Today's Topics: Momentum

Comic: Rose is Rose

Don Wimmer & Pat Brady

Over the last couple weeks, you completed a lab that was different in style than the regular labs – what did you think of the experience?

A. Much better than the usual lab
B. Better than usual, but I wouldn't want to do that all the time
C. Pretty much the same – lab is lab
D. I didn't like it
E. Something else

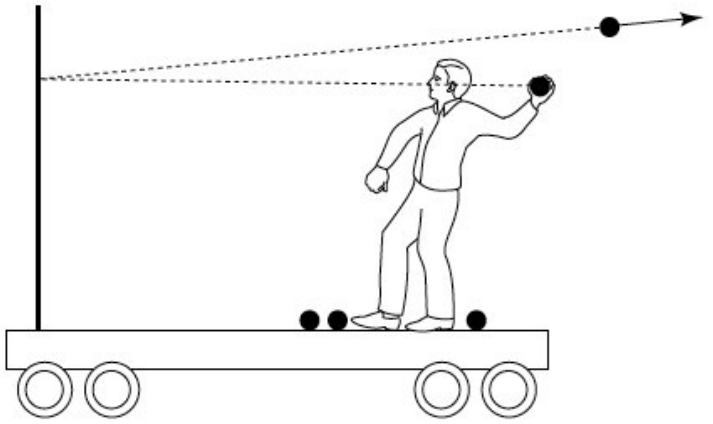
How confident would you feel about answering an exam or homework question based on the experiment you designed?

A. Totally confident!
B. Somewhat confident, but not totally sure
C. I would probably be OK
D. Not confident at all
E. I have no idea

Announcements

- First set of Homework on Ch 11 due tonight at midnight
- Ch 13 reading questions due on Tuesday

Suppose you are on a cart, initially at rest on a track with negligible friction. You throw balls at a partition that is rigidly mounted on the cart. The balls bounce straight back as shown in the figure.



Is the total horizontal momentum conserved in the process of throwing the balls and having them bounce off the partition?

A. Yes.
B. No.
C. You are not given enough information to decide.

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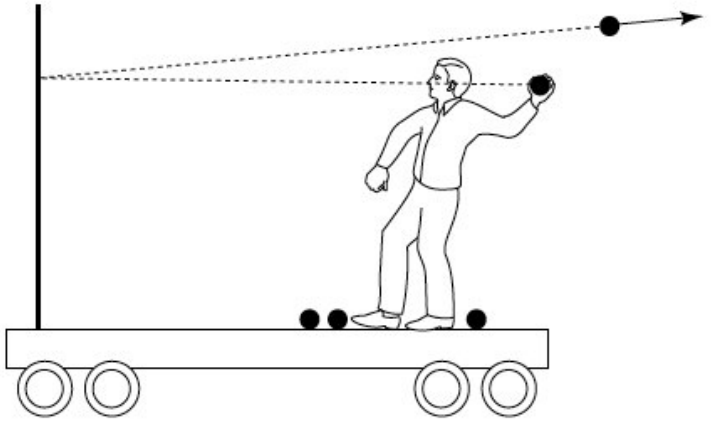


Is the total horizontal momentum conserved in the process of throwing the balls and having them bounce off the partition?

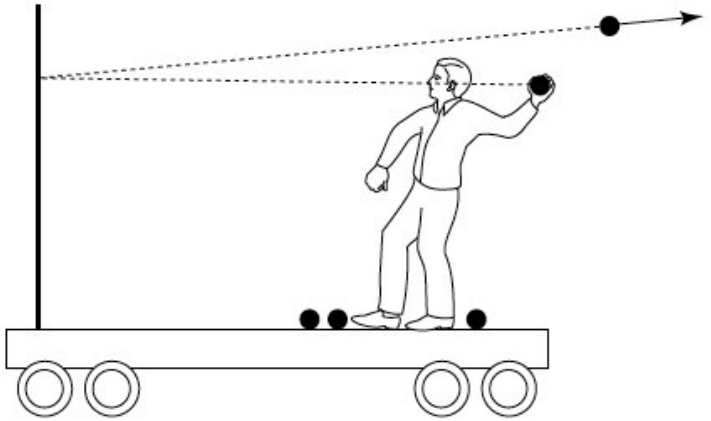
A. Yes.
B. No.
C. You are not given enough information to decide.

It depends on the system!!

