Chapter 7   Momentum

Example Problems

7.2 Conservation of Momentum

E1. A monkey fires a 10 kg rifle. The 0.02 kg bullet leaves the muzzle of the rifle with a velocity of 310 m/s. Calculate the recoil velocity of the rifle.

Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve

$m_1 =$

$m_2 =$

$v_{1,2o} =$

$v_{1f} =$

$v_{2f} =$

a) _____ ⟵ units

E2. A 60 kg gorilla and a 40 kg monkey are at rest on two skateboards. They face each other and touch hands. The monkey pushes the gorilla and the gorilla moves away from the monkey at a speed of 2 m/s. Calculate the speed of the monkey.

Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve
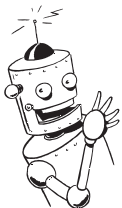
$m_1 =$

$m_2 =$

$v_{1,2o} =$

$v_{1f} =$

$v_{2f} =$

a) _____ ⟵ units

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E3. A railroad car with a mass of 11,000 kg is moving at 4.5 m/s when it collides and couples with a second rail car that is at rest. If the mass of the second rail car is 19,000 kg, calculate the final velocity of the two coupled rail cars after the collision.

Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve

$m_1 =$

$m_2 =$

$v_{1o} =$

$v_{2o} =$

$v_{1,2f} =$

a) _____ ⟵____ units

E4. A 0.105 kg hockey puck is moving at 24 m/s when it is caught by a 75 kg goalie who is initially at rest on the ice. If the goalie holds on to the puck, calculate the new speed of the goalie just after the goalie has caught the puck.

Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve
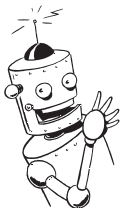
$m_1 =$

$m_2 =$

$v_{1o} =$

$v_{2o} =$

$v_{1,2f} =$

a) _____ ⟵____ units

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E5. A 0.035 kg bullet strikes a 5.0 kg stationary wooden block and embeds itself inside the block. After the collision the block and bullet slide off together at 8.6 m/s. Calculate the original speed of the bullet.

Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve

$m_1 =$

$m_2 =$

$v_{1o} =$

$v_{2o} =$

$v_{1,2f} =$

a) _____ ⟵——— units

E6. A 0.035 kg bullet is moving at 475 m/s when it strikes a 2.5 kg wooden block that is at rest. The bullet passes through the block and exists on the opposite side of the block traveling at 275 m/s. Calculate the speed of the block after the bullet exits.

Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve
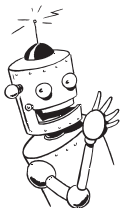
$m_1 =$

$m_2 =$

$v_{1o} =$

$v_{2o} =$

$v_{1f} =$

$v_{2f} =$

a) _____ ⟵——— units

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E7. Ball **A** is traveling at 6.0 m/s when it has a head-on collision with ball **B** moving in the opposite direction at a speed of 12.0 m/s. Ball **A** bounces backward at -14 m/s after the collision. If ball **A** has a mass of 0.50 kg and ball **B** a mass of 1.0 kg, find the speed of ball **B** after the collision.

Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve

$m_1 =$

$m_2 =$

$v_{1o} =$

$v_{2o} =$

$v_{1f} =$

$v_{2f} =$

a) _____ ⟵ units

E8. A monkey throws a 0.05 kg foam ball in the living room and knocks over his mother's 0.60 kg antique vase. After the collision, the foam ball bounces straight back with a speed of -7.0 m/s, while the vase is moving at 1.3 m/s in the opposite direction of the foam ball. Calculate how fast the monkey throw the foam ball.

Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve
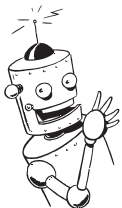
$m_1 =$

$m_2 =$

$v_{1o} =$

$v_{2o} =$

$v_{1f} =$
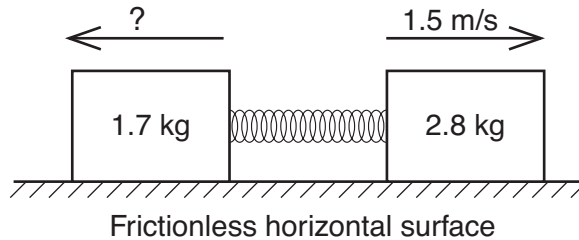
$v_{2f} =$

a) _____ ⟵ units

Chapter 7   Momentum

Student Problems

7.2 Conservation of Momentum

1. A 2.8 kilogram block and a 1.7 kilogram block are initially at rest on a frictionless, horizontal surface. A compressed spring pushes the two blocks apart. The 2.8 kilogram block moves to the right at 1.5 meters per second, as shown.

Calculate the speed of the 1.7 kilogram block after the spring is released.

Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve
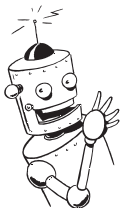
$m_1 =$

$m_2 =$

$v_{1,2o} =$

$v_{1f} =$

$v_{2f} =$

a) _____ ⟵ units

Name _____ Period _____ Date _____

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2. A monkey fires a 5 kg rifle. A 0.01 kg bullet leaves the muzzle of the rifle with a velocity of 420 m/s. Calculate the velocity of the rifle just after the bullet exits.

Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve

$m_1 =$

$m_2 =$

$v_{1,2o} =$

$v_{1f} =$

$v_{2f} =$

a) _____ ⟵ units

3. A 36.3 kg monkey is standing at rest on 2.5 kg skateboard when he decides to jumps off the skateboard sending him in one direction and the skateboard flies off in the opposite direction. If the monkey's final velocity is 0.5 m/s, calculate the magnitude of the skateboard's velocity just after the monkey jumps off.

Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve
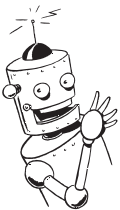
$m_1 =$

$m_2 =$

$v_{1,2o} =$

$v_{1f} =$

$v_{2f} =$

a) _____ ⟵ units

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4. A 82 kg gorilla and a 48 kg monkey are participating in pairs figure skating competition. The two are gliding across the ice at 7.4 m/s preparing for a throw maneuver. The gorilla tosses the monkey forward through the air. If the monkey's new speed is 8.6 m/s, calculate the gorilla's velocity immediately after he throws the monkey forward.

Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve
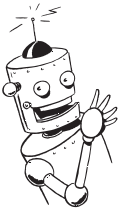
$m_1 =$

$m_2 =$

$v_{1,2o} =$

$v_{1f} =$

$v_{2f} =$

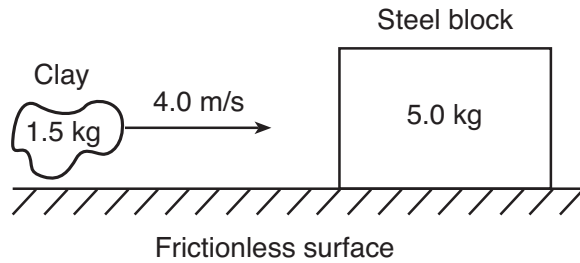a) _____ ⟵ units

Chapter 7   Momentum

5. A 5.0 kilogram block is at rest on a friction-less horizontal surface. A 1.5 kilogram lump of clay is thrown horizontally at 4.0 meters per second toward the block as shown in the diagram below.

Steel block

Clay

4.0 m/s

5.0 kg

1.5 kg

Frictionless surface

Upon the collision, the clay and block stick together and move to the right. What is the combined velocity of the clay and block together?

Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve
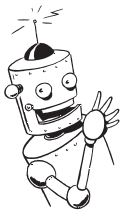
$m_1 =$

$m_2 =$

$v_{1o} =$

$v_{2o} =$

$v_{1,2f} =$

a) _____ ⟵ units

Chapter 7   Momentum

6. A 1000 kilogram empty cart moving with a speed of 6.0 meters per second is about to collide with a stationary loaded cart having a total mass of 5000 kilograms, as shown. After the collision, the carts lock and move off together. Calculate the speed of the combined carts after the collision.

