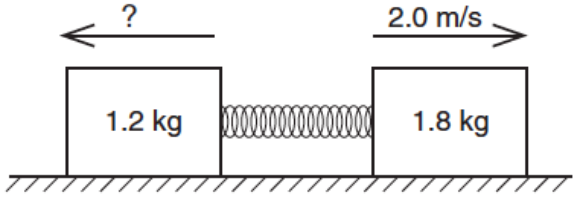
Name: _____ Period: _____

Momentum-Conservation

1. A 1.2-kilogram block and a 1.8-kilogram block are initially at rest on a frictionless, horizontal surface. When a compressed spring between the blocks is released, the 1.8-kilogram block moves to the right at 2.0 meters per second, as shown.



What is the speed of the 1.2-kilogram block after the spring is released?
1. 1.4 m/s
2. 2.0 m/s
3. 3.0 m/s
4. 3.6 m/s

Base your answers to questions 2 and 3 on the information below.

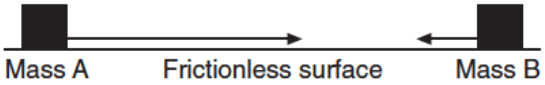
An 8.00-kilogram ball is fired horizontally from a 1.00 × 10^3-kilogram cannon initially at rest. After having been fired, the momentum of the ball is 2.40 × 10^3 kilogram·meters per second east. [Neglect friction.]

2. Calculate the magnitude of the cannon's velocity after the ball is fired. [Show all work, including the equation and substitution with units.]

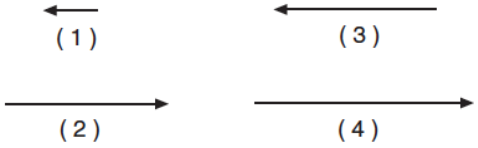
3. Identify the direction of the cannon's velocity after the ball is fired.

4. Ball A of mass 5.0 kilograms moving at 20 meters per second collides with ball B of unknown mass moving at 10 meters per second in the same direction. After the collision, ball A moves at 10 meters per second and ball B at 15 meters per second, both still in the same direction. What is the mass of ball B?
1. 6.0 kg
2. 2.0 kg
3. 10 kg
4. 12 kg

5. In the diagram below, scaled vectors represent the momentum of each of two masses, A and B, sliding toward each other on a frictionless, horizontal surface.



Which scaled vector best represents the momentum of the system after the masses collide?



6. At the circus, a 100-kilogram clown is fired 15 meters per second from a 500-kilogram cannon. What is the recoil speed of the cannon?
1. 75 m/s
2. 15 m/s
3. 3.0 m/s
4. 5.0 m/s

7. A woman with horizontal velocity v_1 jumps off a dock into a stationary boat. After landing in the boat, the woman and the boat move with velocity v_2. Compared to velocity v_1, velocity v_2 has
1. the same magnitude and the same direction
2. the same magnitude and the opposite direction
3. smaller magnitude and the same direction
4. larger magnitude and the same direction

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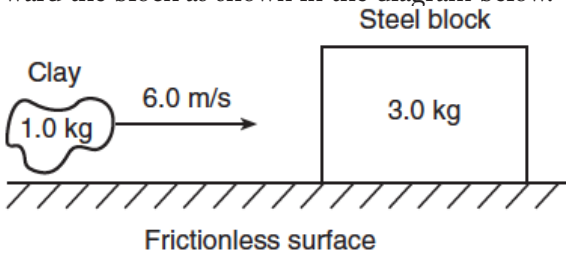
Momentum-Conservation

8. On a snow-covered road, a car with a mass of 1.1×10^3 kilograms collides head-on with a van having a mass of 2.5×10^3 kilograms traveling at 8.0 meters per second. As a result of the collision, the vehicles lock together and immediately come to rest. Calculate the speed of the car immediately before the collision. [Neglect friction.] [Show all work, including the equation and substitution with units.]

9. A 3.0-kilogram steel block is at rest on a frictionless horizontal surface. A 1.0-kilogram lump of clay is propelled horizontally at 6.0 meters per second toward the block as shown in the diagram below.



