

8.4.5: Energy and Momentum

Learning Objectives

- Understand the differences between energy and momentum.

Energy and momentum have many similarities as well as many differences. These similarities and differences were confounding for the scientists of the 1700s and 1800s who were trying to formulate ideas about how the movements of masses followed basic repeatable principles.

Momentum and energy can both be formulated around ideas of mass and velocity. However, the formulation of energy is based on mass times velocity squared while the formulation of momentum is based on mass times velocity. Also, energy is not always based on movement while momentum is always based on movement. We have already seen how potential energy can be calculated for objects which are not moving. As you can probably imagine, there is no component of movement involved in most of the other forms of energy we have not considered in great detail yet.

The other similarity between momentum and energy is that they are both conserved. This is an important similarity, as there are very few properties in nature that are conserved. However, these two are conserved for different reasons and in different ways. Momentum is a vector quantity, while energy is a scalar quantity (an important type of scalar quantity called a state function, as we will learn later). As a vector quantity, momentum could cancel out during a collision. For example, if two cars of equal mass were moving at the same speed directly towards each other we might expect them to stop moving when they collide. In this case the momentum of the system defined as both cars is conserved because their overall momentum adds up to zero both before and after the collision. However, the energy does not cancel out. The energy of motion has been converted into potential energy as the bumpers are compressed and into thermal energy as they warm up. It does not cancel out as momentum does.

Section Summary

- Momentum is based on mass and velocity, and energy can be formulated to also be based on mass and velocity.
- Momentum and energy are both conserved.
- Momentum is a vector property, and energy is a scalar property.
- Momentum and energy are different properties, although they have sometimes been confused with each other.

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