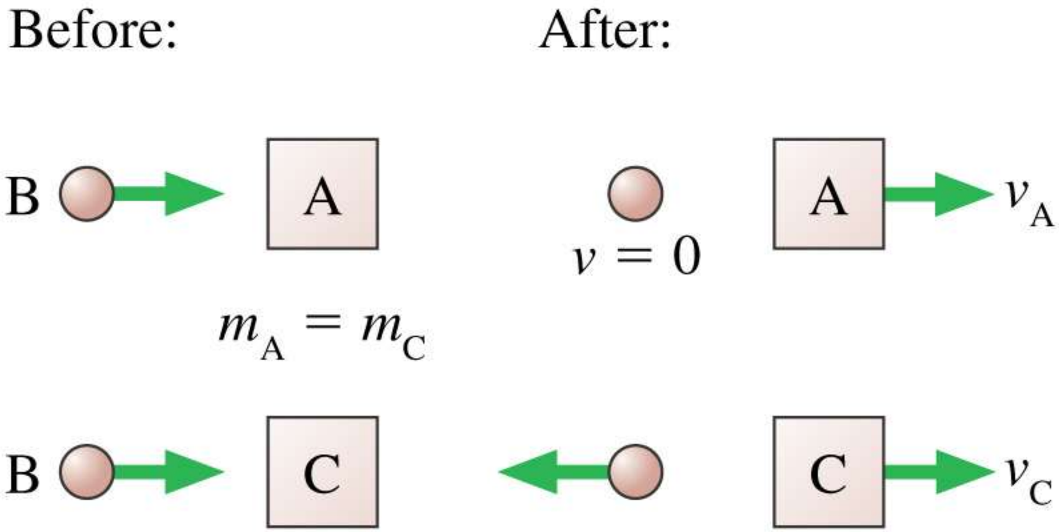
Objects A and C are made of different materials, with different "springiness," but they have the same mass and are initially at rest. When ball B collides with object A, the ball ends up at rest. When ball B is thrown with the same speed and collides with object C, the ball rebounds to the left. Compare the velocities of A and C after the collisions. Is v_A greater than, equal to, or less than v_C?



1. $v_A > v_C$
2. $v_A = v_C$
3. $v_A < v_C$

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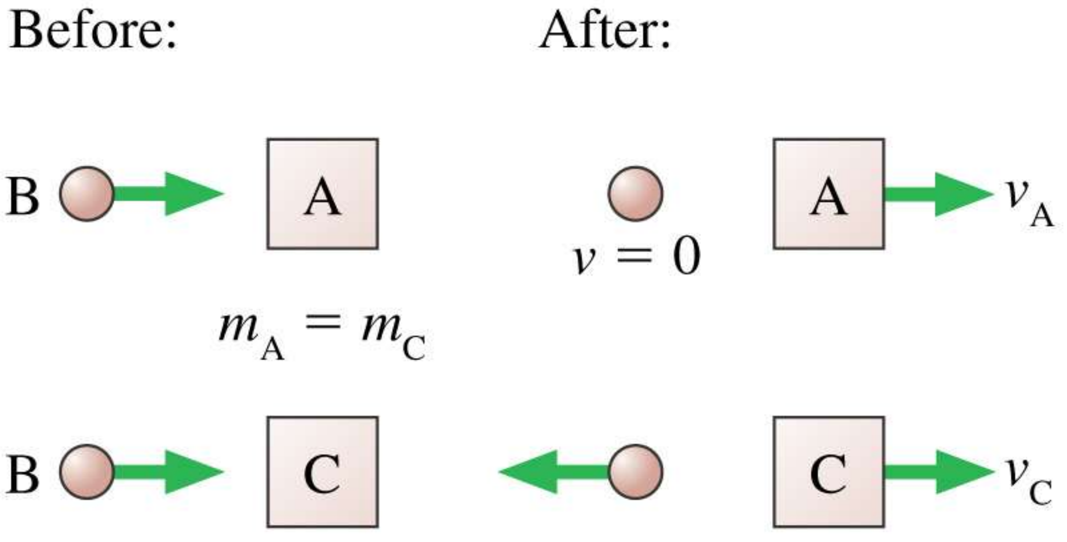

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3. **$v_A < v_C$** ✔

An explosion in a rigid pipe shoots out three pieces. A 6 g piece comes out the right end. A 4 g piece comes out the left end with twice the speed of the 6 g piece. From which end does the third piece emerge?

