1. A boarder (35.20) kg, is on a 1.30-kg skateboard. What is the combined momentum of both boarder and skateboard if they are going 9.45-m/s? (**344.93-kg·m/s**)

2. A hockey player makes a slap shot, exerting a constant force of 29.20-N on the hockey puck for 0.13-s. What is the magnitude of the impulse given to the puck? (**3.80-N·s**)

3. A hockey puck has a mass of 0.108-kg and is at rest. A hockey player makes a shot, exerting a constant force of 32.00-N on the puck for 0.16-s. With what speed does it head toward the goal? (**47.41-m/s**)

4. Before a collision, a 22.00-kg object is moving at 12.00-m/s. Find the impulse that acted on the object if, after the collision, it moves at the following speeds.

(a) 8.00-m/s (**-88.00-N·s**)

(b) -8.00-m/s (**-440.00-N·s**)

5. A constant force of 5.50-N acts on a 2.85-kg object for 10.00-s. What are the changes in the object's momentum and velocity? (**55.00-kg·m/s, 19.3-m/s**)

6. The velocity of a 637.00-kg vehicle is changed from 10.00-m/s to 44.00-m/s in 70.90-s by an external, constant force.

(a) What is the resulting change in momentum of the car? (**2.17 x10^{4}-kg·m/s**)

(b) What is the magnitude of the force? (**305-N**)

7. A 52.00-kg dancer leaps 0.28-m high.

(a) With what momentum does the dancer reach the ground? (**122-kg·m/s**)

(b) What impulse is needed to stop the dancer? (**122-N·s**)

(c) As the dancer lands, his knees bend, lengthening the stopping time to 0.05-s. Find the average force exerted on the dancer's body. (**2440-N**)

(d) Compare the stopping force to the dancer's weight. (stopping force/dancer's weight) (**4.78**)

8. A 100.00-kg fullback, running at 8.20-m/s, collides in midair with a 133.00-kg defensive tackle moving in the opposite direction. Both players end up with zero speed.

(a) What was the fullback's momentum before the collision? (**820-kg·m/s**)

(b) What was the change in the fullback's momentum? (**-820-kg·m/s**)

(c) What was the change in the tackle's momentum? (**-820-kg·m/s**)

(d) What was the tackle's original momentum? (**-820-kg·m/s**)

(e) How fast was the tackle moving originally? (**-6.17-m/s**)

9. Marble A, mass 5.00-g, moves at a speed of 21.50-cm/s. It collides with a second marble, B, mass 10.00-g, moving at 10.50-cm/s. After the collision, marble A continues with a speed of 8.00-cm/s.

(a) Calculate the marbles' momenta before the collision.

(**A: 1.08 x 10^{-3}-kg·m/s B: 1.05 x10^{-3}-kg·m/s**)

(b) Calculate the momentum of marble A after the collision. (**4.00 x 10^{-4}-kg·m/s**)

(c) Calculate the momentum of marble B after the collision. (**1.73 x 10^{-3}-kg·m/s**)

(d) What is the speed of marble B after the collision? (**17.2-cm/s**)

10. A 92.00-kg fullback, running at 5.00-m/s, attempts to dive directly across the goal line for a touchdown. Just as he reaches the line, he is met head-on in midair by two 74.00-kg linebackers both moving in the direction opposite the fullback. One is moving at 2.00-m/s, the other at 4.0-m/s. They all become entangled as one mass.

(a) What is their velocity after the collision? (Take the positive direction to be the initial direction of the fullback.) (**6.67×10^{-2}-m/s**)

(b) Does the fullback score? (**yes**)

11. A 5.00-g bullet is fired with a velocity of 118.50-m/s toward a 10.05-kg stationary solid block resting on a frictionless surface.

(a) What is the change in momentum of the bullet if it is embedded in the block? (**-5.92×10^{-1}-kg·m/s**)

(b) What is the change in momentum of the bullet if it ricochets in the opposite direction with a speed of 99 m/s? (**-1.09-kg·m/s**)

12. The diagrams in Figure 9-13 show a brick weighing 25.1 N being released from rest on a 1.00 m frictionless plane, inclined at an angle of 30.0°. The brick slides down the incline and strikes a second brick weighing 37.8 N.

