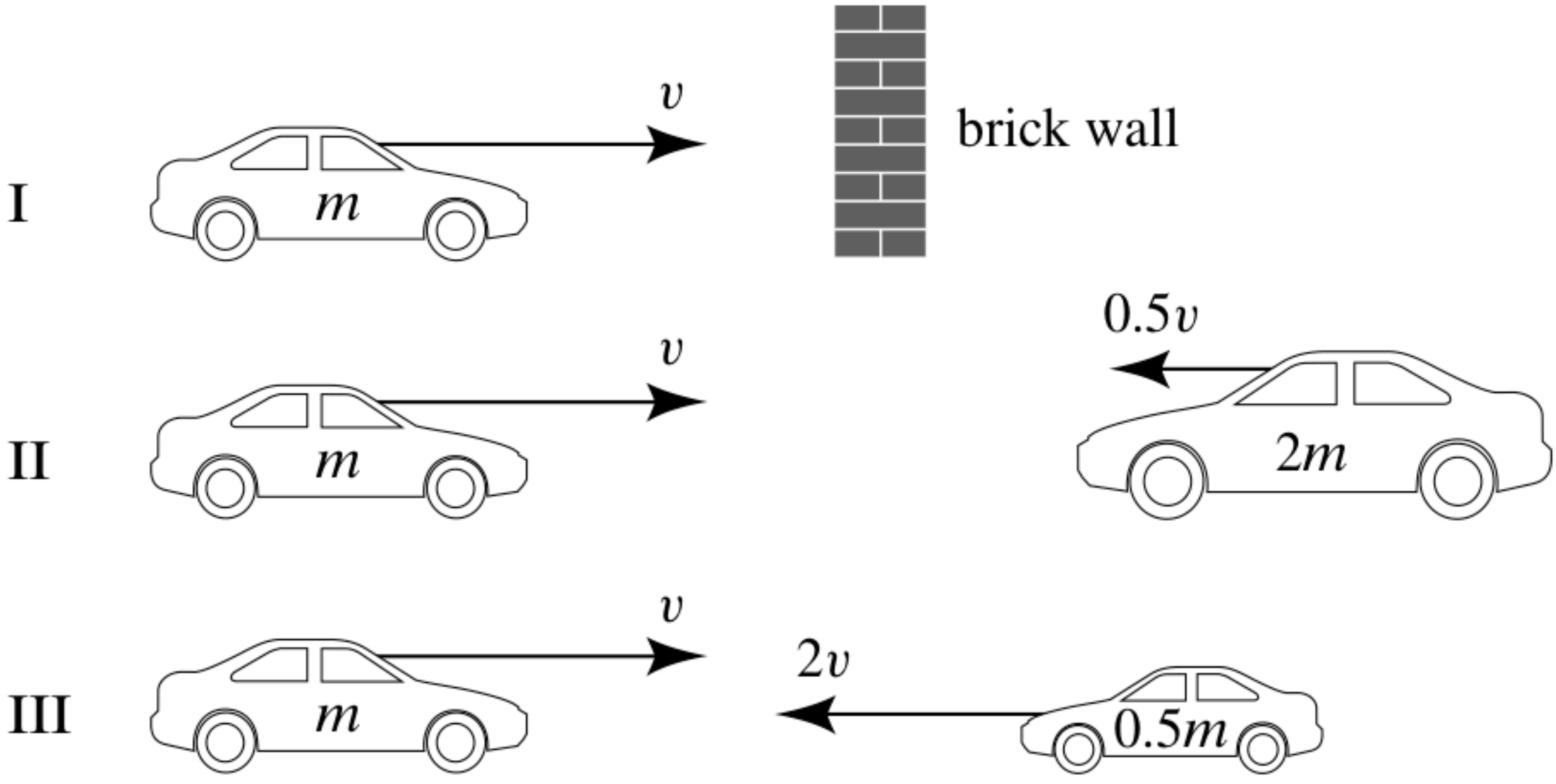
Momentum & Center of Mass

If all three collisions in the figure shown here are totally inelastic, which bring(s) the car on the left to a halt?

