

AP Physics 1
Impulse and Momentum Practice Problems

- 1.) A 0.144 kg baseball is pitched horizontally at +38 m/s. After it is hit by a bat, it moves horizontally at -38 m/s.
 - a.) What impulse did the bat deliver to the ball?
 - b.) If the bat and ball were in contact for 0.80 ms, what was the average force the bat exerted on the ball?

- 2.) Rat hits a stationary 0.12 kg hockey puck with a force that lasts for 1.0×10^{-2} s and makes the puck shoot across the ice with a speed of 20.0 m/s, scoring a goal for her team. With what force did Rat hit the puck?

- 3.) Larry hits a 0.050 kg golf ball, giving it a speed of 75 m/s. What impulse does he impart to the ball?

- 4.) A 0.060 kg tennis ball traveling at 10.0 m/s is returned by Laura. It leaves her racket with a speed of 36.0 m/s in the opposite direction from where it came.
 - a.) What is the change in momentum of the tennis ball?
 - b.) If the ball is in contact with the racket for 0.020 s, with what average force did Laura hit the ball?

- 5.) A 10,000 kg freight car is rolling along a track at 3.00 m/s. Find the time needed for a force of 1000 N to stop the car.

- 6.) A 0.200 kg baseball is traveling at 40.0 m/s. The ball is struck by a bat that exerts an average force of -9000 N during the 0.002 seconds in which it is in contact with the ball. Find the velocity of the batted ball.

- 7.) A 1 kg hammer slams down on a nail at 5.0 m/s and bounces off at 1.0 m/s. If the impact lasts 1.0 ms, what average force is exerted on the nail?

- 8.) A 2.4 kg ball falling vertically hits the floor with a speed of 2.5 m/s and rebounds with a speed of 1.5 m/s.
 - a.) What is the magnitude of the impulse exerted on the ball by the floor?
 - b.) If the ball is contact with the floor for 5.0 ms, what is the magnitude of the force exerted by the floor?

- 9.) A 0.16 kg baseball is thrown with a speed of 40 m/s. It is hit straight back at the pitcher with a speed of 80 m/s. What is the magnitude of the impulse exerted on the ball by the bat?

- 10.) An 8.0 kg object moving 4.0 m/s in the positive x -direction has a one-dimensional collision with a 2.0 kg object moving 3.0 m/s in the opposite direction. The final velocity of the 8.0 kg object is 2.0 m/s in the positive x -direction.
 - a.) What is the velocity of the 2.0 kg object following the collision?
 - b.) What is the total kinetic energy of the two-mass system after the collision?

- 11.) A 2.0 kg object moving with a velocity of 5.0 m/s in the positive x -direction strikes and sticks to a 3.0 kg object moving with a speed of 2.0 m/s in the same direction.
 - a.) What is the speed of the objects following the collision?
 - b.) How much kinetic energy is lost in the collision?

- 12.) A 2400 kg van runs into the back of a 600 kg compact car at rest. They move off together at 10 m/s. Assuming no friction with the ground, find the initial speed of the van.

- 13.) A railroad car with a mass of 10,000 kg is coasting along at 20 m/s. It strikes a second car, initially at rest, with a mass of 15,000 kg. The cars couple and move off together. Find the change in kinetic energy.
- 14.) A 10 kg block, initially at rest, explodes into two pieces. If a 4.0 kg piece moves toward the east at 12 m/s, find the velocity of the second piece.
- 15.) A 6.0 kg object is moving east at 5.0 m/s when it collides with and sticks to a 2.0 kg object. After the collision the composite object is moving west at 2.0 m/s. Determine the velocity of the 2.0 kg object before the collision.
- 16.) A 5.0 kg object with a speed of 4.0 m/s collides head-on with a 10 kg object moving toward it with a speed of 3.0 m/s.
- If the 10 kg object stops after the collision, what is the final speed of the 5.0 kg object?
 - Is this an elastic or inelastic collision?
- 17.) Two identical balls with masses of 0.17 kg collide head on. The initial velocity of one is 4.0 m/s, while that of the other is -3.0 m/s. If the collision is perfectly elastic, what is the final velocity of each ball?
- 18.) Two objects collide head on in a perfectly elastic collision. The first object has a mass of 5.0 kg and an initial velocity of 4.0 m/s. The second object has a mass of 3.0 kg and is initially at rest. Find the final velocities of both objects.
- 19.) Two objects collide head-on in a perfectly elastic collision. The first object has a mass of 6.0 kg and an initial velocity of 4.0 m/s. The second object has a mass of 4.0 kg and an initial velocity of -6.0 m/s. Find the final velocities of both objects.
- 20.) Two objects collide in a perfectly elastic collision. The first object has a mass of 3.0 kg and an initial velocity of 7.0 m/s. The second object has a mass of 6.0 kg and an initial velocity of 4.0 m/s. Find the final velocities of both objects.