Conservation of Momentum

SECTION 2

SECTION OBJECTIVES

- **Describe the interaction between two objects in terms of the change in momentum of each object.**
- **Compare the total momentum of two objects before and after they interact.**
- **State the law of conservation of momentum.**
- **Predict the final velocities of objects after collisions, given the initial velocities.**

MOMENTUM IS CONSERVED

So far in this chapter, we have considered the momentum of only one object at a time. Now we will consider the momentum of two or more objects interacting with each other. **Figure 6** shows a stationary billiard ball set into motion by a collision with a moving billiard ball. Assume that both balls are on a smooth table and that neither ball rotates before or after the collision. Before the collision, the momentum of ball B is equal to zero because the ball is stationary. During the collision, ball B gains momentum while ball A loses momentum. The momentum that ball A loses is exactly equal to the momentum that ball B gains.

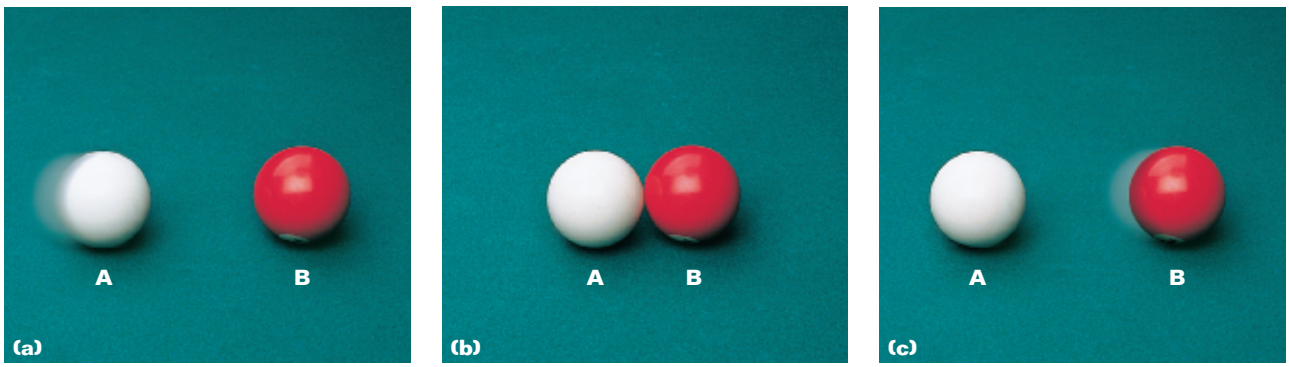

Figure 6
(a) Before the collision, the momentum of ball A is $\mathbf{p}_{A,i}$ and of ball B is zero. **(b)** During the collision, ball A loses momentum, and ball B gains momentum. **(c)** After the collision, ball B has momentum $\mathbf{p}_{B,f}$.

Table 1 shows the velocity and momentum of each billiard ball both before and after the collision. The momentum of each ball changes due to the collision, but the *total* momentum of the two balls together remains constant. In

Table 1 Momentum in a Collision

	Ball A			Ball B		
	Mass	**Velocity**	**Momentum**	**Mass**	**Velocity**	**Momentum**
before collision	0.16 kg	4.50 m/s	0.72 kg•m/s	0.16 kg	0 m/s	0 kg•m/s
after collision	0.16 kg	0.11 m/s	0.018 kg•m/s	0.16 kg	4.39 m/s	0.70 kg•m/s