1. Left end
2. Right end

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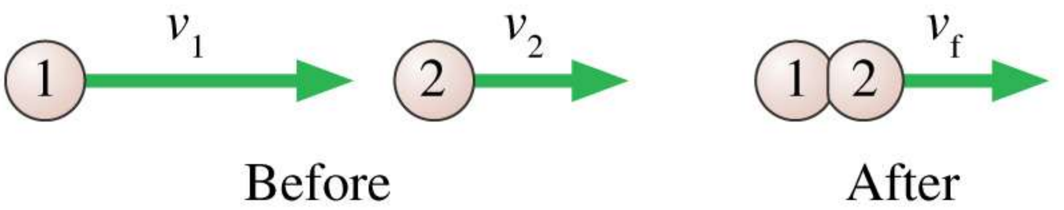
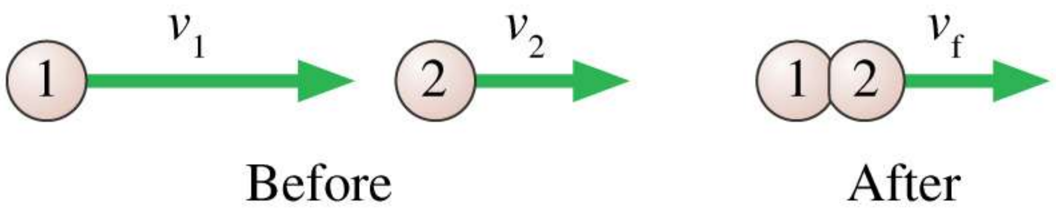


The two particles are both moving to the right. Particle 1 catches up with particle 2 and collides with it. The particles stick together and continue on with velocity v_f. Which of these statements is true?

1. v_f is greater than v_1.
2. $v_f = v_1$.
3. v_f is less than v_2.
4. $v_f = v_2$.
5. v_f is greater than v_2, but less than v_1.



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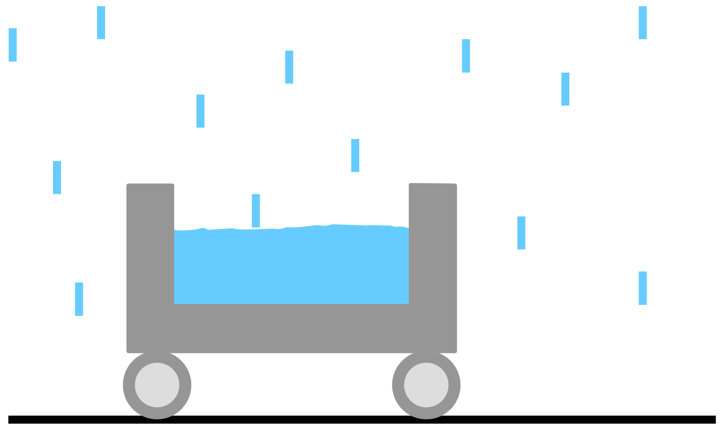
An open cart rolls along a frictionless track while it is raining. As it rolls, what happens to the speed of the cart as the rain collects in it? (assume that the rain falls vertically into the box)

