

Momentum

Students will learn about momentum and its determination.

What is momentum?

- Sir Isaac Newton called momentum “the quantity of motion.”
- Momentum is the tendency of an object to remain in motion.
- Momentum requires two factors: mass and velocity
- Momentum = mass x velocity

Momentum is a vector

- Momentum = $P = \text{mass} \times \text{velocity}$
- Units are (kg x m/s)
- The direction of the velocity is the direction of the momentum.
- Need a frame of reference for positive momentum and for negative momentum

Momentum Example

- An object whose mass is 3.5 kg is traveling at 20 m/s EAST. Calculate the momentum of the object.
- $P = \text{mass} \times \text{velocity}$
- $= 3.5 \text{ kg} \times 20 \text{ m/s EAST}$
- $= 70 \text{ kg} \times \text{m/s EAST}$

Law of Conservation of Momentum

- If two objects collide, the total momentum of the objects before the interaction is equal to their total momentum after the interaction.
- $P(A, \text{initial}) + P(B, \text{initial}) = P(A, \text{final}) + P(B, \text{final})$

Group Activity

- 1. If a 3.0 kg object moves 10 m in 2.0 s, its average momentum is how much?
- 2. An object traveling at 4.0 m/s has a momentum of 16 kg x m/s. What is the mass of the object?
- 3. What is the magnitude of the velocity of a 25 kg mass that is moving with a momentum of 100 kg x m/s?

Group Activity

- 4. A rocket with a mass of 1,000 kg is moving at a speed of 20 m/s. The magnitude of the momentum is how much?
- 5. A car with a mass of 1,000 kg is moving with a speed of 140 m/s. What is its momentum?
- 6. A book with mass 3 kg is at rest. What is its momentum?

Group Activity

- 7. A 1.0 kg object moving east with a velocity of 10 m/s collides with a 5 kg object that is at rest. What is the momentum of the system before and after the collision?
- 8. A 2 kg car and a 3 kg car are at rest on a horizontal, frictionless surface. What is the momentum of this system? If a compressed spring is released that pushes the two cars apart, what is the momentum of this system?