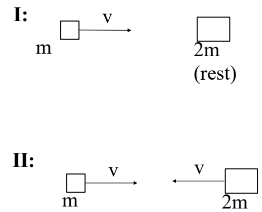
In which situation is the magnitude of the total momentum of the system the largest?

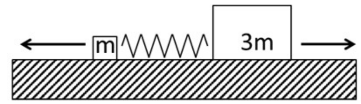


A) Situation I has larger total $|\vec{p}|$

B) Situation II has larger total $|\vec{p}|$

C) Same total $|\vec{p}|$ in both situations

Two masses, m and $3m$, are at rest on a frictionless surface. A compressed, massless spring between them is suddenly allowed to uncompress, pushing the masses apart. After the masses are apart, the speed of m is ____ the speed of $3m$.



A) the same as

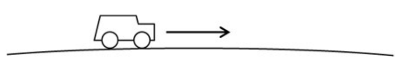
B) two times

C) three times

D) nine times

E) None of these

A car sits on the Earth's surface. Both the car and the Earth are at rest. (Pretend the Earth is not rotating or revolving around the Sun.) The car accelerates to a final velocity. After the car reaches v_{final}, the magnitude of the Earth's momentum is ___________ the magnitude of the car's momentum.



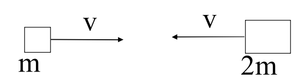
A) more than

B) the same as

C) less than

D) It depends on the ratio of the mass of the car and the mass of the Earth

Two masses are about to collide and stick together, what will be the final speed?



A) zero

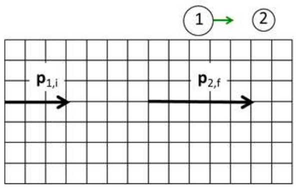
B) v

C) $v/2$

D) $v/3$

E) none of these

Ball 1 strikes *stationary* Ball 2 in a one dimensional (1-D) collision. Two of the relevant momenta, $\vec{\boldsymbol{p}}_{1,i}$ and $\vec{\boldsymbol{p}}_{2,f}$ are given in the figure. Taking the positive direction to the right, what is $\vec{\boldsymbol{p}}_{1,f}$ in "graph units"?



A) 0

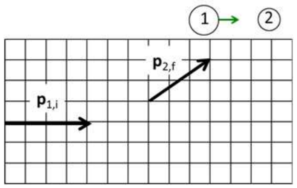
B) +2

C) −2

D) Something else

E) Wait, this is impossible!

Ball 1 strikes *stationary* Ball 2 in a 2-D collision. Two of the relevant momenta, $\vec{\boldsymbol{p}}_{1,i}$ and $\vec{\boldsymbol{p}}_{2,f}$ are given in the figure. Taking the positive direction to the right, what is $p_{1,f,x}$ in "graph units"?



A) 0

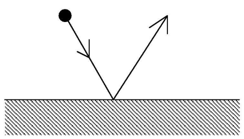
B) +1

C) -1

D) None of these

E) This time it's impossible!

A ball bounces off the floor elastically as shown. The direction of change in momentum of the ball, $\Delta\vec{\boldsymbol{p}}$, is…



A) Straight up ↑

B) Straight down ↓

C) To the right →

D) To the left ←

E) Zero

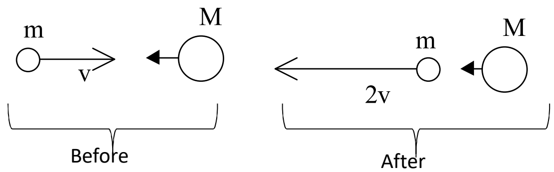
Suppose a tennis ball and a bowling ball are rolling toward you. Both have the same momentum, and you exert the same force to stop each. How do the time intervals to stop them compare?

A) It takes less time to stop the tennis ball.

B) Both take the same time.

C) It takes more time to stop the tennis ball.

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 $2v$. What is the magnitude of the impulse delivered to ball 1?



A) mv

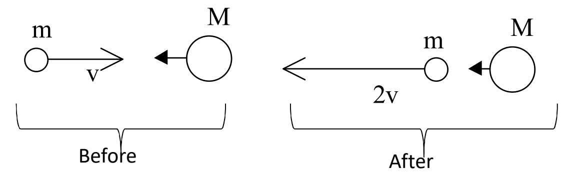
B) $2mv$

C) $3mv$

D) $\frac{1}{2}mv$

E) None of these

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) $\frac{1}{2}mv$

E) None of these

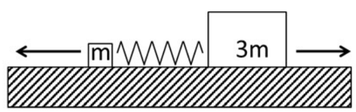
Which ball is more likely to knock over the wood?

A) The elastic, bouncy one (the “happy” ball)

B) The inelastic, flat one (the “sad” ball)

C) Both equally likely

Two masses, m and $3m$, are at rest on a frictionless surface. A compressed, massless spring between them is suddenly allowed to uncompress, pushing the masses apart. After the masses are apart, the KE of m is ____ the KE of $3m$.