If the balls, cart, person, and partition are all in the system, then YES conserved!

If any one of the above are outside the system, then NO not conserved!

Suppose you are on a cart, initially at rest on a track with negligible friction.



You throw balls at a partition that is rigidly mounted on the cart. The balls bounce straight back as shown in the figure.

Is the cart put in motion?

A. Yes. Towards the left
B. Yes. Towards the right.
C. No.
D. You are not given enough information to decide.

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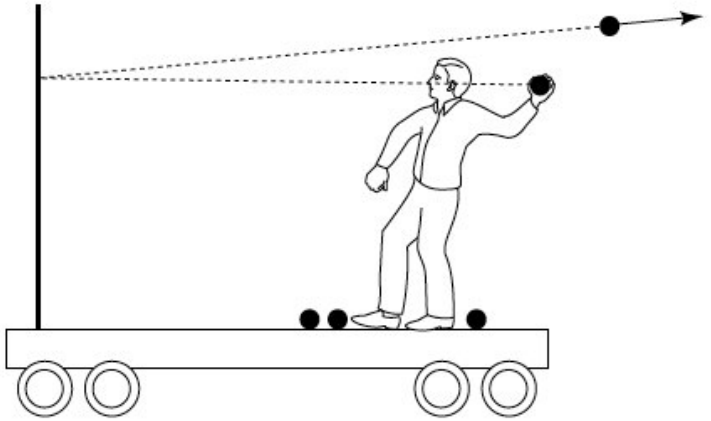
You throw balls at a partition that is rigidly mounted on the cart. The balls bounce straight back as shown in the figure.



Is the cart put in motion?

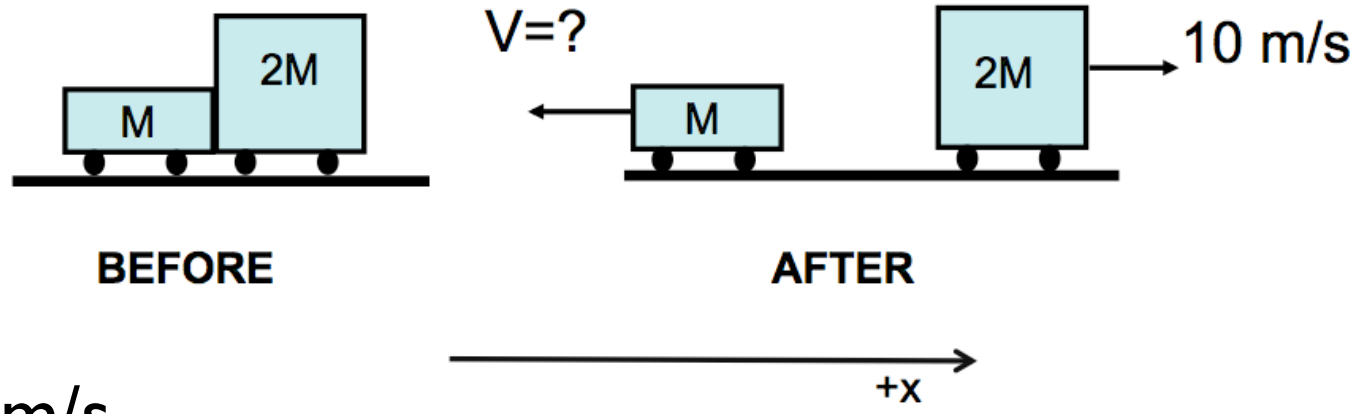
A. Yes. Towards the left
B. Yes. Towards the right.
C. No.
D. You are not given enough information to decide.

If everything is in the system – then momentum is conserved. So the balls shooting off to the right means the cart must move to the left.

Types of Collisions

- “Elastic” -> KE is conserved
  - No KE is converted to PE or any other kind of energy
- “Inelastic” -> Some KE is converted to PE or other types of energy (or moves out of the system)
- “Perfectly” or “totally” inelastic -> collide and stick together

Two cars are initially at rest on a frictionless surface and are blown apart by an explosion. The one with twice the mass ends up moving to the right at 10 meters/second. The less massive car ends up moving to the left at what speed?



