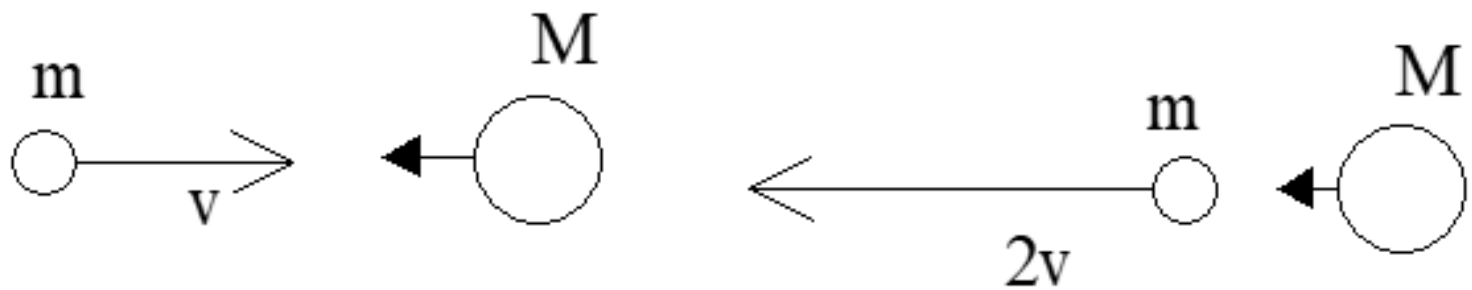
SQUARECAP

Ball 1 of mass m moving right with speed v bounces off ball 2 with mass M (M > m), and then moves left with speed 2v.



By how much did the momentum of ball 2 decrease?

A: mv
B: 2mv
C: 3mv
D: (1/2)mv
E: zero

Notes

- Homework 6 due Friday
- Midterm II next Wednesday – Content is Homeworks 4, 5, 6 +Zombie Problem
- Homework 7 on Momentum and Collisions will be posted Friday but not due until Nov. 1

- I will be out of town
  - Friday: Dr. Jonathan Perry will cover for me
  - Monday: Zoom session for review

Recap: Energy Conservation

- Energy in a loop-de-loop
  - Claim: Need to drop from height $2.5r$
  - Is this true?
  - Where does it go if it's $2r$ instead?

- Energy in a pendulum
  - $\frac{1}{2}mv^2 + mgh = \frac{1}{2}mv^2 + mgl(1 - \cos\theta)$

Recap: Momentum Conservation

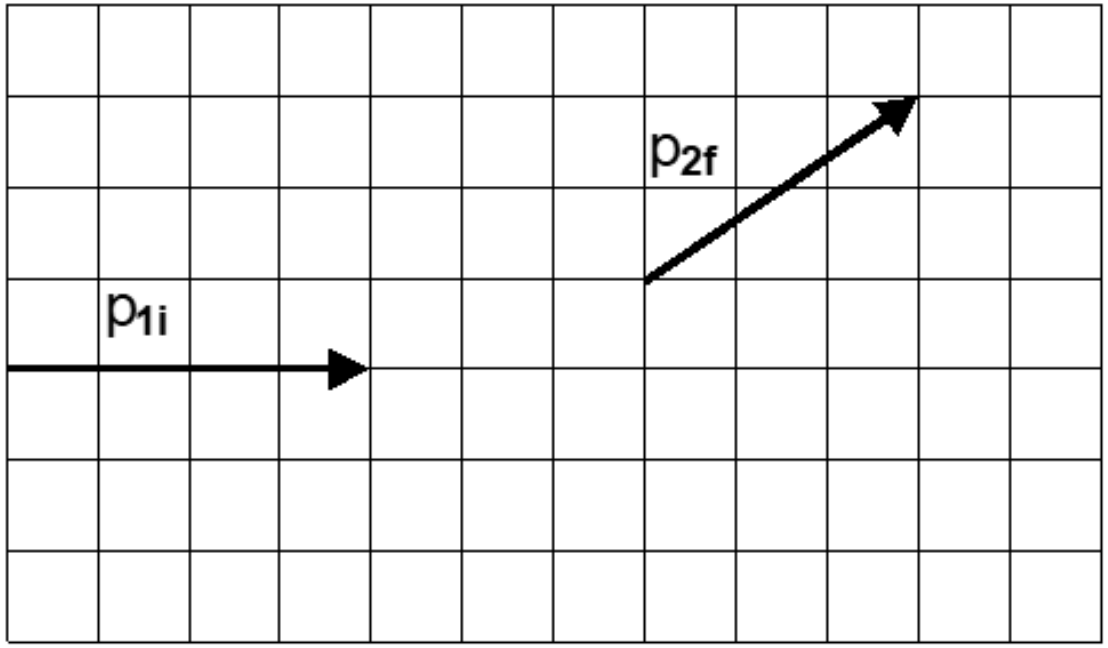
A person attempts to knock down a large wooden bowling pin by throwing a ball at it. The person has two balls of equal size and mass, one made of rubber and the other of putty. The rubber ball bounces back, while the ball of putty sticks to the pin. Which ball is most likely to topple the bowling pin?

