ConcepTest 9.2a Momentum and KE I

A system of particles is known to have a total kinetic energy of zero. What can you say about the total momentum of the system?

1) momentum of the system is positive
2) momentum of the system is positive
3) momentum of the system is zero
4) you cannot say anything about the momentum of the system

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4) you cannot say anything about the momentum of the system

Since the total kinetic energy is zero, this means that all of the particles are at rest ($v = 0$). Therefore, since nothing is moving, the total momentum of the system must also be zero.

ConcepTest 9.2b Momentum and KE II

A system of particles is known to have a total momentum of zero. Does it necessarily follow that the total kinetic energy of the system is also zero?

1) yes
2) no

ConcepTest 9.2b Momentum and KE II

A system of particles is known to have a total momentum of zero. Does it necessarily follow that the total kinetic energy of the system is also zero?

1) yes
2) no

Momentum is a vector, so the fact that $p_{tot} = 0$ does not mean that the particles are at rest! They could be moving such that their momenta cancel out when you add up all of the vectors. In that case, since they are moving, the particles would have non-zero KE.

ConcepTest 9.2c Momentum and KE III

Two objects are known to have the same momentum. Do these two objects necessarily have the same kinetic energy?

1) yes
2) no

ConcepTest 9.2c Momentum and KE III

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1) yes
2) no

If object #1 has mass m and speed v and object #2 has mass 1/2 m and speed 2v, they will both have the same momentum. However, since KE = 1/2 mv^2, we see that object #2 has twice the kinetic energy of object #1, due to the fact that the velocity is squared.

ConcepTest 9.15 Gun Control

When a bullet is fired from a gun, the bullet and the gun have equal and opposite momenta. If this is true, then why is the bullet deadly? (whereas it is safe to hold the gun while it is fired)

1) it is much sharper than the gun
2) it is smaller and can penetrate your body
3) it has more kinetic energy than the gun
4) it goes a longer distance and gains speed
5) it has more momentum than the gun

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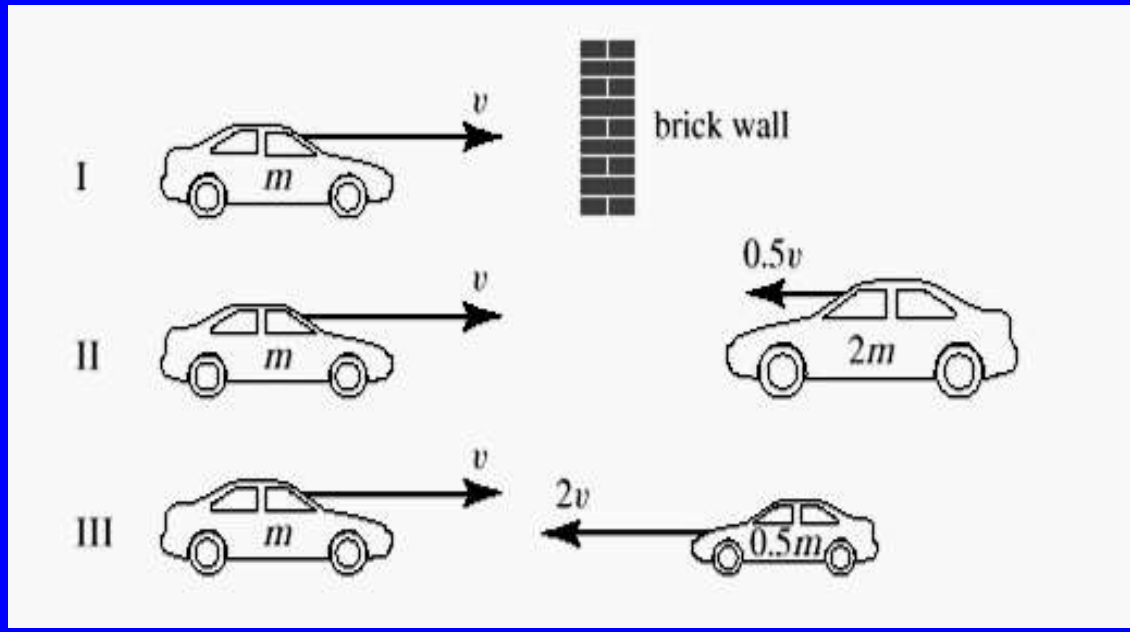
While it is true that the magnitudes of the momenta of the gun and the bullet are equal, the bullet is less massive and so it has a much higher velocity. Since KE is related to v^2, the bullet has considerably more KE and therefore can do more damage on impact.

ConcepTest 9.16a Crash Cars I

If all three collisions below are **totally inelastic**, which one(s) will bring the car on the left to a complete halt?

