6) Two friends are standing on opposite ends of a canoe that is initially at rest with respect to a frictionless lake. The person in the front throws a very massive ball toward the back, and the person in the back catches it. After the ball is caught, the canoe is
A) moving backward.
B) stationary.
C) moving forward.

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 ball
B) the clay
C) Both of them experience the same non-zero momentum change.
D) Both of them experience zero momentum change.

8) A small car meshes with a large truck in a head-on collision. Which of the following statements concerning the magnitude of the momentum change during the collision is correct? (There could be more than one correct choice.)
A) The truck experiences the greater magnitude momentum change.
B) The small car experiences the greater magnitude momentum change.
C) The small car and the truck experience the same magnitude momentum change.
D) The magnitude of the momentum change experienced by each one is inversely proportional to its mass.
E) The magnitude of the momentum change experienced by each one is directly proportional to its mass.

12) Which of the following quantities are units of impulse? (There could be more than one correct choice.)
A) $N \cdot m$
B) $kg \cdot s/m$
C) $kg \cdot m/s$
D) $N \cdot s$
E) $kg \cdot m^2/s^2$

13) Three cars, car X, car Y, and car Z, begin accelerating from rest at the same time. Car X is more massive than car Y, which is more massive than car Z. The net accelerating force exerted on each car is identical. After 10 seconds, which car has the most amount of momentum?
A) They all have the same amount of momentum.
B) Car X
C) Car Y
D) Car Z

18) A small car meshes with a large truck in a head-on collision. Which of the following statements concerning the magnitude of the average force during the collision is correct?
A) The truck experiences the greater average force.
B) The small car experiences the greater average force.
C) The small car and the truck experience the same average force.
D) The force experienced by each one is inversely proportional to its mass.
E) The force experienced by each one is directly proportional to its mass.

2) 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?
A) 0.28 kg · m/s
B) 0.88 kg · m/s
C) 0.44 kg · m/s
D) 0.62 kg · m/s
E) 1.4 kg · m/s

1) What is the magnitude of the momentum of a 0.140 kg baseball traveling at 45.0 m/s?

6) A 100-g ball falls from a window that is 12 m above ground level and experiences no significant air resistance as it falls. What is its momentum when it strikes the ground?
A) 3.3 kg · m/s
B) 4.8 kg · m/s
C) 1.8 kg · m/s
D) 1.5 kg · m/s
E) 2.4 kg · m/s

7) A 0.140-kg baseball is dropped and reaches a speed of 1.20 m/s just before it hits the ground and bounces. It rebounds with an upward velocity of 1.00 m/s. What is the change of the ball's momentum during the bounce?
A) 0.0280 kg · m/s upwards
B) 0.0280 kg · m/s downwards
C) 0.308 kg · m/s upwards
D) 0.308 kg · m/s downwards
E) 0.000 kg · m/s

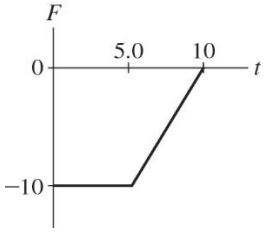
14) In a police ballistics test, 2.00-g bullet traveling at 700 m/s suddenly hits and becomes embedded in a stationary 5.00-kg wood block. What is the speed of the block immediately after the bullet has stopped moving relative to the block?

17) 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 $35\ \text{m/s}$. What is the recoil speed of the cannon? Assume that frictional forces are negligible and the cannon is fired horizontally.
A) 2.9 m/s
B) 35 m/s
C) 3.5 m/s
D) 3.2 m/s

21) A dinner plate falls vertically to the floor and breaks up into three pieces, which slide horizontally along the floor. Immediately after the impact, a 320-g piece moves along the +*x*-axis with a speed of 2.00 m/s and a 355-g piece moves along the +*y*-axis with a speed of 1.50 m/s. The third piece has a mass of 100 g. In what direction relative to the +*x*-axis does the third piece move?
A) 216.9° from the +*x*-axis
B) 219.8° from the +*x*-axis
C) 36.9° from the +*x*-axis
D) 39.9° from the +*x*-axis
E) 39.8° from the +*x*-axis

28) 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?



A) 25 cm/s
B) 0.00 cm/s
C) 75 cm/s
D) -25 cm/s
E) -75 cm/s

32) A 0.17-kg baseball is thrown with a speed of 38 m/s and it is hit straight back toward the pitcher with a speed of 62 m/s. What is the magnitude of the impulse exerted upon the ball by the bat?

35) A 0.140-kg baseball is thrown with a velocity of 27.1 m/s. It is struck by the bat with an average force of 5000 N, which results in a velocity of 37.0 m/s in the opposite direction from the original velocity. How long were the bat and ball in contact?
A) 1.79×10^{-3} s
B) 1.28×10^{-2} s
C) 3.07×10^{-2} s
D) 4.30×10^{-3} s

38) 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?

63) A 1500-kg car traveling at 90 km/h toward the east suddenly collides with a 3000-kg car traveling at 60 km/h toward the south. The two cars stick together after the collision. What is the speed of the cars after collision?
A) 8.3 m/s
B) 14 m/s
C) 17 m/s
D) 22 m/s

15) 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?
A) 14.0 m/s
B) 18.2 m/s
C) 24.2 m/s
D) -14.0 m/s