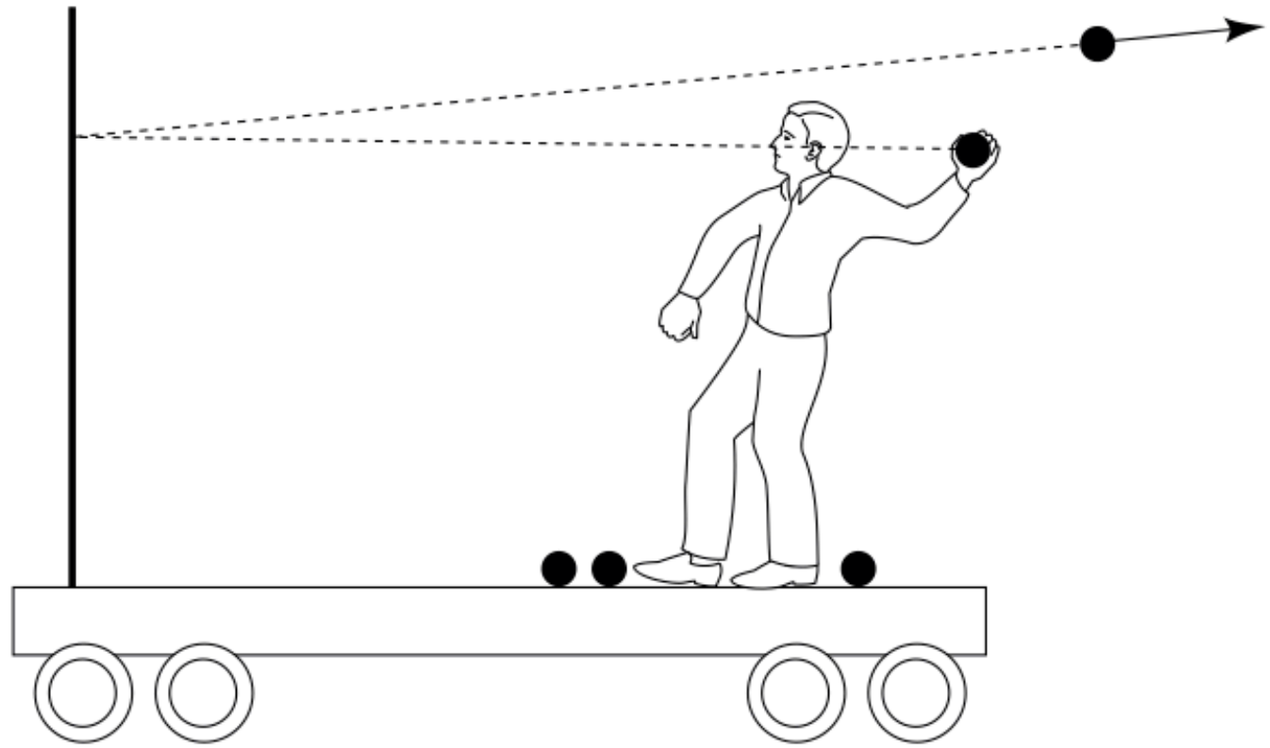


1. I 2. II 3. III 4. I,II 5. I,III 6. II,III 7. all three

Think fast! You've just driven around a curve in a narrow, one-way street at 25 mph when you notice a car identical to yours coming straight toward you at 25 mph.You have only two options: hitting the other car head on or swerving into a massive concrete wall, also head on. In the split second before the impact, you decide to

(1) hit the other car.
(2) hit the wall.
(3) hit either one—it makes no difference.
(4) consult your lecture notes.

Suppose you are on a cart, initially at rest on a track with very little friction. You throw balls at a partition that is rigidly mounted on the cart. If the balls bounce straight back as shown in the figure, is the cart put in motion?



1. Yes, it moves to the right.
2. Yes, it moves to the left.
3. No, it remains in place.

Suppose the entire population of the world gathers in one spot and, at the sounding of a prearranged signal, everyone jumps up. While all the people are in the air, does Earth gain momentum in the opposite direction?

(1) No; the inertial mass of Earth is so large that the planet's change in motion is imperceptible.
(2) Yes; because of its much larger inertial mass, however, the change in momentum of Earth is much less than that of all the jumping people.
(3) Yes; Earth recoils, like a rifle firing a bullet, with a change in momentum equal to and opposite that of the people.
(4) It depends.

Suppose rain falls vertically into an open cart rolling along a straight horizontal track with negligible friction. As a result of the accumulating water, the kinetic energy of the cart:

(1) increases.