1) speeds up

2) maintains constant speed

3) slows down

4) stops immediately



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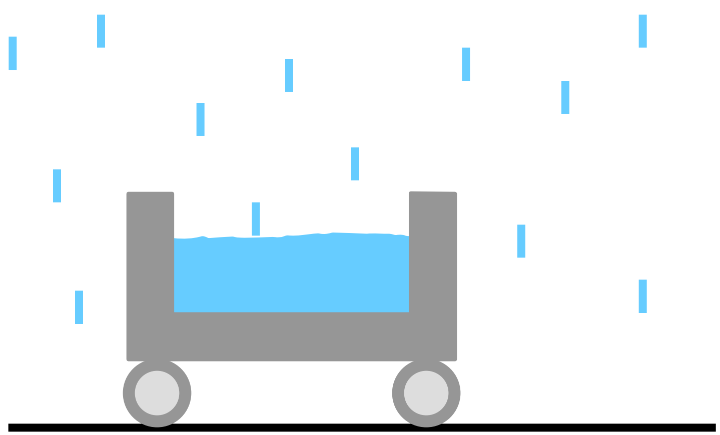
Since the rain falls in vertically, it adds no momentum to the box, thus the box's momentum is conserved. However, since the mass of the box slowly *increases* with the added rain, its velocity has to *decrease*.

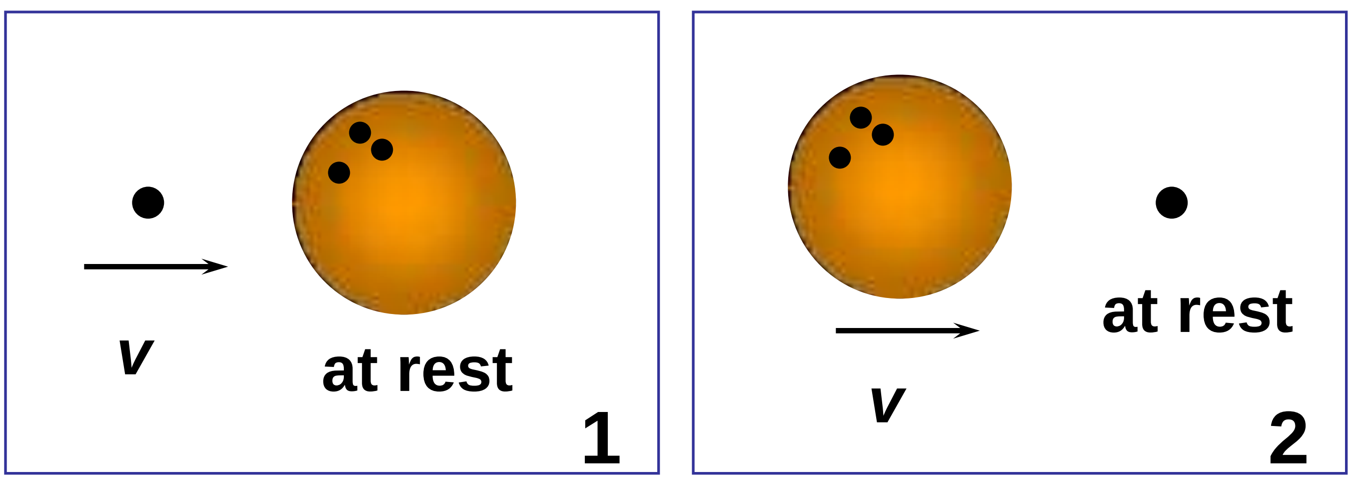


Consider two elastic collisions: 1) a golf ball with speed *v* hits a stationary bowling ball head-on. 2) a bowling ball with speed *v* hits a stationary golf ball head-on. In which case does the golf ball have the greater speed after the collision?