A) the same as

B) greater than

C) less than

Two masses m_1 and m_2 are approaching each other on a frictionless table and collide. Is it possible that, as a result of the collision, all of the kinetic energy of both masses is converted to other forms of energy? [You aren't given the masses or speeds – I'm asking whether there exist masses and speeds such that it's possible]

A) Yes, all the KE can disappear

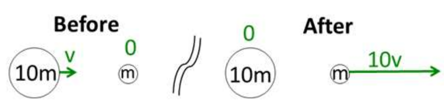
B) No, it's impossible

A moving mass m_1 is approaching a stationary mass m_2 on a frictionless table. Is it possible that, as a result of the collision, all of the kinetic energy of both masses is converted to other forms of energy? [Again, I'm asking whether there exist masses and speeds such that it's possible]

A) Yes, all the KE can disappear

B) No, it's impossible

A big ball, mass $M = 10m$, speed v, strikes a small ball, mass m, at rest. Could the following occur? The big ball comes to a complete stop and the small ball takes off with speed $10v$. (Assume they all remain at constant temperature.)

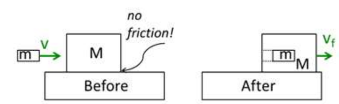


A) Yes, it could.

B) No, it would violate conservation of momentum.

C) No, it would violate conservation of energy.

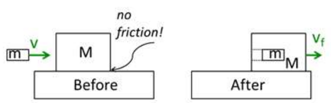
A bullet (mass m, velocity v) is fired into a wood block (mass M) initially at rest on a frictionless surface. The bullet buries itself in the wood block and then the wood block is seen to have a final velocity v_f. Was this an *elastic* collision?



A) Yes

B) No

A bullet (mass m, velocity v) is fired into a wood block (mass M) initially at rest on a frictionless surface. The bullet buries itself in the wood block and then the wood block is seen to have a final velocity v_f. True or False: $mv = Mv_f$

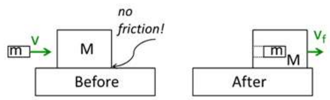


A) True

B) False

A bullet (mass m, velocity v) is fired into a wood block (mass M) initially at rest on a frictionless surface. The bullet buries itself in the wood block and then the wood block is seen to have a final velocity v_f.

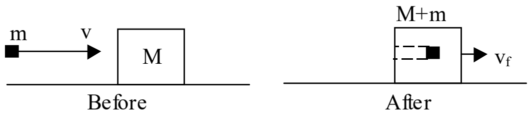
True or False: $\frac{1}{2}mv^2 = \frac{1}{2}(M+m){v_f}^2$



A) True

B) False

A bullet of mass m traveling horizontally with initial speed v strikes a wooden block of mass M resting on a frictionless table. The bullet buries itself in the block, and the block+bullet have a final speed vf. Fill in the blank: The total kinetic energy of the bullet+block after the collision is _________ the total KE before the collision.



A) greater than

B) less than

C) equal to

A Cadillac and a Volkswagen have a head-on collision and stick to together in a mangled pile of metal. The police determine that the wreckage is in the exact same spot where the two cars collided. Detective O'Newton (who got an A in Physics 1110) writes in her report that, just prior to the collision, the two cars had the same...

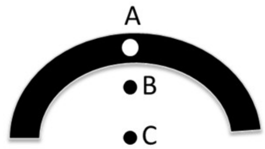
A) magnitude of momentum

B) kinetic energy

C) mass

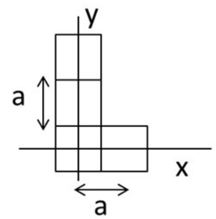
D) speed

Roughly where do you expect the CM of a semicircular arc of solid material?



D) None of these looks even close!

Four square floor tiles are laid out in an L-pattern as shown. The origin of the x-y axes is at the center of the lower left tile. Find the x-coordinate of the center of mass.



A) a

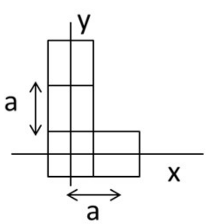
B) a/2

C) a/3

D) a/4

E) None of these

Four square floor tiles are laid out in an L-pattern as shown. The origin of the x-y axes is at the center of the lower left tile. Find the y-coordinate of the center of mass.



A) a

B) a/2

C) a/3

D) a/4

E) None of these

A mass m moves right with speed v. It is heading to collide with mass $2m$ (which is at rest). What is the velocity v_{CM} of the system BEFORE the collision?

A) v

B) v/2

C) v/3

D) 2/3 v

E) 0

A mass m moves right with speed v. It is heading to collide with mass $2m$ (which is at rest). What is the velocity v_{CM} of the system AFTER the collision?

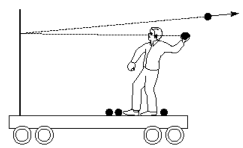
A) still v/3

B) 0

C) something else

D) It depends on if its and elastic collision or not

Suppose you are on a cart, initially at rest on a track with very little friction. You throw balls at a partition that is rigidly mounted on the cart. If the balls bounce straight back as shown in the figure, is the cart put in motion?



A) Yes, to the left

B) Yes, to the right

C) No

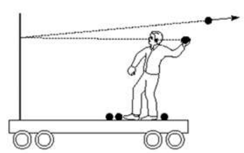
You see a cart, initially at rest on a track with very little friction. There is a thin curtain in front of it. Then you see some heavy balls start flying out to the right. As they start coming out, is the cart put in motion?

A) Yes, to the left

B) Yes, to the right

C) No

In the previous question(s), what is happening to the location of the CM of the *entire system* (person + cart + heavy balls)



A) Shifting left

B) Shifting right

C) Staying put