

1. Carolyn has a mass of 35.6 kg and her skateboard has a mass of 1.3 kg. What is the momentum of Carolyn and her skateboard together if they are going 9.50 m/s?  
( $3.5 \times 10^2 \text{ kg}\cdot\text{m/s}$ )
2. A hockey player makes a slap shot, exerting a force of 30.0 N on the hockey puck for 0.16 s. What impulse is given to the puck? ( $4.8 \text{ N}\cdot\text{s}$ )
3. The hockey puck in question 2 has a mass of 0.115 kg and was at rest before the shot. With what speed does it head toward the goal? ( $42 \text{ m/s}$ )
4. A force of 6.00 N acts on a 3.00 kg object for 10.0 s.
  - a. What is the object's change in momentum? ( $60 \text{ kg}\cdot\text{m/s}$ )
  - b. What is its change in velocity? ( $20 \text{ m/s}$ )
5. The velocity of a 600 kg car is changed from +10.0 m/s to +44.0 m/s in 68.0 s by an applied constant force.
  - a. What change in momentum does the force produce? ( $2.04 \times 10^4 \text{ kg}\cdot\text{m/s}$ )
  - b. What is the magnitude of the force? ( $300 \text{ N}$ )
6. A 845 kg race car accelerates from rest to 100 km/h in 0.90 s.
  - a. What is the change in momentum of the car? ( $2.3 \times 10^4 \text{ kg}\cdot\text{m/s}$ )
  - b. What average force is exerted on the car? ( $2.6 \times 10^4 \text{ N}$ )
7. A sprinter with a mass of 76 kg accelerates from 0 to 9.4 m/s in 2.8 s. Find the average force acting on the runner. ( $2.6 \times 10^2 \text{ N}$ )

8. A 0.25 kg soccer ball is rolling at 6.0 m/s toward a player. The player kicks the ball back in the opposite direction and gives it a velocity of  $-14$  m/s. What is the average force during the interaction between the player's foot and the ball if the interaction lasts  $2.0 \times 10^{-2}$  s? ( $-250$  N)
9. A force of  $1.21 \times 10^3$  N is needed to bring a car moving at  $+22.0$  m/s to a halt in 20.0 s. What is the mass of the car? ( $1100$  kg)
10. A 10 000 kg freight car is rolling along a track at 3.00 m/s. Calculate the time needed for a force of 1000 N to stop the car. ( $30$  s)
11. Ball A of mass 5.0 g moves at a velocity of 20.0 cm/s. It collides with ball B of mass 10.0 g moving at a velocity of 10.0 cm/s. After the collision ball A is still moving but with a velocity of 8.0 cm/s.
- What was ball A's original momentum? ( $1.0 \times 10^{-3}$  kg·m/s)
  - What is ball A's change in momentum? ( $-6.0 \times 10^{-4}$  kg·m/s)
  - What is ball B's change in momentum? ( $6.0 \times 10^{-4}$  kg·m/s)
  - What is the momentum of ball B after the collision? ( $1.6 \times 10^{-3}$  kg·m/s)
12. A 2575 kg van runs into the back of a 825 kg compact car at rest. They move off together at 8.5 m/s. Assuming no friction with the ground, find the initial speed of the van. ( $11$  m/s)
13. A 15 g bullet is shot into a 5085 g wooden block standing on a frictionless surface. The block with the bullet in it acquires a velocity of 1.0 m/s. Calculate the velocity of the bullet before striking the block. ( $340$  m/s)
14. A car with mass 1245 kg, moving at 29 m/s strikes a 2175 kg car at rest. If the two cars stick together, with what speed do they move? ( $11$  m/s)
15. Ball A rolling west at 3.0 m/s has a mass of 1.0 kg. Ball B has a mass of 2.0 kg and is stationary. After colliding with ball B, ball A moves south at 2.0 m/s. Calculate the momentum and velocity of ball B after the collision.