

AP PHYSICS I
Chapter 9 Review

Name: _____ Period: _____ Date: _____

- 1) A rubber ball and a lump of clay have equal mass. They are thrown with equal speed against a wall. The ball bounces back with nearly the same speed with which it hit. The clay sticks to the wall. Which one of these objects experiences the greater momentum change?
 - A) the clay
 - B) the ball
 - C) Both of them experience the same non-zero momentum change.
 - D) Both of them experience zero momentum change.
- 2) A tiger is running in a straight line. If we double both the mass and speed of the tiger, the magnitude of its momentum will increase by what factor?
 - A) $\sqrt{2}$
 - B) 8
 - C) 4
 - D) 2
 - E) 16
- 3) You are standing on a skateboard, initially at rest. A friend throws a very heavy ball towards you. You have two choices about what to do with the ball: either catch the ball or deflect it back toward your friend with the same speed as it was originally thrown. Which choice should you make in order to maximize your speed on the skateboard?
 - A) Catch the ball.
 - B) Deflect the ball back.
 - C) Your final speed on the skateboard will be the same regardless whether you catch the ball or deflect the ball.
- 4) A small car meshes with a large truck in a head-on collision. Which of the following statements concerning the momentum during the collision are correct? (There could be more than one correct choice.)
 - A) The car and the truck must undergo the same change in speed.
 - B) The momentum of the truck is conserved.
 - C) The momentum of the car-truck system is conserved, but the momentum of each one separately is not conserved.
 - D) The momentum of the car is conserved.
 - E) The momentum of the car and the momentum of the truck are each conserved.
- 5) Consider two less-than-desirable options. In the first you are driving 30 mph and crash head-on into an identical car also going 30 mph. In the second option you are driving 30 mph and crash head-on into a stationary brick wall. In neither case does your car bounce back from the thing it hits, and the collision time is the same in both cases. Which of these two situations would result in the greater impact force on your car?
 - A) The force would be the same in both cases.
 - B) hitting the other car
 - C) hitting the brick wall
 - D) None of the above choices are correct.
- 6) Identical forces act for the same length of time on two different objects. The magnitude of the change in momentum of the lighter object is
 - A) larger than the magnitude of the change in momentum of the larger mass.
 - B) exactly equal to the magnitude of the change in momentum of the larger mass.
 - C) zero.
 - D) smaller than the magnitude of the change in momentum of the larger mass, but not zero.
 - E) There is not enough information to answer the question.

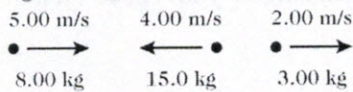
7) A very light ping-pong ball moving east at a speed of 4 m/s collides with a very heavy stationary bowling ball. The Ping-Pong ball bounces back to the west, and the bowling ball moves very slowly to the east. Which object experiences the greater magnitude impulse during the collision?

- A) Neither; both experienced the same magnitude impulse.
- B) the bowling ball
- C) the Ping-Pong ball
- D) It is impossible to tell since the actual mass values are not given.
- E) It is impossible to tell since the velocities after the collision are unknown.

8) A 5-kg ball collides inelastically head-on with a 10-kg ball, which is initially stationary. Which of the following statements is true? (There could be more than one correct choice.)

- A) The magnitude of the change of the momentum of the 5-kg ball is equal to the magnitude of the change of momentum of the 10-kg ball.
- B) The magnitude of the change of velocity the 5-kg ball experiences is less than that of the 10-kg ball.
- C) The magnitude of the change of velocity the 5-kg ball experiences is equal to that of the 10-kg ball.
- D) The magnitude of the change of velocity the 5-kg ball experiences is greater than that of the 10-kg ball.
- E) Both balls lose all their momentum since the collision is inelastic.

9) Three objects are moving along a straight line as shown in the figure. Taking the positive direction to be to the right, what is the total momentum of this system?

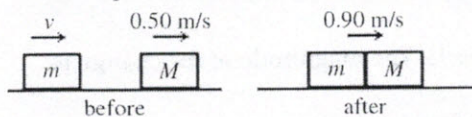


- A) $+106 \text{ kg} \cdot \text{m/s}$
- B) $-106 \text{ kg} \cdot \text{m/s}$
- C) $-14.0 \text{ kg} \cdot \text{m/s}$
- D) $0.00 \text{ kg} \cdot \text{m/s}$
- E) $+14.0 \text{ kg} \cdot \text{m/s}$

10) Two air track carts move along an air track towards each other. Cart A has a mass of 450 g and moves toward the right with a speed of 0.850 m/s. Cart B has a mass of 300 g and moves toward the left with a speed of 1.12 m/s. What is the total momentum of the two-cart system?