1) situation 1

2) situation 2

3) both the same



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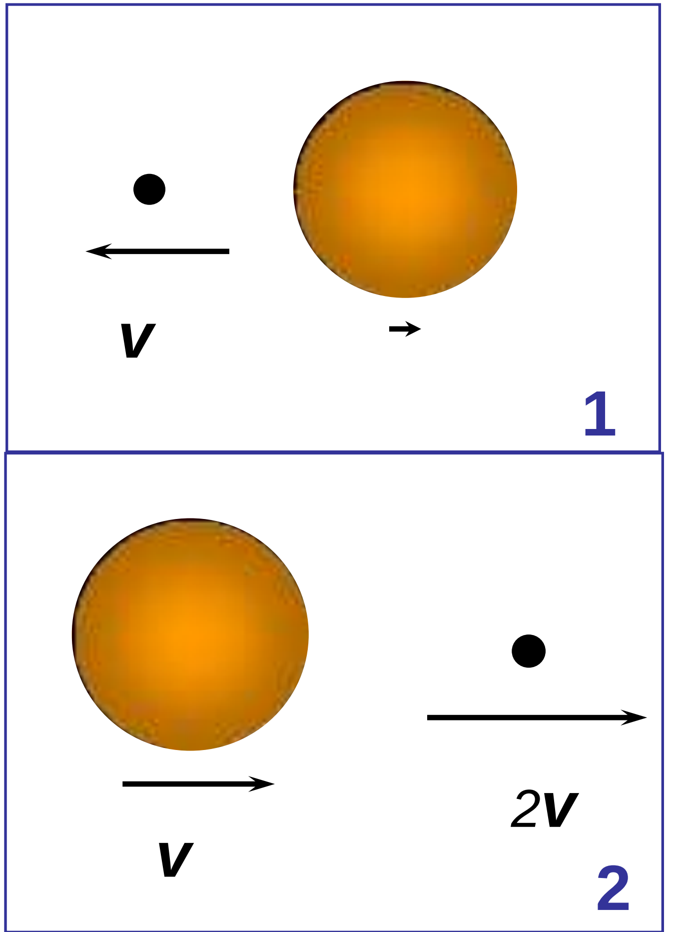

Remember that the magnitude of the *relative velocity* has to be equal before and after the collision! In case 1 the bowling ball will almost remain at rest, and the golf ball will bounce back with speed close to *v*. In case 2 the bowling ball will keep going with speed close to *v*, hence the golf ball will rebound with speed close to 2*v*.

You tee up a golf ball and drive it down the fairway. Assume that the collision of the golf club and ball is elastic. When the ball leaves the tee, how does its speed compare to the speed of the golf club?

1) **greater than**
2) **less than**
3) **equal to**

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1) **greater than**
2) **less than**
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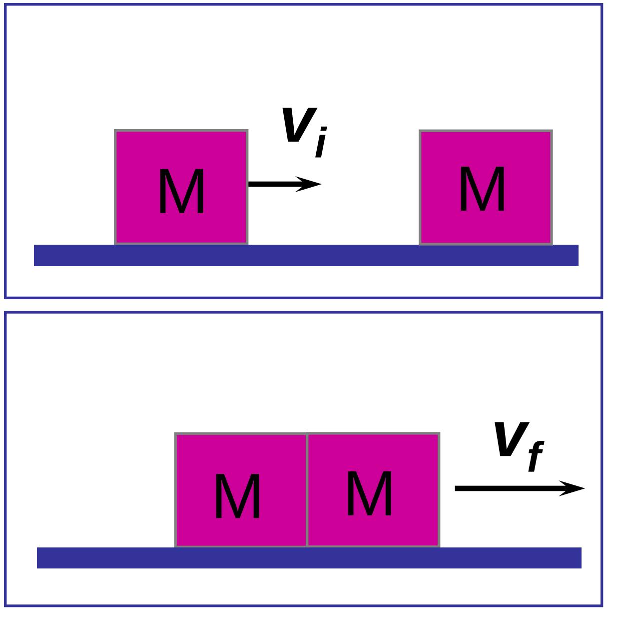
If the speed of approach (for the golf club and ball) is *v*, then the speed of recession must also be *v*. Since the golf club is hardly affected by the collision and it continues with speed *v*, then the ball must fly off with a speed of 2*v*.

A box slides with initial velocity 10 m/s on a frictionless surface and collides inelastically with an identical box. The boxes stick together after the collision. What is the final velocity?

