NO Reading assignment

Exam 2 scores on D2L

Action Center Thursday

Group Thursday (Energy)

H.W Due Friday

Office hrs 9:30-10:30

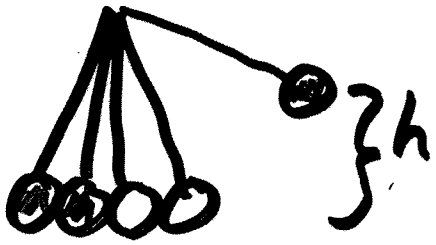
Review

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

rewrote Newton's 2nd Law $\vec{F} = \frac{\Delta \vec{p}}{\Delta t}$

in any collision magnitude of change in momentum same

if no external forces momentum conserved



$E_i = mgh$

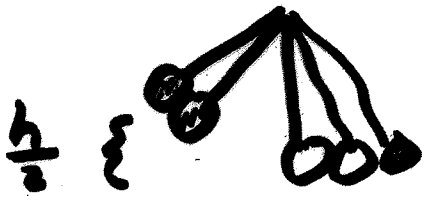
$E_f = \frac{1}{2}mv^2$

$mgh = \frac{1}{2}mv^2$

$v = \sqrt{2gh}$

$p = mv$

$p_i = m\sqrt{2gh}$



$E_f = 2mg\frac{h}{2} = mgh$

$E_i = \frac{1}{2}(2m)v^2$

$mgh = mv^2$

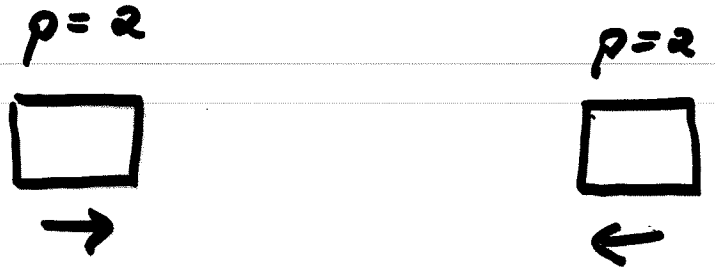
$v = \sqrt{gh}$

$p_f = 2m\sqrt{gh}$

$p_i = m\sqrt{2gh}$ $\quad p_f = 2m\sqrt{gh}$

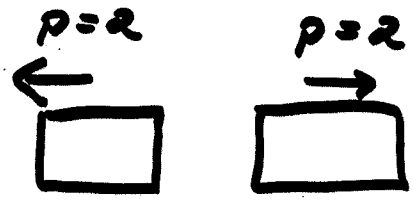
$p_i \neq p_f$ momentum not conserved so cannot happen

Before



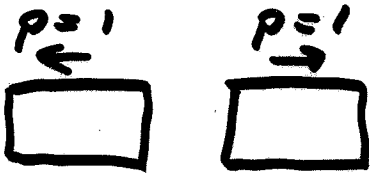
Total $\vec{p} = 0$

① after



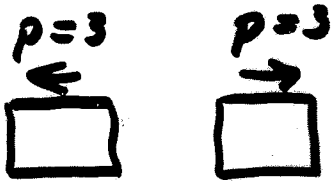
Total $\vec{p} = 0$

② after



Total $\vec{p} = 0$

③ after



Total $\vec{p} = 0$

③ not possible, cannot gain energy ✗

ex) A 100 g ball is dropped from a height of 2.0 m above ground. It rebounds to a height of 1.5 m. What was the average force exerted by the floor if the ball was in contact with the floor for 0.1 s

$F = \frac{\Delta p}{\Delta t}$ $\quad E_i = E_f$

$mgh = \frac{1}{2}mv^2 \quad v = \pm\sqrt{2gh}$

$v = -\sqrt{2(9.8 m/s^2)(2m)}$ $= -6.26$ m/s hits ground

bounces up ↑ $\quad E_i = E_f$

$\frac{1}{2}mv^2 = mgh \quad v = \pm\sqrt{2gh}$

$v = +\sqrt{2(9.8 m/s^2)(1.5m)} = +5.42$ m/s

$\Delta p = mv_f - mv_i = (0.1kg)(5.42 m/s) -$
$(0.1kg)(-6.26 m/s) = 1.17$ kg-m/s

$F = \frac{\Delta p}{\Delta t} = \frac{1.17 kg\text{-}m/s}{0.1 s} = 11.7 N$

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.

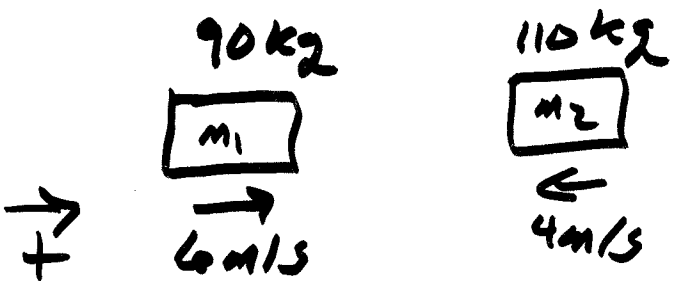
C) It takes more time to stop the ping-pong ball.

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

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

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

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

$\vec{p}_i = m_1\vec{v}_{1i} + m_2\vec{v}_{2i}$

$v_{1f} = v_{2f} = v_f$

$\vec{p}_f = m_1\vec{v}_{1f} + m_2\vec{v}_{2f} = (m_1 + m_2)v_f$

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

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

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

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

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

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

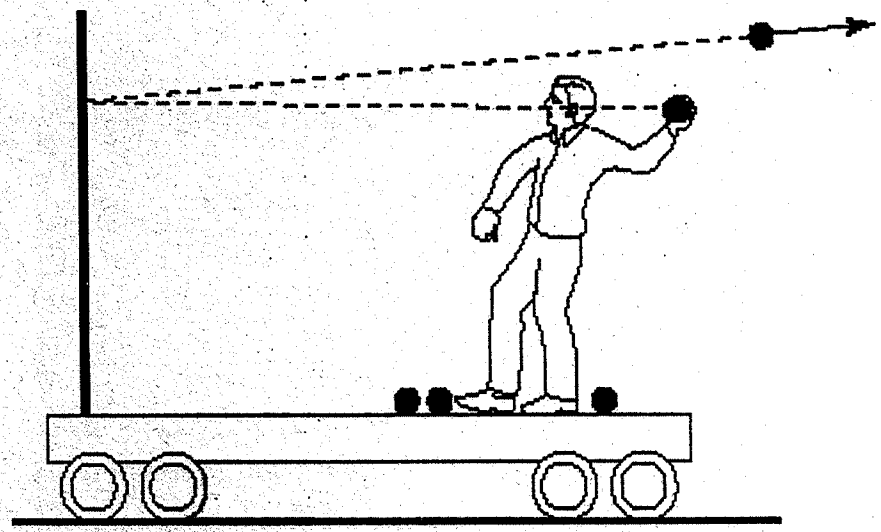
Interactive Question

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.

Interactive Question

You are on a cart initially at rest on a track with no friction. You throw balls at a partition that is rigidly mounted on the cart. If the balls bounce straight back as shown, is the cart put in motion?



A) Yes, it moves to the right.
B) Yes, it moves to the left.
C) No, it remains in place.