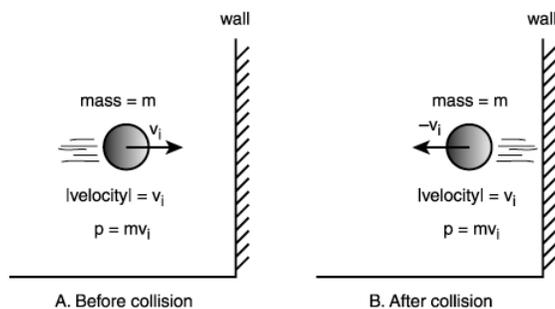


AP Physics 1
Target Quiz

Momentum Transfer, Conservation and Collisions



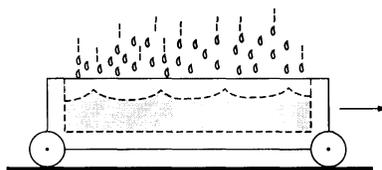
1. A ball is thrown at a wall and rebounds in the opposite direction with the same speed. Which of the following statements about this situation are false?
 - a. The ball's total momentum is conserved during the impact.
 - b. The magnitude of the ball's force on the wall is equal to the magnitude of the wall's force on the ball.
 - c. The ball and wall impart identical impulses during the impact.
 - d. The wall's momentum change is actually zero as a result of the impact.

2. A mass m has speed v . It then collides with a stationary object of mass $2m$. If both objects stick together in a perfectly inelastic collision, what is the final speed of the newly formed object?

(A) $v/3$ (B) $v/2$ (C) $2v/3$ (D) v (E) $3v/2$

3. An object of mass M travels along a horizontal air track at a constant speed v and collides elastically with an object of identical mass that is initially at rest on the track. Which of the following statements is true for the two objects after the impact?

(A) The total momentum is Mv and the total kinetic energy is $\frac{1}{2} Mv^2$
 (B) The total momentum is Mv and the total kinetic energy is less than $\frac{1}{2} Mv^2$
 (C) The total momentum is less than Mv and the total kinetic energy is $\frac{1}{2} Mv^2$
 (D) The momentum of each object is $\frac{1}{2} Mv$
 (E) The kinetic energy of each object is $\frac{1}{4} Mv^2$



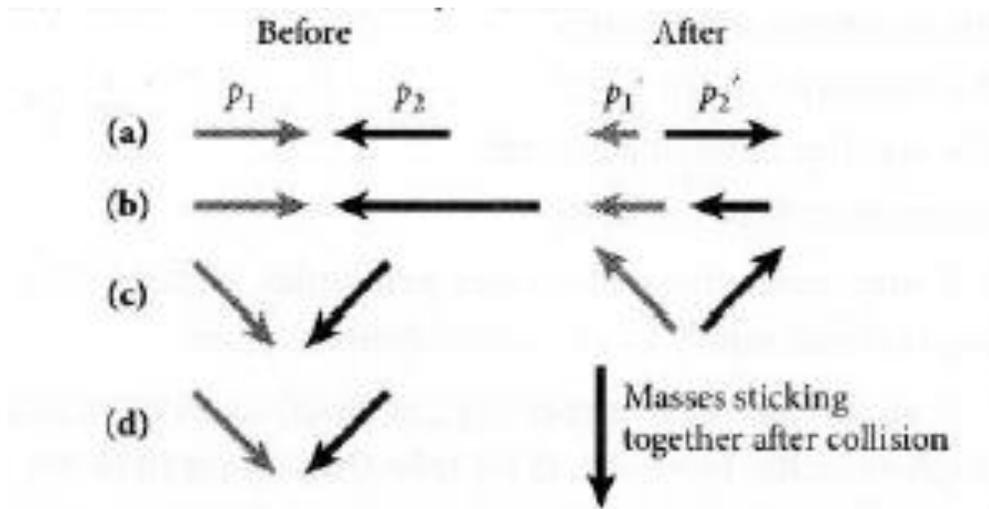
4. An open cart on a level surface is rolling without frictional loss through a vertical downpour of rain, as shown above. As the cart rolls, an appreciable amount of rainwater accumulates in the cart. The speed of the cart will

(A) increase because of conservation of momentum	(B) increase because of conservation of mechanical energy
(C) decrease because of conservation of momentum	(D) decrease because of conservation of mechanical energy
(E) remain the same because the raindrops are falling perpendicular to the direction of the cart's motion	

5. Which of the following statements concerning collisions is (are) true?

- Inelastic collisions conserve momentum, but not total energy.
- Elastic collisions conserve neither momentum, not kinetic energy.
- The laws of physics demand that both elastic and inelastic collisions conserve momentum.