1) 10 m/s
2) 20 m/s
3) 0 m/s
4) 15 m/s
5) 5 m/s



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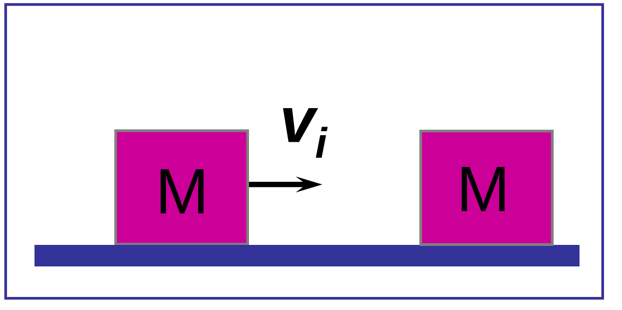
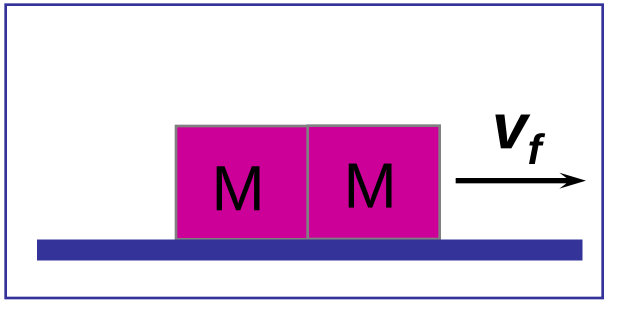
The initial momentum is:

$$M v_i = (10)\, M$$

The final momentum must be the same!! The final momentum is:

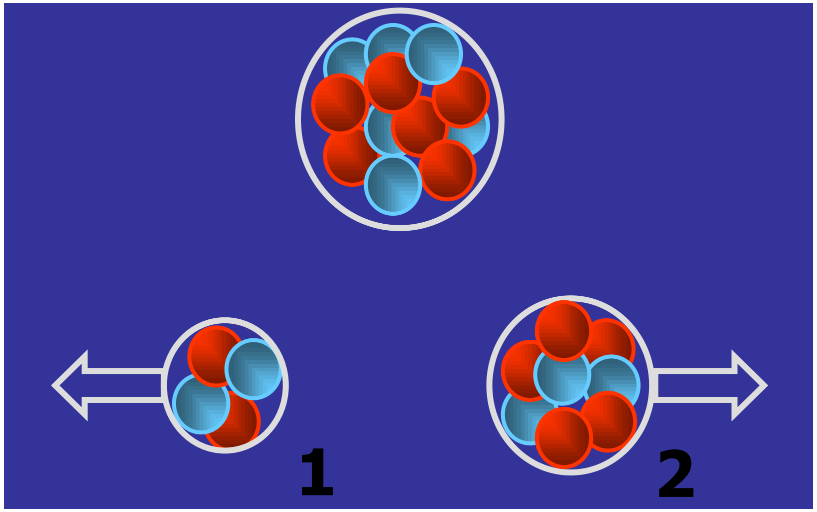
$$M_{tot}\, v_f = (2M)\, v_f = (2M)\,(5)$$





A uranium nucleus (at rest) undergoes fission and splits into two fragments, one heavy and the other light. Which fragment has the greater momentum?

1) the heavy one
2) the light one
3) both have the same momentum
4) impossible to say



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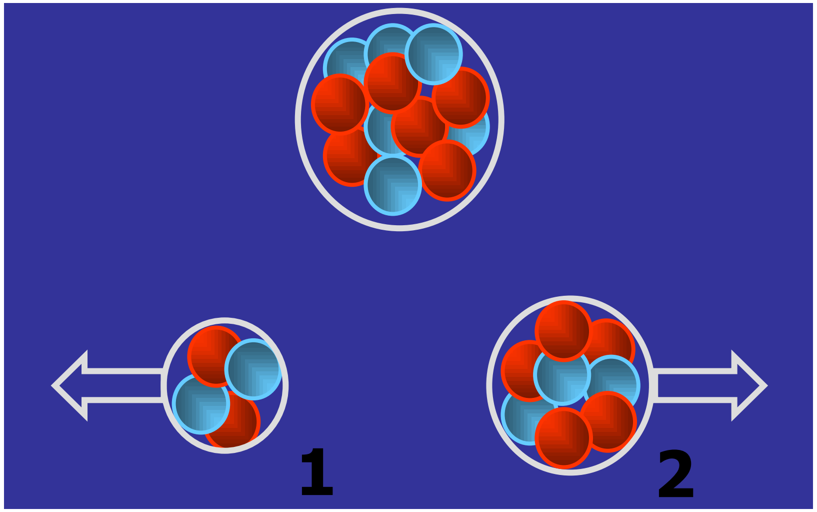
The initial momentum of the uranium was zero, so the final total momentum of the two fragments must also be zero. **Thus the individual momenta are equal in magnitude and opposite in direction.**