A. 5 m/s
B. 10 m/s
C. 14.1 m/s
D. 20 m/s
E. 25 m/s

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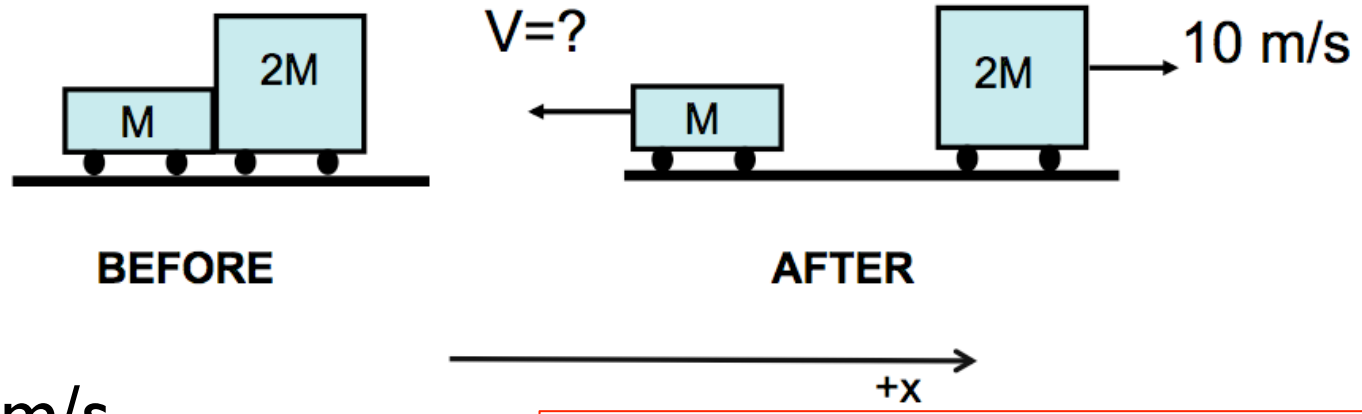
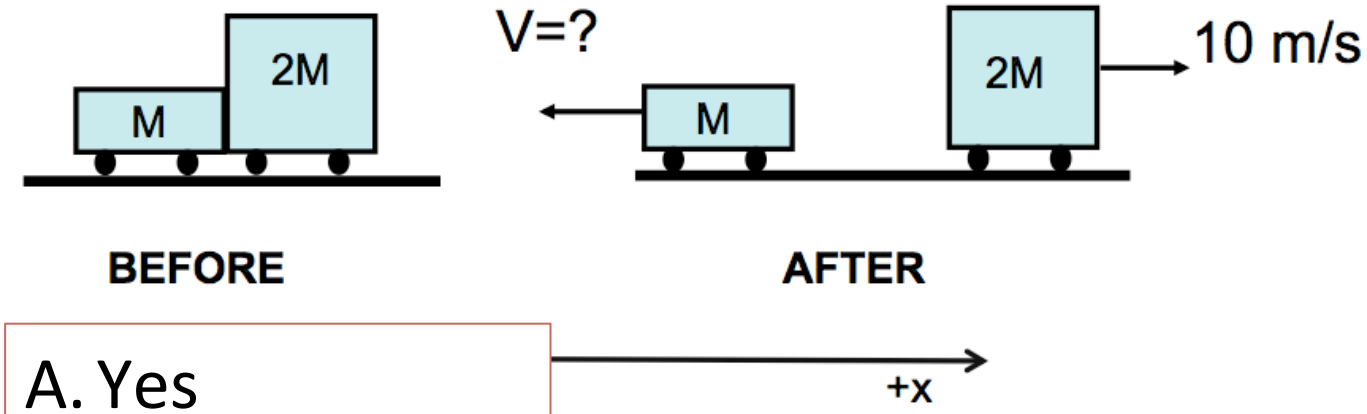


A. 5 m/s
B. 10 m/s
C. 14.1 m/s
D. 20 m/s
E. 25 m/s

If we think of the explosion as a force that changes the momentum of both carts; then the change in momentum must be equal. So if one cart is 2M of the other, the smaller one must go 2V = 20 m/s.

Two cars are initially at rest on a frictionless surface and are blown apart by an explosion. The one with twice the mass ends up moving to the right at 10 meters/second. The less …at speed?

Is example an elastic collision?



A. Yes
B. No
C. Maybe?

A. 5
B. 10
C. 1…
D. 20 m/s
E. 25 m/s

Two cars are initially at rest on a frictionless surface and are blown apart by an explosion. The one with twice the mass ends up moving to the right at 10 meters/second. The less

...hat speed?

