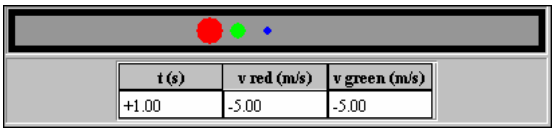
Worksheet for Exploration 8.5: Two and Three Ball Collisions



If you drop a rubber ball and it hits the ground at 5 m/s it bounces back at almost the same speed **(position is given in meters and time is given in seconds)**. But what happens if you drop two balls stacked one upon another? A common lecture demonstration has a professor dropping a light ball and a heavy ball at the same time. The light ball is directly above the heavy ball so that the heavy ball hits the ground first, bounces back, and then hits the light ball which is still on its way down. Restart.

This animation uses two balls with a mass to mass ratio of 1:10. We consider motion on a horizontal air track so we can ignore the effect of gravity so as to make the physics as clear as possible. The balls move at constant speed to the left before hitting the wall and assume all collisions are elastic.

a. Predict the velocities of the balls after the first set of collisions. That is, when both balls are moving to the right.
   i. Measure the velocity of each ball just before the collision occurs.

$V_{red\ i}$=_____ $V_{green\ i}$=_____

   ii. Predict the final velocities using results from conservation laws.

$V_{red\ f}$=_____ $V_{green\ f}$=_____

   iii. Measure the velocities after the collision.

$V_{red\ f}$=_____ $V_{green\ f}$=_____

b. Predict the velocities if you use three balls with mass ratios of 1:10:100.
   i. You already have the results of the red/green ball collision above. With the same results for red and green, the green ball then hits the blue ball. What are the velocities of each ball immediately after the next collision occurs (green to blue)?

$v_{red\ later}$=_____ $v_{green\ later}$=_____

$v_{blue\ later}$=_____

   ii. Now measure each velocity

$v_{red\ later}$=_____ $v_{green\ later}$=_____

$v_{blue\ later}$=_____

As a side note, you should notice that the subscript names have been changed from initial, to final, and then "later" so that different names apply to different numbers (within the same problem).

c. Now run the animations. Were you correct? If not, explain why.

   i. You should check to ensure that momentum is conserved through each of the ball to ball collisions in this simulation. However, as a ball hits the edge of the box you may notice it bounces back. What has happened to conservation of momentum in this instance? Discuss.