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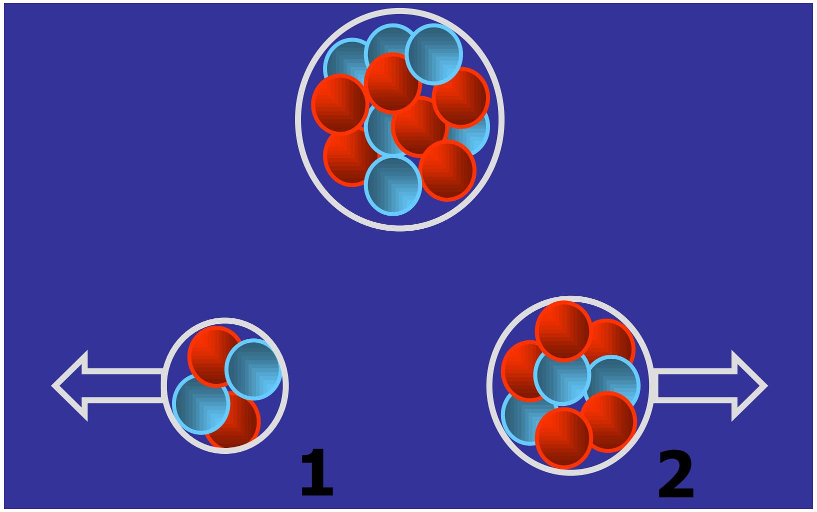

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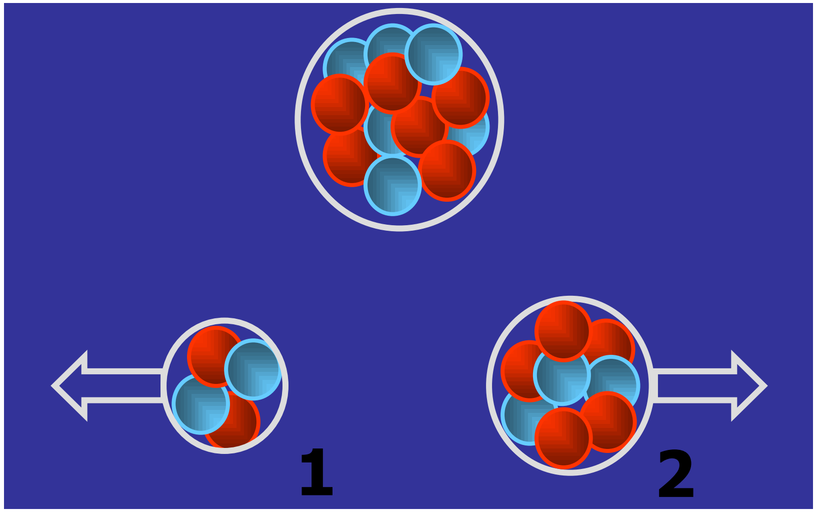
1) the heavy one
2) the light one
3) both have the same speed
4) impossible to say

We have already seen that the individual momenta are equal and opposite. In order to keep the magnitude of momentum ***mv*** the same, the heavy fragment has the lower speed and the **light fragment has the greater speed**.



Amy (150 lbs) and Gwen (50 lbs) are standing on slippery ice and push off each other. If Amy slides at 6 m/s, what speed does Gwen have?

