
Collision Problems

23. An automobile has a mass of 2300 kg and a velocity of 16 m/s. It makes a rear-end collision with a stationary car whose mass is 1800 kg. The cars lock bumpers and skid off together with the wheels locked. What is the velocity of the two cars just after the collision?

9.0 m/s

34. A 60-kg person, running horizontally with a velocity of 3.8 m/s, jumps onto a 12-kg sled that is initially at rest. Find the velocity of the sled and person immediately after the collision.

3.17 m/s

E4. A dry cleaner throws a 22-kg bag of laundry onto a stationary 9-kg cart. The cart and laundry bag begin moving at 3 m/s to the right. Find the speed of the laundry bag before the collision.

4.2 m/s

E5. A 47.4-kg student runs down the sidewalk and jumps with a horizontal speed of 4.2 m/s onto a stationary skateboard. The student and skateboard move down the sidewalk with a speed of 3.95 m/s.
(a) What is the mass of the skateboard?
(b) How fast would the student have to jump in order to have a final speed of 5.0 m/s?

(a) 3 kg; (b) 5.3 m/s

31. A 0.150-kg projectile is fired with a velocity of 715 m/s at a 2.0-kg wooden block that rests on a frictionless table. The velocity of the block immediately after the projectile passes through it is 40 m/s. Find the velocity with which the projectile exits from the block.

182 m/s

G1. A 0.015-kg marble moving to the right at 22.5 cm/s collides head-on with an identical marble moving to the left at 18 cm/s. After the collision, the first marble moves to the left at 18 cm/s. What is the velocity (speed and direction) of the second marble after the collision?

22.5 cm/s right

G3. A 4-kg bowling ball moving to the right at 8 m/s collides head-on with a 6-kg bowling ball at rest. After the collision, the 4-kg ball moves to the left at 1.6 m/s. What is the velocity (speed and direction) of the 6-kg ball after the collision?

6.4 m/s right

55. A person stands in a stationary canoe and throws a 5-kg stone horizontally with a velocity of 8.0 m/s. The person and canoe have a combined mass of 105 kg. (a) Ignoring air resistance and friction, find the velocity of the canoe after the person throws the stone. (b) With what velocity would the person have to throw the stone in order to get the canoe to move at 1 m/s?

0.38 m/s; 21 m/s

56. A 3.0-kg block of wood rests on the muzzle opening of a vertically oriented rifle, the stock of the rifle being firmly planted on the ground. When the rifle is fired, an 8.0-g bullet (velocity 800 m/s upward) becomes completely embedded in the block. (a) Find the velocity of the block/bullet system immediately after the collision. (b) Ignoring air resistance, find how high the block/bullet system rises above the muzzle opening of the rifle.

2.13 m/s; 0.23 m