Read 7.6

H.w #7 Due today

H.w #8 available

ex) A 50g golfball is struck by a club. The ball is deformed by 2.0 cm during the collision. The ball leaves the club with a velocity of 44 m/s.

a) what is impulse during collision?

b) How long is the collision?

c) what is average force of collision?

a) impulse: $F\Delta t = \Delta p = mv_f - mv_i$

$(.05kg)(44m/s) - 0$

$\boxed{2.2\ kg\text{-}m/s}$

b) $v_f = \frac{\Delta x}{\Delta t} \Rightarrow \Delta t = \frac{\Delta x}{v_f} = \frac{.02m}{44m/s} \Rightarrow$

$\boxed{\Delta t = 4.5 \times 10^{-4} s}$

c) $F = \frac{\Delta p}{\Delta t} = \frac{2.2\ kg\text{-}m/s}{4.5 \times 10^{-4} s} = \boxed{4.9 \times 10^{3} N}$

Interactive Question

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) It takes less time to stop the ping-pong ball.

B) Both take the same time.

C) It takes more time to stop the ping-pong ball.

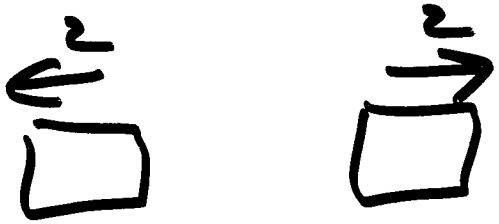
Interactive Question

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) makes no difference
D) need more information

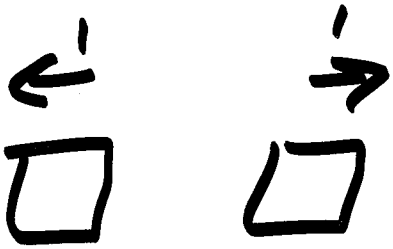
Total $p = 0$

after

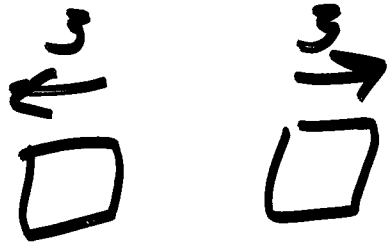


Total $p = 0$

✓



Total $p = 0$



Total $p = 0$

✗

cannot gain energy

Interactive Question

A bullet is fired from a rifle. Neglect any external forces on the rifle. In doing so the bullet gains a certain amount of momentum and the rifle gains

A) more momentum.
B) the same amount of momentum.
C) less momentum.
D) the answer depends on how we define the system.

Interactive Question

Suppose the entire population of the world gathered together at one spot and everyone jumps up at the same time. While all the people are in the air, does the earth gain momentum in the opposite direction?

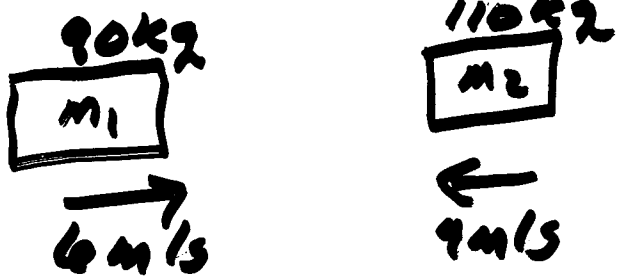
A) No; the inertial mass of the earth is so large that the planet's change in motion is imperceptible.

B) Yes; because of its much larger inertial mass, however, the change in momentum of the earth is much less than that of all the jumping people.

C) Yes; the earth recoils, like a rifle firing a bullet, with a change in momentum equal and opposite to that of the people

ex) A 90 kg fullback attempts to dive over goal line with a velocity of 6.0 m/s. He is met by a 110 kg linebacker moving at 4.0 m/s in opposite direction. The linebacker holds on to the fullback. Does the fullback score?

momentum is conserved



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

$\vec{p} = m\vec{v}$

$p_i = m_1 v_{1i} + m_2 v_{2i}$

$p_f = (m_1 + m_2) v_f = m_1 v_f + m_2 v_f$

$p_i = (90\text{kg})(6\text{m/s}) + (110\text{kg})(-4\text{m/s})$

$p_f = (90\text{kg} + 110\text{kg}) v_f$

$p_i = p_f \Rightarrow v_f = \boxed{0.5\text{ m/s}}$

There is a relationship between kinetic energy and momentum

$K = \frac{1}{2}mv^2 \qquad \vec{p} = m\vec{v}$

multiply top and bottom by m $\left(\frac{m}{m}\right)$ multiply by 1

$K = \frac{1}{2}mv^2\frac{m}{m} = \frac{m^2v^2}{2m} = \frac{p^2}{2m}$

$$\boxed{K = \frac{p^2}{2m}}$$

Interactive Question

A car accelerates from rest. In doing so the car gains a certain amount of kinetic energy and the Earth gains

A) more kinetic energy.
B) the same amount of kinetic energy.
C) less kinetic energy.