

Conservation of Momentum

1. A freight train having 85 cars in all including the engine, each of which has a mass of 8.0×10^4 kg, is moving down the track at 0.50 m/s. (a) What is the momentum of the train?
(b) What impulse would have to be put on the train in order to stop it?
(c) What impulse was given to the train in the first place in order to get it up to speed?
2. How long must an unbalanced force of 500 N act on a 1500 kg car in order to increase its speed from 5.0 m/s to 15 m/s?
3. A ball that weighs 2.3 N is moving at a velocity of 15 m/s when it is hit by a bat causing it to move in the opposite direction at 30 m/s. Find the force exerted by the bat if the blow lasts for 0.01 seconds.
4. A car of mass 1400 kg crashes into a solid wall and is stopped in 0.50 seconds. If the car was travelling 5.0 m/s when it hit the wall,
(a) What is the force of the wall on the car?
(b) What is the force of the car on the wall?
(c) What impulse did the car put on the wall?
5. A 150 gram baseball travelling 30 m/s is stopped by a Catcher's mitt in 0.050 seconds. What force must the Catcher exert while stopping the ball?
6. If a bullet of mass 50 grams is moving at 400 m/s when it encounters a retarding force of 3000 N, find (a) the time required to stop the bullet and (b) the distance it will go in that time.
7. A small red cart of mass 2.0 kg is travelling west at 4.0 m/s when it collides "head-on" with a blue cart of mass 5.0 kg travelling east at 3.0 m/s. If the carts remain stuck together after the collision, find:
(a) the common velocity after the collision
(b) the impulse on the red cart.
8. A 4000 kg truck travelling east at 8.0 m/s hits a 2500 kg car travelling west at 6.0 m/s. If they lock bumpers, find the common velocity after the collision.
9. A 16 gram bullet is fired into a 484 gram block of wood resting on a large ice surface. If the bullet strikes the wood horizontally at 80 m/s and remains in the wood after impact,
(a) what will be the velocity of the wood after impact?
(b) What impulse will the ice put on the block in getting it stopped?
10. A plastic ball having a mass of 250 grams and a velocity of 20.0 cm/s east collides with another ball having a mass of 100 g moving along the same line, also east, but at 10.0 cm/s. After the collision, the 250 g ball has a velocity of 15.0 cm/s east.
(a) What is the velocity of the other ball?
(b) What impulse does the 100 g ball put on the other one?
(c) What impulse does the 250 g ball put on the other one?
11. A 40,000 kg loaded freight car moving at 1.00 m/s eastward on a level track strikes and becomes coupled to an empty freight car of mass 10,000 kg moving westward at 0.50 m/s. Calculate:
(a) the common velocity after the collision.
(b) the impulse on the loaded freight car.
(c) the impulse on the empty freight car.

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12. A blue cart (mass 6.0 kg) is travelling 12 m/s east. It collides with a red cart (mass 10 kg) moving 2.8 m/s in the same direction. After the collision, the blue cart continues moving east at 2.0 m/s. Calculate:
- the velocity of the red cart after the collision.
 - the impulse on the blue cart.
 - the net force on the blue cart if the impulse lasts 0.30 s.
13. A 10 kg object moving north at 6.0 m/s collides with a 20 kg object moving south at 4.0 m/s. After the collision the first object rebounds at 4.0 m/s. Calculate:
- the velocity of the second object after the collision.
 - the impulse on the 10 kg object.
 - the net force on the 10 kg object if the impulse lasts 0.200
14. A red ball of mass 2.00 kg is moving east at 10.0 m/s. It collides with a blue ball that is also travelling east but at a speed of 4.00 m/s. Because of the collision, the blue ball's speed increases to 7.00 m/s while the red ball reverses direction and travels at 5.00 m/s. Calculate: (a) the mass of the blue ball.
- the initial momentum of the red ball.
 - the impulse on the red ball.
15. A space explorer finds himself some distance from the space vehicle with no motion between himself and the vehicle. He throws a hammer of mass 2.0 kg away from himself in a direction opposite to that of the space vehicle at a speed of 15 m/s. If his mass is 100 kg., what is his resulting velocity?
16. A 90 kg cart is moving east at 5.0 m/s when it collides head on with a 50 kg cart which was initially moving west at 3.0 m/s. If they become entangled together, calculate their common velocity after the collision.
17. A stationary bowling ball of unknown mass is hit head on by another hard ball of mass 2.5 kg moving to the right at 3.0 m/s. The 2.5 kg ball rebounds with a velocity of 2.0 m/s and the bowling ball moves to the right at 4.0 m/s. What is the mass of the bowling ball?
18. Two swimmers simultaneously dive off the opposite ends of a 50 kg canoe initially at rest. If A has a mass of 80 kg and dives off the front with a velocity of 3.0 m/s and B has a mass of 70 kg and dives off the back with a velocity of 4.0 m/s, what is the velocity of the canoe?
19. A 15 kg body is moving north at 2.0 m/s. It collides with and becomes coupled to a second body of mass 25 kg moving west at 4.0 m/s. Calculate their velocities after the collision.