A.The rubber ball
B.The ball of putty
C.It makes no difference
D.Need more information

SQUARECAP

Discuss and Answer:

Ball 1 strikes stationary Ball 2 in 2D collision. The initial momentum of Ball 1, $\vec{p}_{1i}$, and the final momentum of Ball 2, $\vec{p}_{2f}$, are shown on the graph.



Assuming both balls have the same mass, what's the final momentum of the first ball?

Is Energy Conserved?

Prelecture Review: Introduction to Momentum

What are our questions about energy and energy conservation?

- Momentum is a conserved quantity

$$\sum \vec{p}_i = \sum \vec{p}_f$$

- It's helpful for e.g. understanding collisions
- It's related but distinc from kinetic energy

$$E = \frac{p^2}{2m}$$

- Does not have a named unit, kg m/s
- Newton's Third Law

$$\vec{F} = \frac{d\vec{p}}{dt}$$

Comments and Questions

- How do shapes of objects effect momentum?
- How does momentum conservation in both directions predict ball velocities in billiards and how do friction and spin affect this?
- How do we account for friction in problems about momentum conservation during collisions?
- Could you use the momentum equation(or some derivation) to find force?

My Comments and Questions

- Comment: Some values of momentum for comparison:

Cargo ship: about 10^9 kgm/s

Protons at LHC: 10^-17 kgm/s

New Idea: Impulse

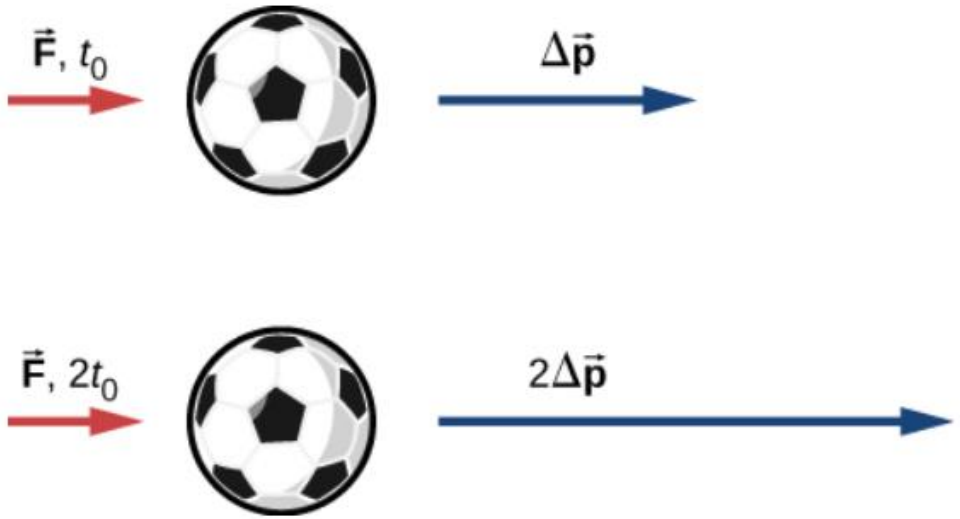
- When a force acts through a distance, we call that work, and it represents a transfer of energy.