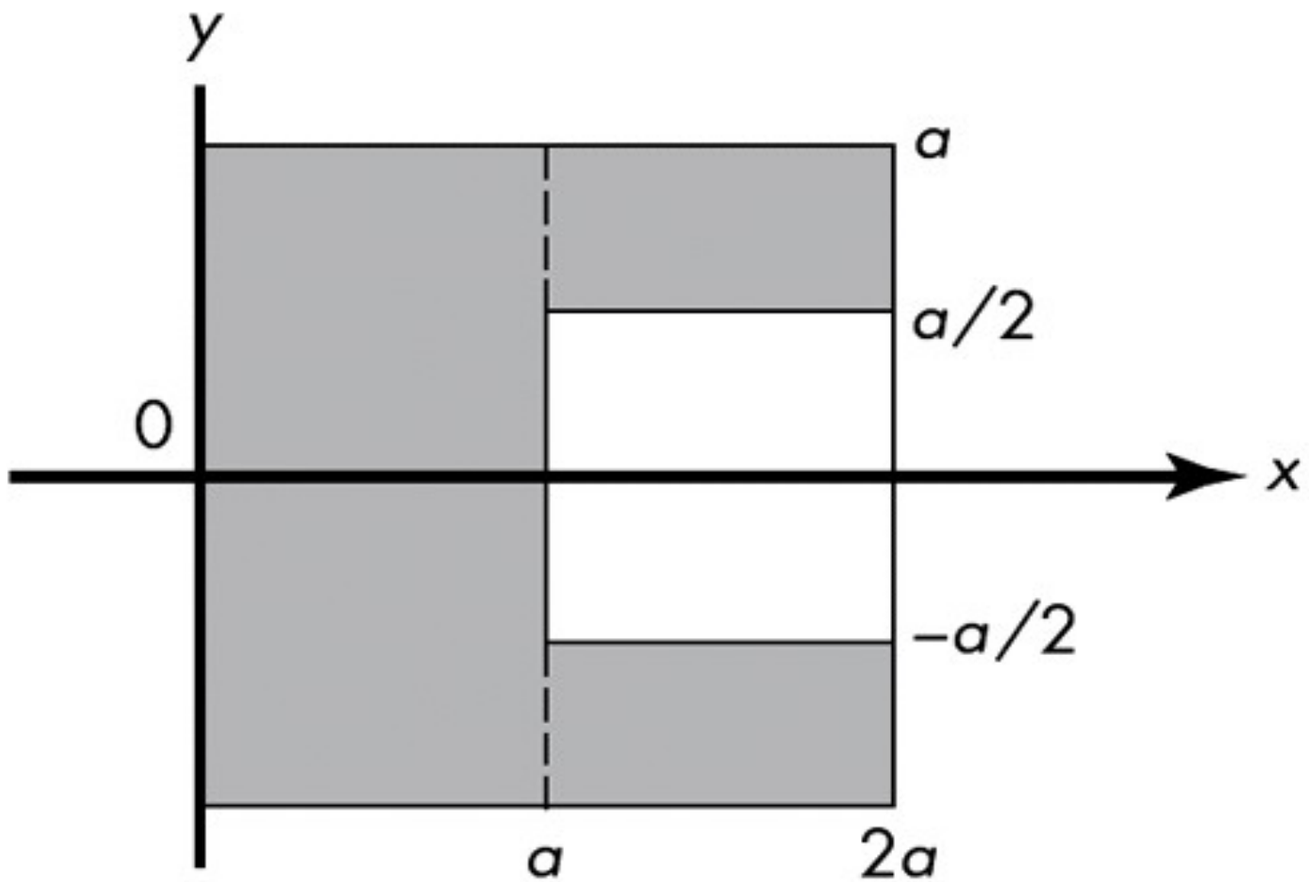
(2) does not change.

(3) decreases.

Consider two carts, of masses m and 2m, at rest on an air track. If you push first one cart for 3 s and then the other for the same length of time, exerting equal force on each, the momentum of the light cart is

(1) four times
(2) twice
(3) equal to
(4) one-half
(5) one-quarter

the momentum of the heavy cart.



Consider a letter "C" that is obtained by cutting a large square plate $2a \times 2a$ and removing a square $a \times a$ from the side, as shown in the sketch. Determine the x coordinate of the center of mass, x_{CM}:

(1)	(2)	(3)
$x_{CM} < a$	$x_{CM} = a$	$x_{CM} > a$