

## Momentum and Impulse

### Concept Tests

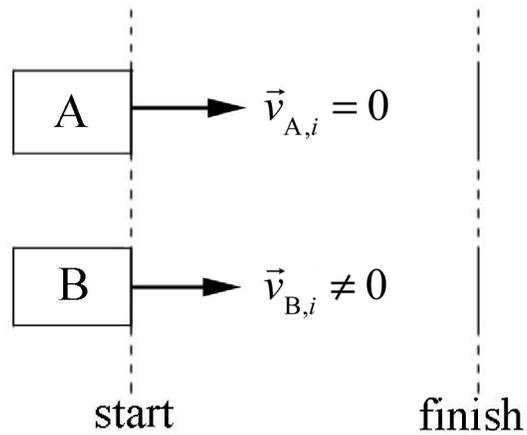
**Question 1** Consider two carts, of masses  $m$  and  $2m$ , at rest on an air track. If you push first one cart for 3 s and then the other for the same length of time, exerting equal force on each, the momentum of the light cart is

1. four times
2. twice
3. equal to
4. one-half
5. one-quarter

the momentum of the heavy cart.

## Question 2 Pushing Identical Carts

Identical constant forces push two identical objects A and B continuously from a starting line to a finish line. If A is initially at rest and B is initially moving to the right,



1. Object A has the larger change in momentum.
2. Object B has the larger change in momentum.
3. Both objects have the same change in momentum
4. Not enough information is given to decide.

### Question 3 Pushing Non-Identical Carts

Consider two carts, of masses  $m$  and  $2m$ , at rest on an air track. If you push first one cart for 3 s and then the other for the same length of time, exerting equal force on each, the kinetic energy of the light cart is

1. larger than
2. equal to
3. smaller than

the kinetic energy of the heavy car.

**Question 4: Same Momentum Different Masses**

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 distances needed to stop them compare?

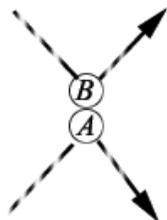
1. It takes a shorter distance to stop the ping-pong ball.
2. Both take the same distance.
3. It takes a longer distance to stop the ping-pong ball.
4. Not enough information is given to decide.

### Question 5

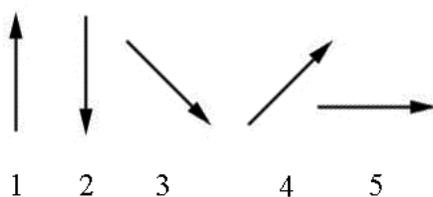
A ball is thrown against a wall; the ball bounces off and returns with speed equal to the speed it had before striking the wall. Which of the following statements is true from before to after the collision between the ball and the wall? Explain your answer.

- 1) The kinetic energy of the ball is the same.
- 2) The momentum of the ball is the same.
- 3) Both the kinetic energy and the momentum of the ball are the same.
- 4) Neither the kinetic energy nor the momentum of the ball are the same.
- 5) The collision is inelastic.
- 6) Two of the above.

**Question 6** The figure below depicts the paths of two colliding steel balls, *A* and *B*.

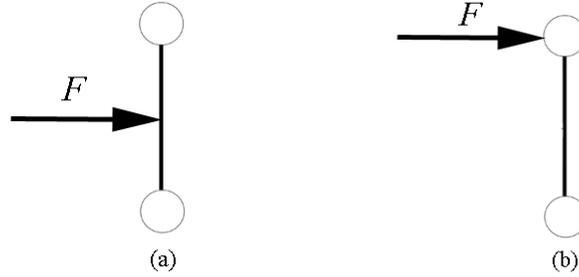


Which of the arrows 1-5 best represents the impulse applied to ball *B* by ball *A* during the collision? Explain your answer.



**Question 7**

A force of magnitude  $F$  is applied to a dumbbell first as in (a) and then as in (b). In which case does the dumbbell acquire the greater center-of-mass acceleration? Explain your reasoning.



### Question 8

Skater A of mass 75 kg and skater B of mass 50 kg are initially at rest some distance apart. Each skater holds tightly onto a rope of negligible mass. Skater A pulls on the rope with constant force so that the skaters approach each other and meet. The ice is completely frictionless. Which statements below are true and which are false? Explain your reasoning.

1. Only skater B moves relative to the ice.
2. The magnitude of the acceleration of skater A is less than the magnitude of the acceleration of skater B.
3. Just before they meet, the speed of skater A is less than the speed of B.
4. While the skaters are moving, their momentum vectors have equal magnitudes.

MIT OpenCourseWare  
<http://ocw.mit.edu>

## 8.01SC Physics I: Classical Mechanics

For information about citing these materials or our Terms of Use, visit: <http://ocw.mit.edu/terms>.