Simulation 8: Momentum

Here is our momentum simulation:
https://phet.colorado.edu/sims/collision-lab/collision-lab_en.html

The setup is quite versatile, and we’re going to be using only a portion of it. If you want to explore more features, you are welcome to do so.

Start by keeping all the default settings that are in the green box in the upper right. First we are going to view the qualitative features.

Look at the initial setup.

1. After the collision, do you think the green ball will be moving faster, slower or the same speed as the red ball? Run it and see if you are right.

Now reverse the masses.

2. After collision, now what do you think the green ball’s speed will be compared to the red ball? Check it out.

Now make the two masses equal.

3. What do you think happens now? Are you correct?

In these collisions we have conserved momentum AND energy (that’s called elastic collisions). Go back to the first setting. Now put the slider to “inelastic”. Be sure you get it all the way to the left. After the collision, the two balls will now stick together.

Compare the initial set up (red ball 0.5 kg, green 1.5 kg) with the reverse set up (red 1.5 kg, green 0.5 kg).

4. How do the final motions compare with the two alternative setups? Why are they different if the total mass after the collision is 2 kg in both cases?

Now we want to do a couple of quantitative calculations.

5. Use the last setting and calculate what you expect for the velocity of the combination of the two balls, by using the conservation of momentum:

\[ m_1 v_1 = (m_1+m_2) v_{\text{final}} \]

6. Compare the velocity you predict with the velocity shown in the simulation. Do they agree?
7. Calculate the energy before the collision \((1/2 m_1 v_1^2)\) and after \((1/2 (m_1+m_2) v_{\text{final}}^2)\). How do they compare?

Now reset to the initial conditions.

8. Calculate the momentum before the collision, and the momentum after the collision. How do they compare?

9. Finally calculate the kinetic energy before and the kinetic energy after. How do they compare?

10. What did you learn from doing this simulation?