- A) $0.047 \text{ kg} \cdot \text{m/s}$ toward the right
- B) $0.719 \text{ kg} \cdot \text{m/s}$ toward the right
- C) $0.750 \text{ kg} \cdot \text{m/s}$ toward the right
- D) $0.750 \text{ kg} \cdot \text{m/s}$ toward the left
- E) $0.719 \text{ kg} \cdot \text{m/s}$ toward the left

11) A block of mass $m = 34 \text{ kg}$ and speed V is behind a block of mass $M = 81 \text{ kg}$ and speed of 0.50 m/s , as shown in the figure. The surface is frictionless and the blocks collide and couple. After the collision, the blocks have a common speed of 0.90 m/s . What is the magnitude of the impulse on the 34-kg block due to the collision?



- 12) A 2.0-kg ball moving eastward at 3.0 m/s suddenly collides with and sticks to a 4.0-kg ball moving northward at 2.0 m/s. What is the magnitude of the momentum of this system just after the collision?
- 13) A 0.14-kg baseball is dropped from rest from a height of 2.0 m above the ground. What is the magnitude of its momentum just before it hits the ground if we neglect air resistance?
- 14) A firecracker breaks up into two pieces, one of which has a mass of 200 g and flies off along the $+x$ -axis with a speed of 82.0 m/s. The second piece has a mass of 300 g and flies off along the $+y$ -axis with a speed of 45.0 m/s. What is the total momentum of the two pieces?
- 15) A 60-kg swimmer suddenly dives horizontally from a 150-kg raft with a speed of 1.5 m/s. The raft is initially at rest. What is the speed of the raft immediately after the diver jumps if the water has negligible effect on the raft?

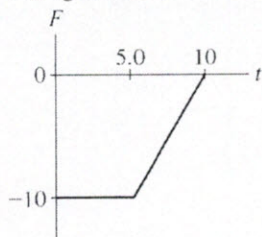
16) In a police ballistics test, 2.00-g bullet traveling at 700 m/s suddenly hits and becomes embedded in a stationary 5.00-kg wood block. What is the speed of the block immediately after the bullet has stopped moving relative to the block?

17) A 328-kg car moving at 19.1 m/s in the $+x$ direction hits from behind a second car moving at 13.0 m/s in the same direction. If the second car has a mass of 790 kg and a speed of 15.1 m/s right after the collision, what is the velocity of the first car after this sudden collision?

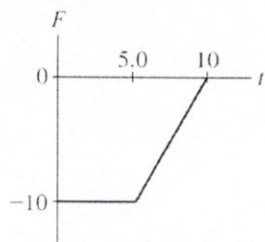
18) An empty train car of mass 2.0×10^4 kg coasts along at 10 m/s. A 3000-kg boulder is suddenly dropped vertically into the car. Find the speed of the car immediately after the boulder is dropped in.

19) A 1200-kg cannon suddenly fires a 100-kg cannonball at 35 m/s. What is the recoil speed of the cannon? Assume that frictional forces are negligible and the cannon is fired horizontally.

20) The graph in the figure shows the x component F of the net force that acts for 10 s on a 100-kg crate. What is the change in the momentum of the crate during the 10 s that this force acts?



- 21) A forklift pushes a 100-kg crate, starting from rest, with a horizontal force of magnitude F . The graph in the figure shows the x component of this force as a function of time. What is the instantaneous velocity of the crate at time $t = 10$ s?



- 22) A batter hits a 0.140-kg baseball that was approaching him at 30 m/s and, as a result, the ball leaves the bat at 40 m/s in the reverse of its original direction. The ball remains in contact with the bat for 2.0 ms. What is the magnitude of the average force exerted by the bat on the ball?

- 23) A girl of mass 55 kg throws a ball of mass 0.80 kg against a wall. The ball strikes the wall horizontally with a speed of 25 m/s, and it bounces back with this same speed. The ball is in contact with the wall 0.050 s. What is the magnitude of the average force exerted on the wall by the ball?

- 24) A 475-gram ball is traveling horizontally at 12.0 m/s to the left when it is suddenly struck horizontally by a bat, causing it to reverse direction and initially travel at 8.50 m/s to the right. If the bat produced an average force of 1275 N on the ball, for how long (in milliseconds) was it in contact with the ball?