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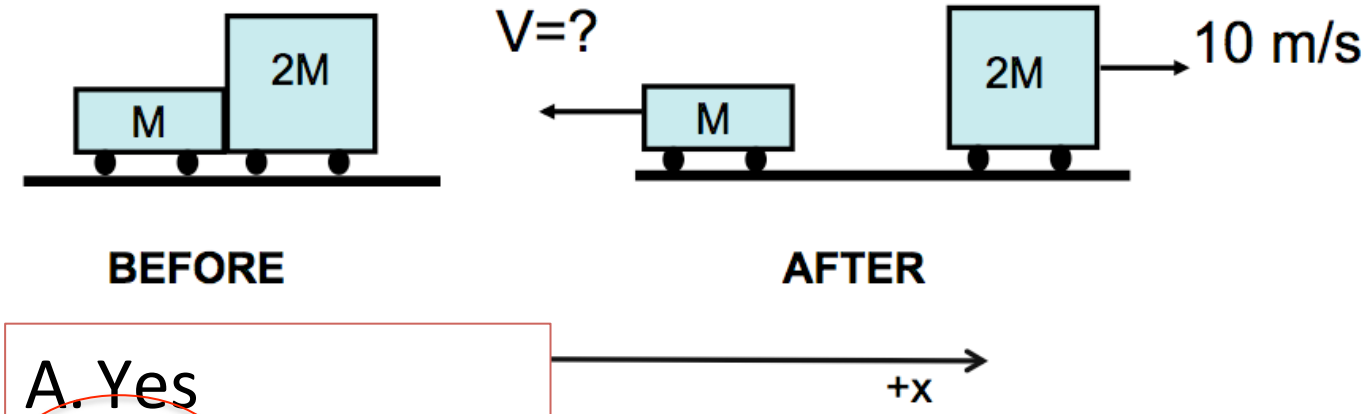
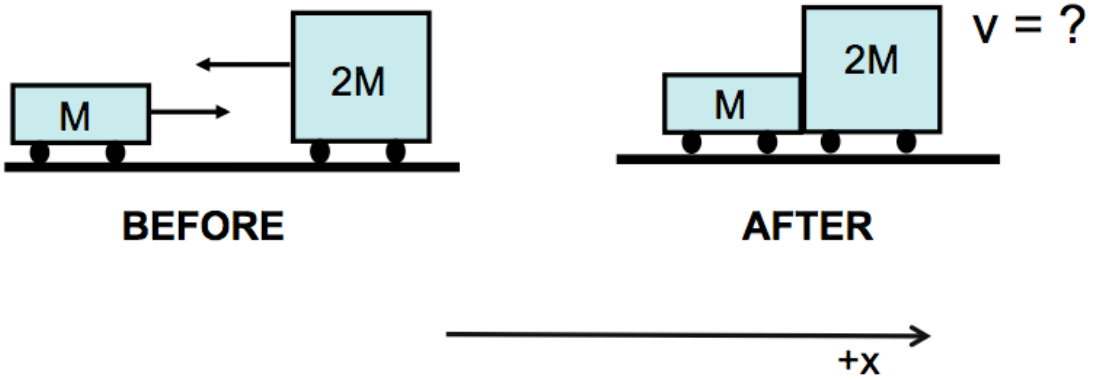


A. 5
B. 10
C. 1
D. 20 m/s
E. 25 m/s

A. Yes
B. No
C. Maybe?

No matter how I define the system, all of the energy is not in kinetic energy both before and after the explosion. So this example is not elastic.

A car with a mass M is moving toward another car with a mass 2M on a frictionless surface. Both cars have a speed of 10 m/s. Subsequently, they collide and stick together. What is the final velocity of the system?