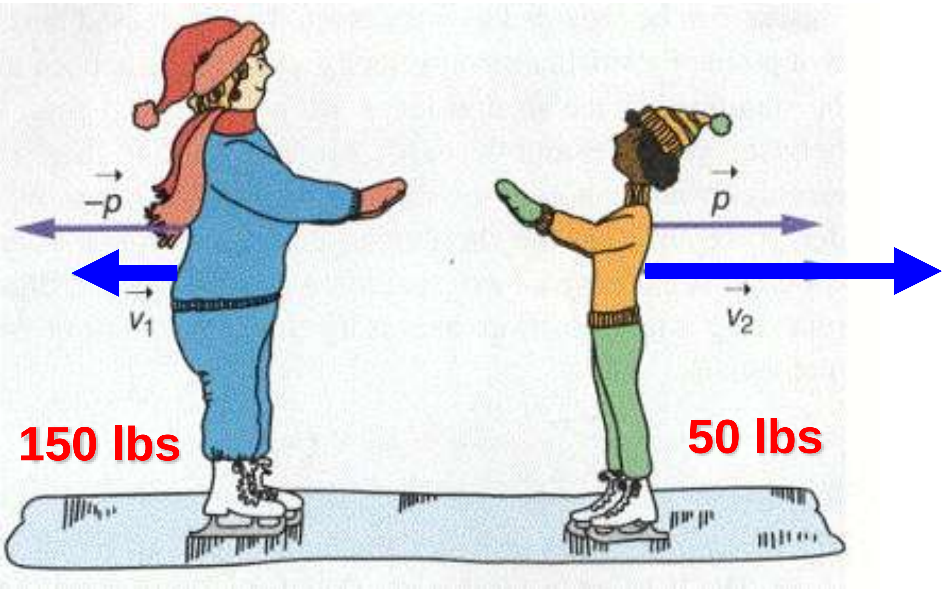
(1) 2 m/s

(2) 6 m/s

(3) 9 m/s

(4) 12 m/s

(5) 18 m/s



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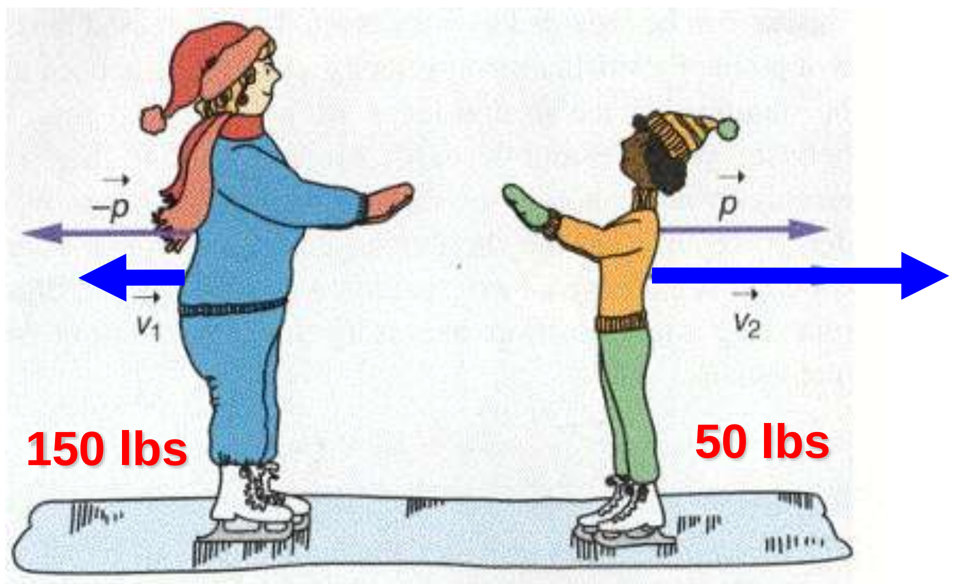
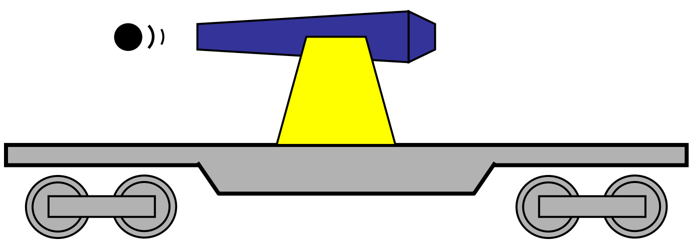
The **initial momentum is zero**, so the momenta of Amy and Gwen must be **equal and opposite**. Since $p = mv$, then if **Amy has 3 times more mass**, we see that **Gwen must have 3 times more speed**.