Upon collision, the clay and steel block stick together and move to the right with a speed of
1. 1.5 m/s
2. 2.0 m/s
3. 3.0 m/s
4. 6.0 m/s

10. A 1.0-kilogram laboratory cart moving with a velocity of 0.50 meter per second due east collides with and sticks to a similar cart initially at rest. After the collision, the two carts move off together with a velocity of 0.25 meter per second due east. The total momentum of this frictionless system is
1. zero before the collision
2. zero after the collision
3. the same before and after the collision
4. greater before the collision than after the collision.

11. Which two quantities can be expressed using the same units?
1. energy and force
2. impulse and force
3. momentum and energy
4. impulse and momentum

12. A 3.1-kilogram gun initially at rest is free to move. When a 0.015-kilogram bullet leaves the gun with a speed of 500 meters per second, what is the speed of the gun?
1. 0.0 m/s
2. 2.4 m/s
3. 7.5 m/s
4. 500 m/s

Base your answers to questions 13 and 14 on the information below. Show all work, including the equation and substitution with units.

A 1200-kilogram car moving at 12 meters per second collides with a 2300-kilogram car that is waiting at rest at a traffic light. After the collision, the cars lock together and slide. Eventually, the combined cars are brought to rest by a force of kinetic friction as the rubber tires slide across the dry, level asphalt road surface.

13. Calculate the speed of the locked-together cars immediately after the collision.

14. Calculate the magnitude of the frictional force that brings the locked-together cars to rest.

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Momentum-Conservation

15. The diagram below represents two masses before and after they collide. Before the collision, mass m_A is moving to the right with speed v, and mass m_B is at rest. Upon collision, the two masses stick together.

Which expression represents the speed, v', of the masses after the collision? [Assume no outside forces are acting on m_A or m_B.]

(1) $\frac{m_A + m_B v}{m_A}$

(2) $\frac{m_A + m_B}{m_A v}$

(3) $\frac{m_B v}{m_A + m_B}$

(4) $\frac{m_A v}{m_A + m_B}$

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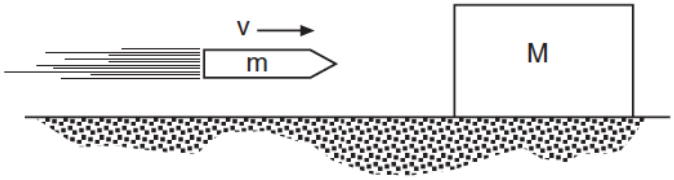
16. In the diagram below, a block of mass M initially at rest on a frictionless horizontal surface is struck by a bullet of mass m moving with a horizontal velocity v.



What is the velocity of the bullet-block system after the bullet embeds itself in the block?

(1) $\left(\frac{M+v}{M}\right)m$

(2) $\left(\frac{m+M}{m}\right)v$

(3) $\left(\frac{m+v}{M}\right)m$

(4) $\left(\frac{m}{m+M}\right)v$

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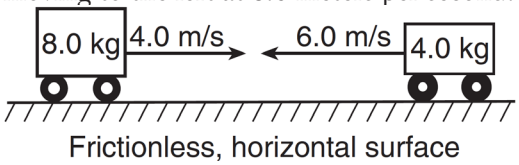
17. When a 1.0-kilogram cart moving with a speed of 0.50 meter per second on a horizontal surface collides with a second 1.0-kilogram cart initially at rest, the carts lock together. What is the speed of the combined carts after the collision? [Neglect friction.]
    1. 1.0 m/s
    2. 0.50 m/s
    3. 0.25 m/s
    4. 0 m/s

18. The diagram below shows an 8.0-kilogram cart moving to the right at 4.0 meters per second about to make a head-on collision with a 4.0-kilogram cart moving to the left at 6.0 meters per second.



After the collision, the 4.0-kilogram cart moves to the right at 3.0 meters per second. What is the velocity of the 8.0-kilogram cart after the collision?
    1. 0.50 m/s left
    2. 0.50 m/s right
    3. 5.5 m/s left
    4. 5.5 m/s right

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Momentum-Conservation

19. A 7.28-kilogram bowling ball traveling 8.50 meters per second east collides head-on with a 5.45-kilogram bowling ball traveling 10.0 meters per second west. Determine the magnitude of the total momentum of the two-ball system after the collision.