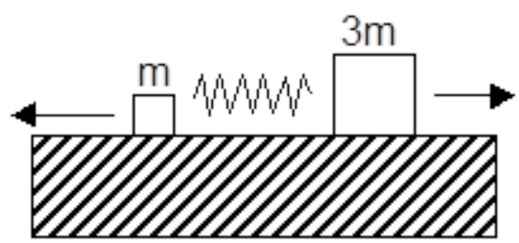
The masses start at rest (on an air track) with a compressed spring between them. After releasing the spring, the final KE of m is ___??____ the final KE of 3m?



A) Equal to B) Greater than C) Less than

Spring 2014
PHYS-2010

Guest Lecturer:
Dr. Michael Dubson

Lecture 29

Announcements:

- Written HW today.
- CAPA #10 is in the bins

- Reading: we will start **Giancoli Ch 8** after the break. (Skipping 7.7 on)

Why is momentum conserved?

$$\vec{F}_{net} = m\vec{a}$$

$$= m\frac{\Delta\vec{v}}{\Delta t}$$

$$= \frac{\Delta(m\vec{v})}{\Delta t} = \frac{\Delta\vec{p}}{\Delta t}$$

(if m const)

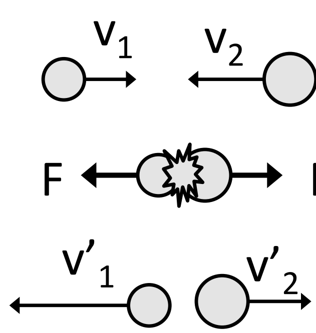
$$\vec{F}_{net} = \frac{\Delta \vec{p}}{\Delta t}$$

$$\Delta \vec{p} = \vec{F}_{net} \Delta t$$

We call $\vec{F}_{net}\Delta t$ the IMPULSE

No $F_{external}$, no change in p!

Total momentum of a system conserved?



During collision,
same |**F**|(by NIII),
same Δt,
So same $|\Delta \mathbf{p}| = |\mathbf{F}|\ \Delta t$

$$\Delta \vec{p}_1 = -\Delta \vec{p}_2 \Rightarrow \Delta \vec{p}_{tot} = \Delta \vec{p}_1 + \Delta \vec{p}_2 = 0$$

$$\Rightarrow \vec{p}_{tot} = \text{const}$$

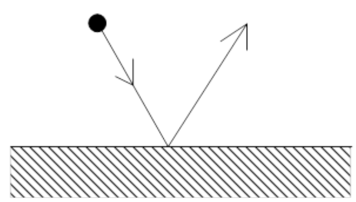
A fastball has momentum $|p_i|$ = 12 kg m/s

The batter hits the ball straight back at the pitcher with momentum $|p_f|$ = 24 kg m/s.

What is the magnitude of the impulse, Δp?

A) $|p_f| - |p_i|$ = 12 kg m/s
B) $|p_f| + |p_i|$ = 36 kg m/s
C) 24 kg m/s
D) Something else!

A superball bounces elastically off the floor, as shown. What is the direction of Δp_{ball}?



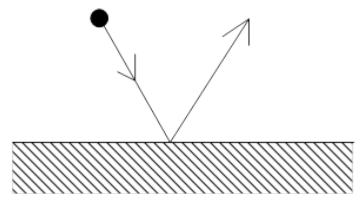
A) Straight Up
B) Straight Down
C) To the Right
D) Zero impulse, so no direction

A superball bounces elastically off the floor.

Is the momentum of this superball conserved?

A) Yes

B) No



A(frictionless) projectile is launched as shown.

During the flight, is the projectile's x-component of momentum conserved?

A) Yes

B) No

C) ??

A(frictionless) projectile is launched as shown.

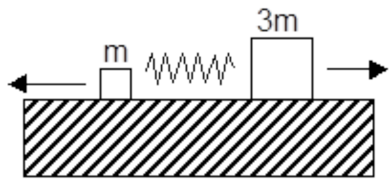
During the flight, is the projectile's y-component of momentum conserved?

A) Yes
B) No
C) ??

Suppose a ping-pong ball and a bowling ball are rolling toward you. Both have the **same** momentum, and you exert the same force to stop each. How do the time intervals to stop them compare?