$$W = \int F \cdot dr = \Delta E$$

- When a force acts for some duration of time, we call that an impulse, and it represents a transfer of momentum

$$\vec{I} = \int \vec{F} dt = \Delta \vec{p}$$

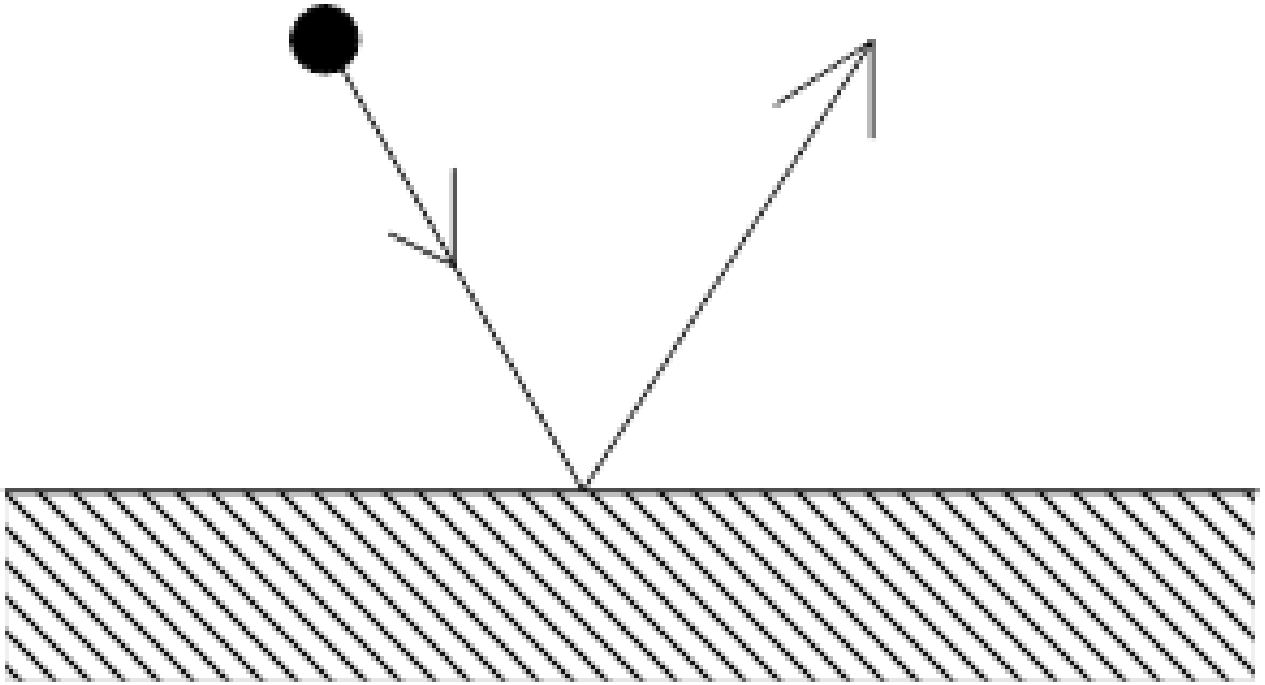
$$since\ \vec{F} = \frac{d\vec{p}}{dt}$$



SQUARECAP

Discuss and Answer:

A ball bounces off the floor as shown.
The direction of the impulse on the ball,
is ...



A: straight up
B: straight down
C: to the right
D: to the left
E: up and to the right
F: up and to the left
G: down and to the right
H: down and to the left
I: Impossible to determine