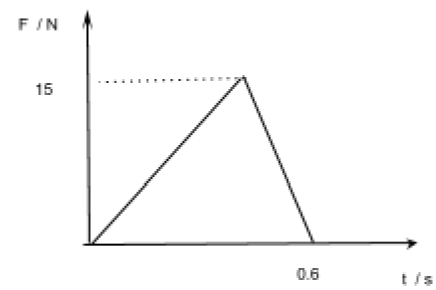
More Momentum

1. A 0.250 kg ball is travelling 10.0 m s^{-1} when it hits a wall. The magnitude of the force of the wall on the ball is described by the graph at the right.
    a. Calculate the initial momentum of the ball.
    b. Calculate the impulse on the ball.
    c. Determine the final momentum of the ball.
    d. Determine the final velocity of the ball.



2. Two blocks are sliding towards each other on a level frictionless surface. The first block has a mass of 5.0 kg and initial velocity of 10 ms^{-1}. The second block has a mass of 7.0 kg. Upon impact, the blocks stick together and stop. Calculate the initial velocity of the second block.

3. A .05 kg bullet travelling at 370 m s^{-1} is fired into a 5 kg block at rest on a level frictionless surface. The bullet remains in the block. Calculate the final velocity of the system.

4. A 100 kg running back is travelling 8.0 m s^{-1} when he is tackled by a 120 kg linebacker who is traveling 7.0 m s^{-1} in the opposite direction. The linebacker holds on to the running back so they move away together as one.
    a. Calculate their final velocity.
    b. Determine the amount of energy dissipated in the collision.
    c. Describe the forms this energy takes.

5. A 3000 kg railroad car is moving along a track with an initial velocity of 2.0 m s^{-1}. On its path, sand falls into the car at a rate of 200 kg s^{-1}.
    a. If no other forces are acting horizontally, calculate the cart’s velocity 10.0 s after sand begins to fall into the car.
    b. Write an expression for the cart’s velocity at a time t seconds after sand begins to fall into the cart.
    c. Determine the force needed to keep the cart traveling at a constant speed.

6. A 0.05 kg bullet travelling at 300 m s^{-1} is fired through a 3 kg block, coming out the other side at 200 m/s.
    a. Calculate the final velocity of the block.
    b. Determine the amount of energy “lost” during the collision.
    c. Describe where the energy goes.

7. A 3.0 kg block is sliding across a frictionless surface at 10 m s^{-1} when it hits a 2.0 kg block that is initially at rest. After the collision, the 3.0 kg block travels 4.0 m s^{-1}.
    a. Calculate the final velocity of the 2.0 kg block.
    b. Describe the type of collision.

8. A 10 kg block traveling at 2.0 m/s collides elastically with a 2.0 kg block traveling 4.0 m/s in the opposite direction.
    a. Calculate the total initial momentum of the system.
    b. Calculate the total initial kinetic energy of the system.
    c. Determine the final velocity of each block after the collision.

9. A 2.0 kg mass traveling at 12 m s^{-1} collides with a 6.0 kg stationary object. Given the collision is elastic, determine the final velocity of each of the objects.

10. A cue ball is travelling 5 m s^{-1} along the x-axis when it strikes a stationary 8-ball of equal mass. The 8-ball leaves with a velocity of 3 m s^{-1} at 30° from the line of motion the cue ball was traveling.
    a. Calculate the final x-velocity of the cue ball.
    b. Calculate the final y-velocity of the cue ball.
    c. Determine the final speed of the cue ball.
    d. State the final direction of the cue ball.

11. A radioactive nucleus at rest decays into a second nucleus, an electron, and a neutrino. The electron and neutrino are emitted at right angles and have momenta of 9.6×10^{-23} kg m s^{-1} and 6.2×10^{-23} kg m s^{-1}, respectively. Determine the magnitude and the direction of the momentum of the second recoiling nucleus.

12. A 2000 kg truck is driving 15 m s^{-1} to the east when it enters the intersection. Immediately after it enters the intersection, it is hit by a 1200 kg car that ran a stoplight. The two vehicles lock bumpers and move away together at 60 degrees North of East.
    a. Determine the final speed of the combination.
    b. Calculate the original velocity of the car.

13. A 0.05 kg bullet is fired at 300 m s^{-1} into a 5.0 kg block that is hanging from a 1.0 meter rope.
    a. Calculate the velocity of the block after the collision.
    b. Determine the maximum height of the block.
    c. Determine the maximum angle the pendulum makes to the vertical.

14. A 980 kg sports car collides into the rear end of a 2300 kg SUV stopped at a red light. The bumpers lock, the brakes are locked, and the two cars skid forward 2.6 m before stopping. The police officer estimates the coefficient of kinetic friction to be 0.80.
    a. Calculate the force of friction on the system of cars.
    b. Calculate the kinetic energy of the system immediately after the collision.
    c. Calculate the speed of the system immediately after the collision.
    d. Calculate the speed of the sports car at the time of impact.