$v_i = 6.0$ m/s $v_i = 0.0$ m/s

1000. kg   5000. kg

Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve
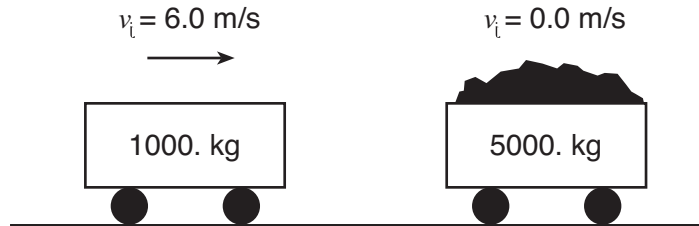
$m_1 =$

$m_2 =$

$v_{1o} =$

$v_{2o} =$

$v_{1,2f} =$

a) _____ ⟵ units

Chapter 7   Momentum

7. A 20,000 kg truck driven by a gorilla has a head on collision with a 1,500 kg car driven by a monkey. Just before impact the truck's speed was 5.00 m/s and the car's speed was -8.00 m/s in the opposite direction. If the truck and the car stick together after the collision, calculate the velocity of the wreckage immediately after the collision.

Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve

$m_1 =$

$m_2 =$

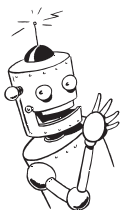$v_{1o} =$

$v_{2o} =$

$v_{1,2f} =$

a) _____ ⟵ units

8. A 0.068 kg bullet is shot from a gun. The bullet embeds itself into a stationary 2 kg block of wood sitting on a table. After the collision the bullet and the block are moving together at 4.93 m/s. Calculate the original speed of the bullet.

Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve
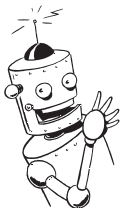
$m_1 =$

$m_2 =$

$v_{1o} =$

$v_{2o} =$

$v_{1,2f} =$

a) _____ ⟵ units

Chapter 7   Momentum

9. A 1100 kg car traveling north collides head-on with a 2500 kg van traveling south at 8.0 m/s. After the collision the vehicles lock together and travel south at 1.73 m/s. What was the original velocity of the 1100 kg car before the collision?

Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve

$m_1 =$

$m_2 =$

$v_{1o} =$

$v_{2o} =$

$v_{1,2f} =$

a) _____ ⟵——— units

10. A 7 kg bowling ball strikes a 1.5 kg bowling-pin head on. The pin flies off with a speed of 4 m/s and the bowling ball continues in the same direction at 2 m/s. What was the original speed of the bowling ball just before it hit the pin?

Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve
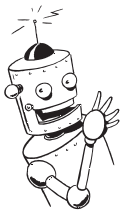
$m_1 =$

$m_2 =$

$v_{1o} =$

$v_{2o} =$

$v_{1f} =$

$v_{2f} =$

a) _____ ⟵——— units

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11. A monkey throws his 0.20 kg football in the living room and it knocks over his mother's 0.80 kg antique vase. After the collision, the football bounces straight back with a velocity of -3.9 m/s while the vase is moving at 2.6 m/s in the opposite direction. How fast did the monkey throw the football?

Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve

$m_1 =$

$m_2 =$

$v_{1o} =$

$v_{2o} =$

$v_{1f} =$

$v_{2f} =$

a) _____ ◄——— units

12. A bullet (0.01 kg) is fired at a speed of 520 m/s into a 0.4 kg wooden block that is initially at rest. The bullet passes through the block and leaves on the opposite side with a speed of 200 m/s. Calculate the final speed of the block after the collision.

Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve

$m_1 =$

$m_2 =$

$v_{1o} =$

$v_{2o} =$

$v_{1f} =$

$v_{2f} =$

a) _____ ◄——— units