1) I
2) II
3) I and II
4) II and III
5) all three



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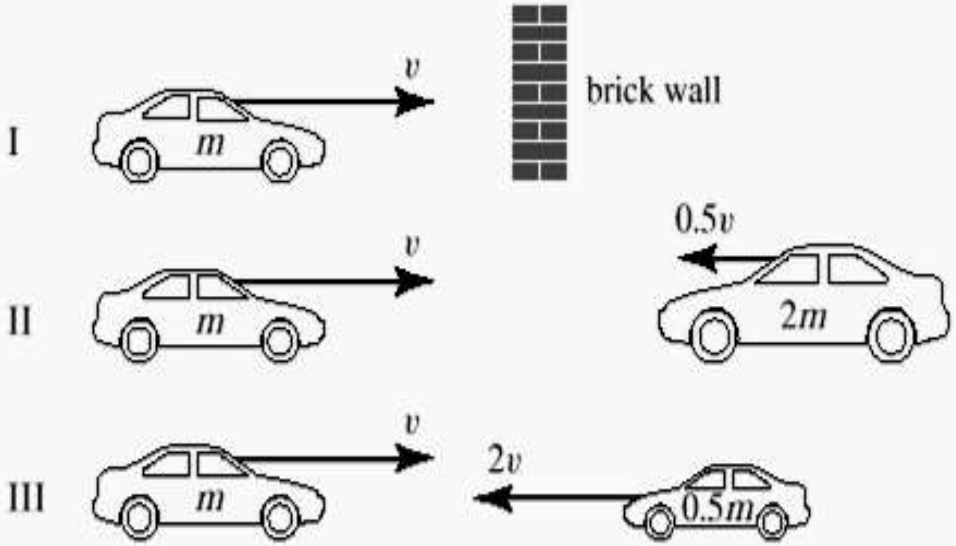
1) I
2) II
3) I and II
4) II and III
5) all three

In case I, the solid wall clearly stops the car.

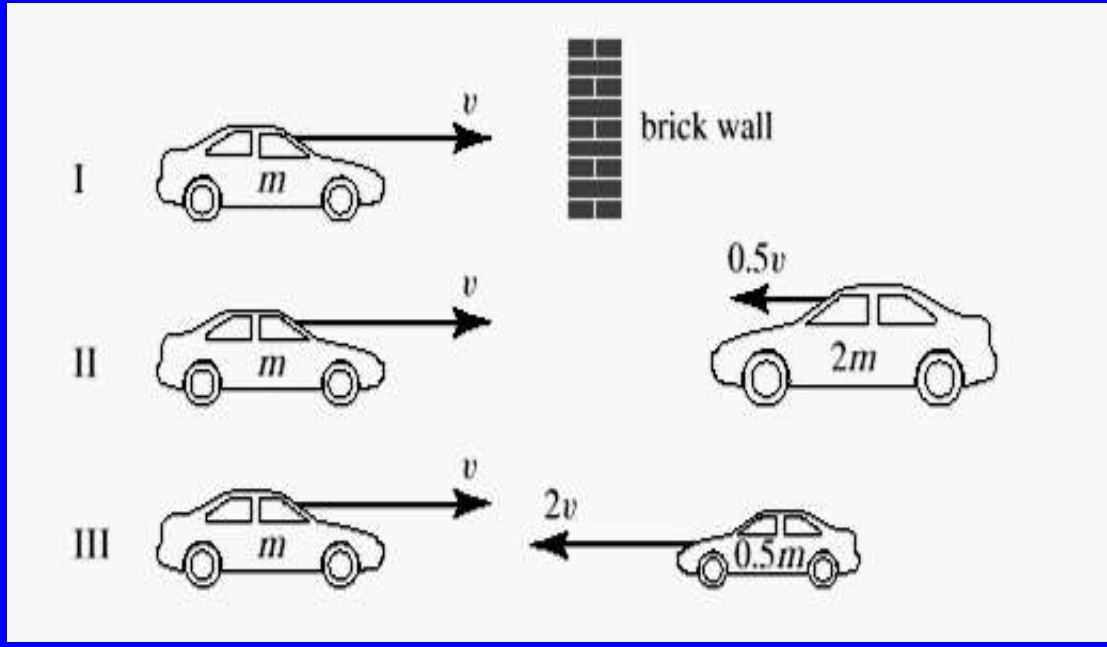
In cases II and III, since $p_{tot} = 0$ before the collision, then p_{tot} must also be zero after the collision, which means that the car comes to a halt in all three cases.



ConcepTest 9.16b Crash Cars II

If all three collisions below are **totally inelastic**, which one(s) will cause the most damage (in terms of lost energy)?

1) I
2) II
3) III
4) II and III
5) all three



ConcepTest 9.16b Crash Cars II

If all three collisions below are totally inelastic, which one(s) will cause the most damage (in terms of lost energy)?

1) I
2) II
3) III
4) II and III
5) all three

The car on the left loses the same KE in all 3 cases, but in case III, the car on the right loses the most KE because $KE = 1/2\ m\ v^2$ and the car in case III has the largest velocity.