A. -5 m/s
B. -3.33 m/s
C. 0 m/s
D. +3.33 m/s
E. +5 m/s

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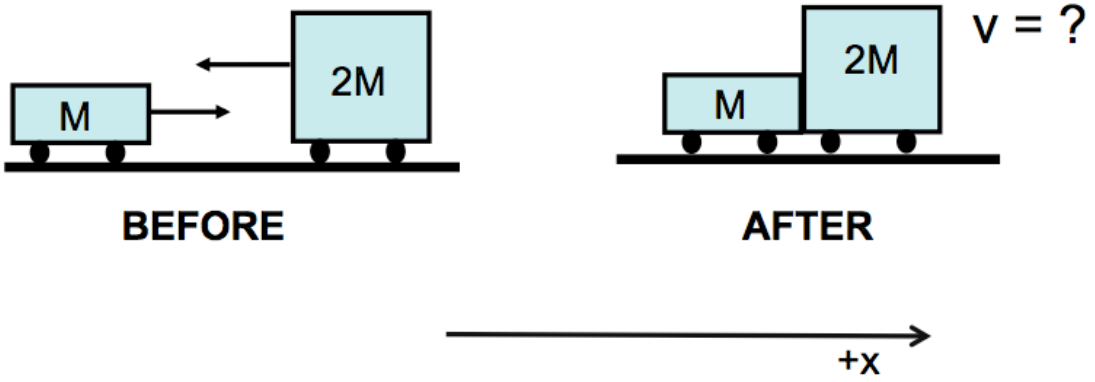


A. -5 m/s
B. -3.33 m/s
C. 0 m/s
D. +3.33 m/s
E. +5 m/s

P(i) = p(f)
Initial: m(10) – 2M (10) = -10 (M) m/s
Final: (m+2M)v = -10(M) m/s
so v = -3.33 m/s

Example: Recoil

- https://www.youtube.com/watch?v=QQxO-TAagvc (minute 1:35)
- What's happening?

(bullet goes forward)

(gun goes backwards)

Do it!

Some additional Q's we didn't get to in class…

When I was young I went deer hunting with my uncle. I decided I didn't like the "kick" of the gun, so I pressed myself against a tree before firing a 12-guage (3.5kg) loaded with a deer slug (.22kg). Was this a…

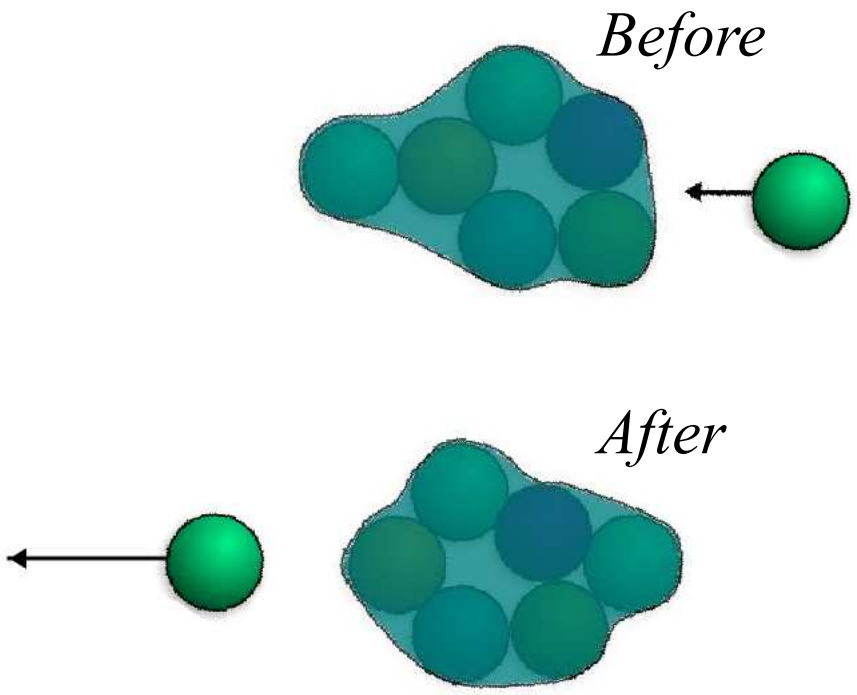
A. A good idea?
B. A big mistake?
C. Doesn't matter

If I choose the system to be the deer slug and the gun, which of the following would describe the velocity of the gun?

A. $v_G = (m_s/M_G)v_s$
B. $v_G = -(m_s/M_G)v_s$
C. $v_G = (M_G/m_s)v_s$
D. $v_G = -(M_G/m_s)v_s$
E. None of these

A molecular cluster at rest collides with an atom. As a result, the atom becomes strongly bound to the cluster and an identical atom (from a different part of the molecule) gets shot off with much higher speed. What can you say about the motion of the reformed cluster after the collision?

A. It will be stationary.
B. It will move to the left.
C. It will move to the right.
D. This is not really possible, despite the claim that it is.
E. You can't say anything about it from the information given.



The diagram at the right depicts the path of two colliding steel balls rolling on a table. Which set of arrows best represents the direction of the change in momentum of each ball?