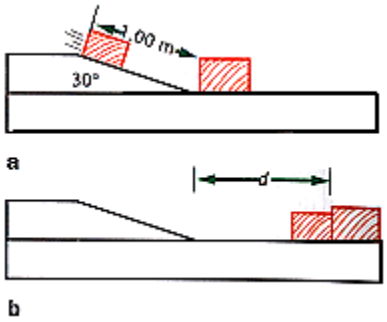


Figure 9-13

(a) Calculate the speed of the first brick at the bottom of the incline. (**3.13-m/s**)

(b) If the two bricks stick together, with what initial speed will they move along? (**1.25-m/s**)

(c) If the force of friction acting on the two bricks is 5.00-N, how much time will elapse before the bricks come to rest? (**1.6-s**)

(d) How far will the two bricks slide before coming to rest? (**1.0-m**)

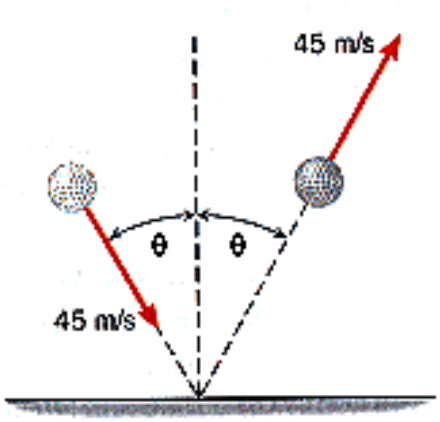
13. Two children sit on a 3.00-m seesaw. Child 1 (10.00-kg) sits .50-m from one side while the other child (15.00-kg) sits 1.00-m from the edge on the opposite side.

a) What is the COM? (**1.40-m**)

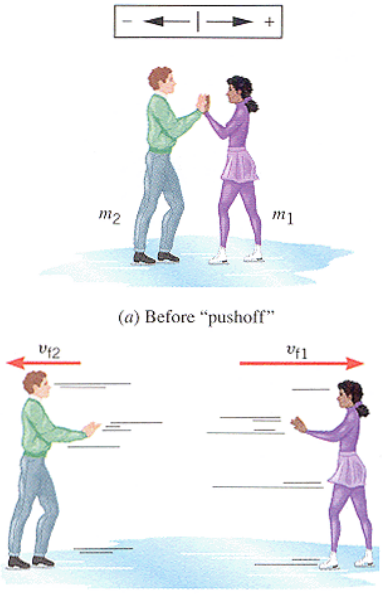
b) If they are not moving, what child will be in the air? (**Child 2**)

E1. A 0.370-kg ball is dropped from rest at a point 1.85-m above the floor. The ball rebounds straight upward to a height of 0.650-m. What are the magnitude and direction of the impulse of the net force applied to the ball during the collision with the floor? (**3.55-kg·m/s**)

E2. A golf ball strikes a hard, smooth floor at an angle of $\theta = 31.8°$ and, as the drawing shows, rebounds at the same angle. The mass of the ball is 0.047-kg, and its speed is 45.00-m/s just before and after striking the floor. What is the magnitude of the impulse applied to the golf ball by the floor? (Hint: Note that only the vertical component of the ball's momentum changes during impact with the floor, and ignore the weight of the ball.) (**3.6-N·s**)



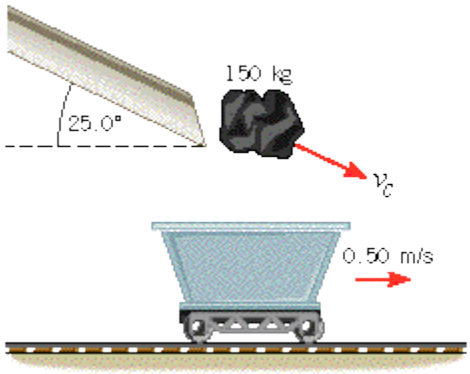
E3. Two ice skaters have masses m1 and m2 and are initially stationary. Their skates are identical. They push against one another, as shown below, and move in opposite directions with different speeds. While they are pushing against each other, any kinetic frictional forces acting on their skates can be ignored. However, once the skaters separate, kinetic frictional forces eventually bring them to a halt. As they glide to a halt, the magnitudes of their accelerations are equal, and skater 1 glides 2 times as far as skater 2. What is the ratio m1 / m2 of their masses? (**.71**)



(*a*) Before "pushoff"

(*b*) After "pushoff"

E4. A mine car (mass 560-kg) rolls at a speed of 0.50-m/s on a horizontal track, as the drawing shows. A 150.00-kg chunk of coal has a speed of 0.65-m/s when it leaves the chute. Determine the velocity of the car/coal system after the coal has come to rest in the car. (**0.519-m/s (to the right)**)



E5. A person stands in a stationary canoe and throws a 4.96-kg stone with a velocity of 7.75-m/s at an angle of 33.50° above the horizontal. The person and canoe have a combined mass of 105-kg. Ignoring air resistance and effects of the water, find the horizontal recoil velocity (magnitude and direction) of the canoe. (**3.05×10^{-1}-m/s**)