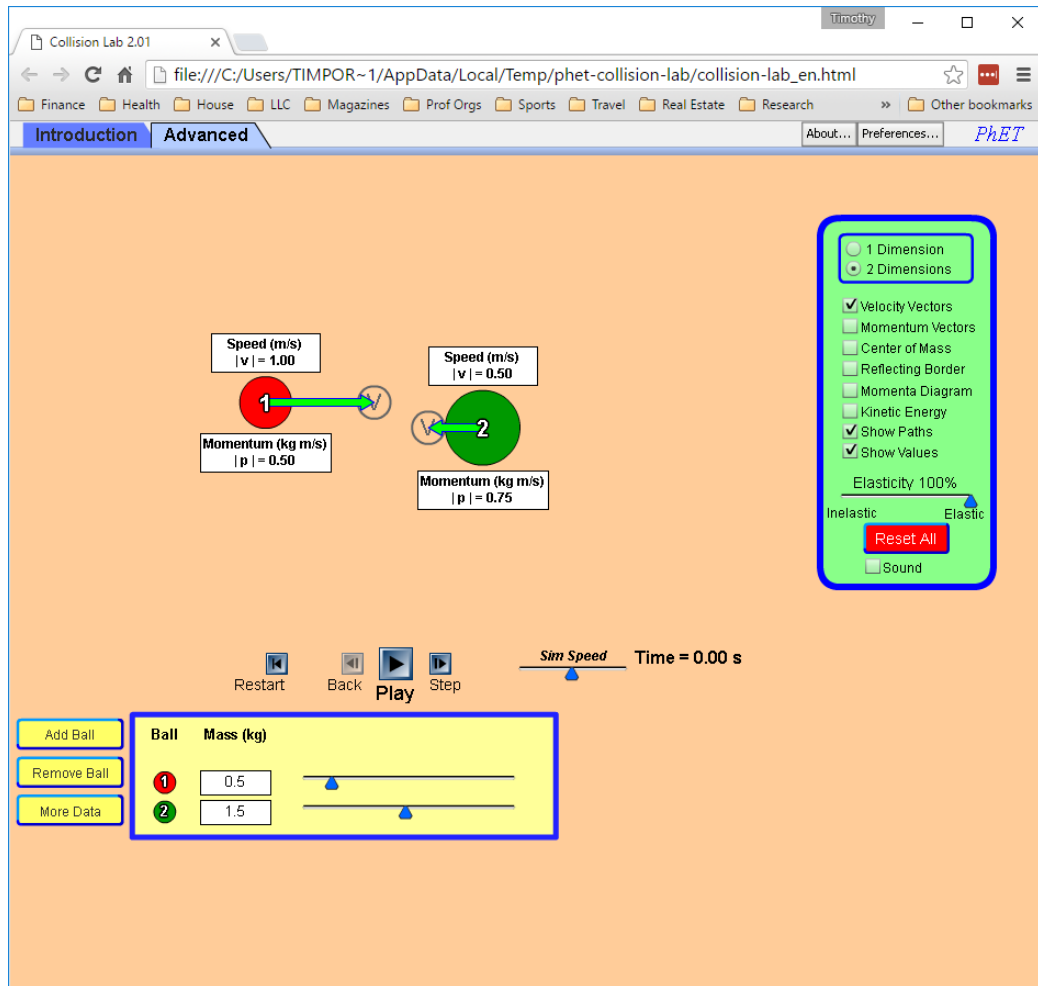
- d) Repeat the same collision if necessary. Calculate the kinetic energy of each of the two balls and the total kinetic energy of the two ball “system” before they collide. Explain any equations that you used, and give the results.

- e) Calculate the kinetic energy of each of the two and the total kinetic energy of the two ball “system” after they collide. Explain any equations that you used, and give the results.

- f) Was kinetic energy conserved in the collision? Explain your answer.

- Restart the simulation by pressing the restart button. Set the app to “2 dimensions” by selecting 2 dimensions on the right. Select “show paths” and “show values”. Leave all other values the same.

Click and drag the red ball slightly upward, about 1/3 its own diameter. The collision setup should look like the screen below.



- Calculate the momenta of the two balls, and the total momentum of the system before you start the collision. Use the convention of velocity vectors pointing right and up as

positive, and vectors pointing left or down as negative. Explain the formula used, and give your results.

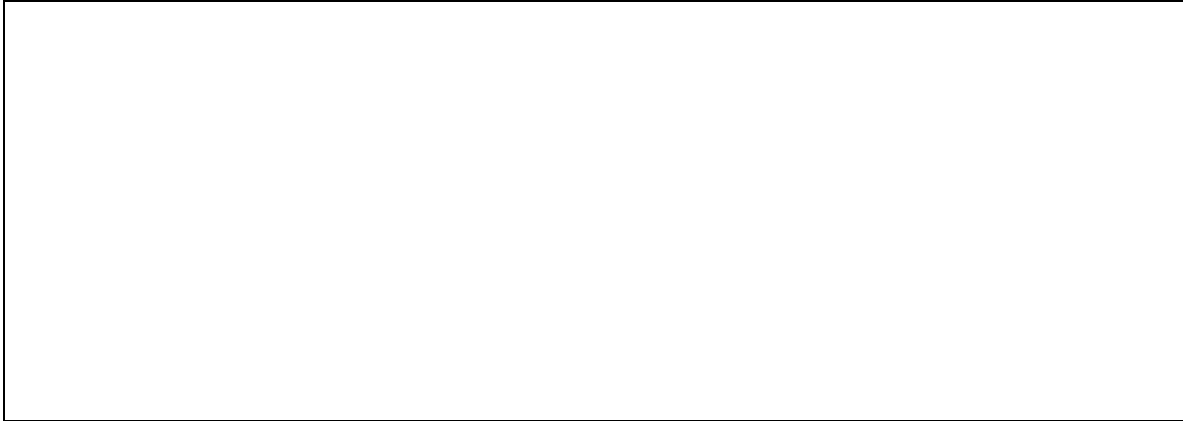
Now start the collision by pressing the play button. Stop the collision before any of the balls leaves the screen after they collide.

- b) If you had “show paths” selected, you can use a protractor on your screen to measure the angle that each ball moved with after the collision. Calculate the x-component momenta of the two balls, and the total “x” momentum of the system after the collision.

- c) Was the x component of momentum conserved in this collision? Explain your result.

- d) What was the y-component of the momentum of each ball before the collision? What was the total “y” system momentum before the collision?

- e) Again, use a protractor on your screen to measure the angle that each ball moved with after the collision. Calculate the y-component momenta of the two balls, and the total “y” momentum of the system after the collision. Explain how you did your calculations, and give the result.



- f) Was the “y” system momentum conserved during this collision? Explain your answer.