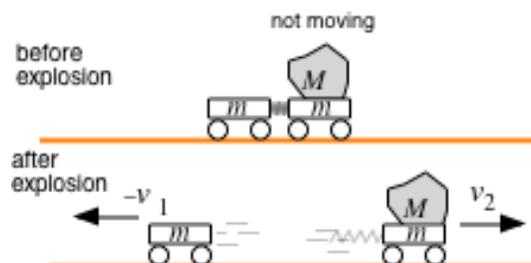
6. Two masses collide. Which of the following sets of **Before** – **After** momentum vectors violate the law of momentum conservation?



7. Which of the following is true when an object of mass m moving on a horizontal frictionless surface hits and sticks to an object of mass $M > m$, which is initially at rest on the surface?

- The collision is elastic.
- All of the initial kinetic energy of the less massive object is lost.
- The momentum of the objects that are stuck together has a smaller magnitude than the initial momentum of the less-massive object.
- The speed of the objects that are stuck together will be less than the initial speed of the less massive object.
- The direction of motion of the objects that are stuck together depends on whether the hit is a head-on collision.

8. Consider the situation shown below in which the initial momentum of the cart system is zero. When the two carts explode by means of a compressed spring they recoil in opposite directions.



Which must be true regarding this event?

- $V_2 = (V_1 M) / m$
- $V_2 = V_1$
- $V_2 = (M + m) / mV_1$
- $V_2 = mV_1 / (M + m)$
- None of the above choices are correct

Answers and Solutions

1. The choices a, c and d are false.

a-False because the ball's momentum was changed. Although its speed remained unchanged, its momentum changed..from being initially positive to negative after the interaction with the wall.

c-False because the impulses are equal in magnitude only..not in direction, so they are not identical.

d-False because the wall does have a change in momentum, but since it attached to the Earth, which has a very, very, very, very, very great mass compared to the ball, its momentum change is not observed..but it's there!

2. The correct answer is a.

Applying momentum conservation yields the following derivation:

$$m_1 v_{1i} = m_{\text{tot}}(v_f)$$

$$(m)(v) = (3m) v_f \quad \text{Cancelling the m and dividing out gives } v/3 = v_f$$

3. The correct answer is a.

Since it is an elastic collision, the energy after must equal the energy before, and in all collisions total momentum before equals total momentum after. So if we simply find both the energy before and the momentum before, these have the same values after as well.

$$p = Mv, K = \frac{1}{2} Mv^2$$

4. The correct answer is c.

As the cart moves forward it gains mass due to the rain but in the x direction the rain does not provide any impulse to speed up the car so its speed must decrease to conserve momentum.

5. The correct answer is c.

a-is False: Inelastic collisions conserve momentum and total energy, but not total kinetic energy.

b-is False: Elastic collisions conserve momentum, total energy and total kinetic energy.

c-True: All collisions conserve momentum as long as no external impulses are imparted to the system.

6. The correct answer is c.

When the y-axis vector components of the **Before** momentums are added we get a total negative y-axis momentum. When the y-axis vector components of the **After** momentums are added we get a total positive y-momentum. This is a violation of the law since momentum along each axis must be conserved in both magnitude AND direction.

7. The correct answer is d.

In an inelastic collision with one of the objects at rest, the speed after will always be less no matter what the masses. The 'increase' of mass in 'mv' is offset by a decrease in velocity. If the masses do not hit head-on then they will rebound with angles as in billiard balls.

8. The correct answer is d.

Apply momentum conservation:

Before the collision total P is 0

$$0 = -m V_1 + V_2 (M + m)$$

Solving for V_2 gives:

$$V_2 = mV_1 / (M + m)$$