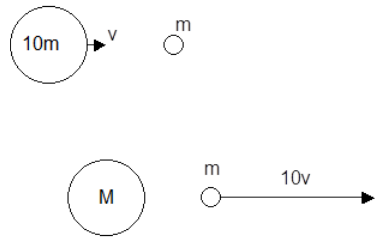
A) Less time to stop the ping-pong ball
B) Less time to stop the bowling ball
C) Both times are the same
D) Need more information

Recall this concept test.
Little m recoils with big speed



(Demo)

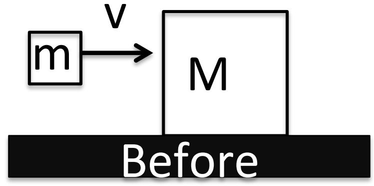
A big ball (mass M=10m, speed v) strikes a small ball (mass m) at rest. Could the big ball STOP and the small ball takes off with speed 10v?



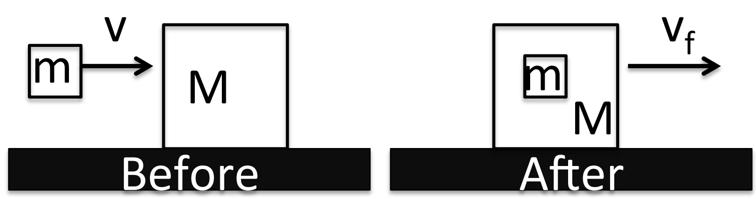
A) Yes
B) No, it violates conservation of energy
C) No, it violates conservation of momentum
D) No, it violates both conservation laws

The ballistic pendulum

A bullet (mass m, velocity v) hits a block (mass M, at rest on a frictionless surface) The bullet buries itself in the wood.

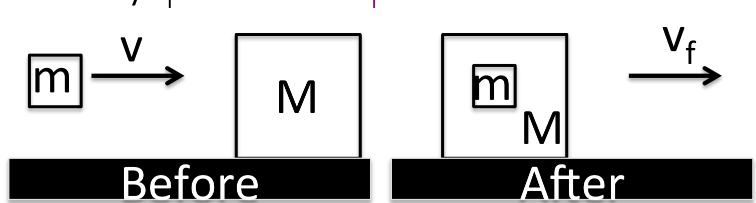


A bullet (mass m, velocity v) hits a block (mass M, at rest on a frictionless surface) The bullet buries itself in the wood, and the system has final velocity v_f Was this collision elastic?



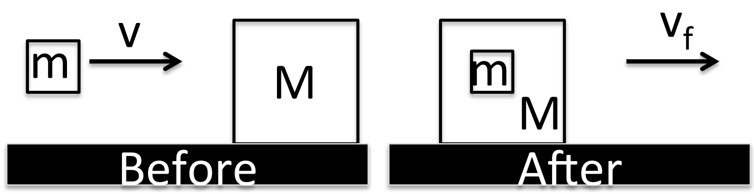
A) Yes
B) No

A bullet (mass m, velocity v) hits a block (mass M, at rest on a frictionless surface) The bullet buries itself in the wood, and the system has final velocity v_f Is $mv = Mv_f$?



A) Yes
B) No

A bullet (mass m, velocity v) hits a block (mass M, at rest on a frictionless surface) The bullet buries itself in the wood, and the system has final velocity v_f Is $\frac{1}{2} mv^2 = \frac{1}{2} (M+m) v_f^2$?



A) Yes
B) No

Two carts (mass m and 2m) are at rest on an air track. You push each on with the same force for 3 seconds. How do the momenta compare?

A) Heavy cart has MORE momentum
B) Light cart has more momentum
C) Both have the same momentum
D) ???

Two carts (mass m and 2m) are at rest on an air track. You push each on with the same force for 3 seconds. How do the kinetic energies compare?

A) Heavy cart has MORE KE
B) Light cart has more KE
C) Both have the same KE
D) ???

The entire population of earth gathers at one spot and, on a prearranged signal, we all jump!

While everyone is in the air, just after jumping, does the Earth gain momentum in the opposite direction?

A) No

B) Yes, but the change in momentum is less.

C) Yes, the change in momentum is equal and opposite that of the people

D) ??

The entire population of earth gathers at one spot and, on a prearranged signal, we all jump!

After we all land, is the momentum of the earth changed?

A) No, it's the same as how it started

B) Yes