A cannon sits on a stationary railroad flatcar with a total mass of 1000 kg. When a 10-kg cannon ball is fired to the left at a speed of 50 m/s, what is the recoil speed of the flatcar?

1) 0 m/s
2) 0.5 m/s to the right
3) 1 m/s to the right
4) 20 m/s to the right
5) 50 m/s to the right



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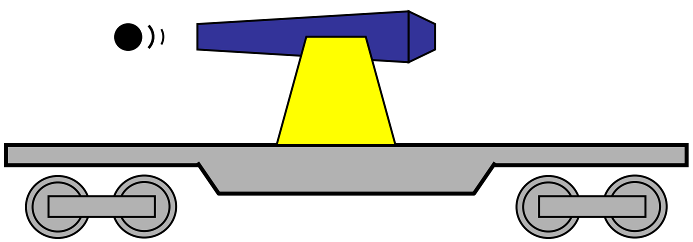
5) 50 m/s to the right

Since the initial momentum of the system was zero, the final total momentum must also be zero. **Thus, the final momenta of the cannon ball and the flatcar must be equal and opposite.**

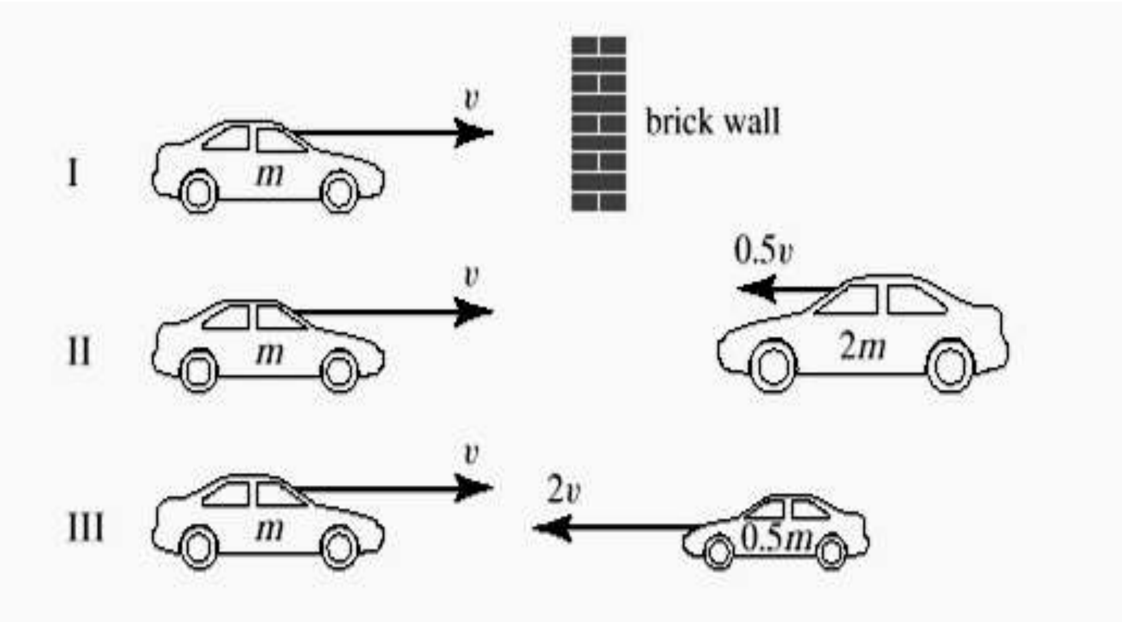
$p_{\text{cannonball}}$ = (10 kg)(50 m/s) = 500 kg-m/s

p_{flatcar} = 500 kg-m/s = (1000 kg)**(0.5 m/s)**



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
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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.