**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) 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) stationary. B) moving forward. C) moving backward.**

**3) A 1200-kg ferryboat is moving south at 20 m/s. What is the magnitude of its momentum?**

**A) 2.4 × 104 kg∙m/s B) 6.0 × 102 kg∙m/s**

**C) 2.4 × 103 kg∙m/s D) 1.7 × 10-3 kg∙m/s**

**4) What is the momentum of a 2000-kg truck traveling at 35 m/s?**

**A) 7.0 × 104 kg∙m/s B) 3.5 × 104 kg∙m/s**

**C) 57 kg∙m/s D) 7.0 × 105 kg∙m/s**

**5) A 50-kg pitching machine (excluding the baseball) is placed on a frozen pond. The machine fires a 0.40-kg baseball with a speed of 35 m/s in the horizontal direction. What is the recoil speed of the pitching machine? (Assume negligible friction.)**

**A) 4.4 × 103 m/s B) 0.70 m/s**

**C) 0.14 m/s D) 0.28 m/s**

**6) A 1000-kg car traveling at 25 m/s runs into the rear of a stopped car that has a mass of 1500 kg and they stick together. What is the speed of the cars after the collision?**

**A) 15 m/s B) 5.0 m/s C) 20 m/s D) 10 m/s**

**7) A constant 9.0-N net force acts for 2.0 s on a 6.0-kg object. What is the object's change of velocity?**

**A) 9.0 m/s B) 27 m/s C) 3.0 m/s D) 110 m/s**

**8) A 2000-kg car, traveling to the right at 30 m/s, collides with a brick wall and comes to rest in 0.20 s. What is the average force the car exerts on the wall?**

**A) 12,000 N to the right B) 60,000 N to the right**

**C) 300,000 N to the right D) none of the above**

**9) A 3.0-kg object moves to the right with a speed of 2.0 m/s. It collides in a perfectly elastic collision with a 6.0-kg object moving to the left at 1.0 m/s. What is the total kinetic energy after the collision?**

**A) 9.0 J B) 0 J C) 3.0 J D) 6.0 J**

**10) 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) hitting the brick wall**

**B) hitting the other car**

**C) The force would be the same in both cases.**

**D) None of the above choices are correct.**

**11) A firecracker breaks up into two pieces, one has a mass of 200 g and flies off along the x-axis with a speed of 82.0 m/s and the second 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?**

**A) 21.2 kg∙m/s at 56.3° from the x-axis**

**B) 21.2 kg∙m/s at 39.5° from the x-axis**

**C) 93.5 kg∙m/s at 28.8° from the x-axis**

**D) 361 kg∙m/s at 56.3° from the x-axis**

**E) 361 kg∙m/s at 0.983° from the x-axis**

**12) 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 and air track 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 system?**

**A) 0.719 kg∙m/s toward the left**

**B) 0.750 kg∙m/s toward the left**

**C) 0.719 kg∙m/s toward the right**

**D) 0.047 kg∙m/s toward the right**

**E) 0.750 kg∙m/s toward the right**

**13) A golf club exerts an average force of 1000 N on a 0.045-kg golf ball which is initially at rest. The club is in contact with the ball for 1.8 ms. What is the speed of the golf ball as it leaves the tee?**

**A) 45 m/s B) 50 m/s C) 30 m/s**

**D) 40 m/s E) 35 m/s**

**14) A 0.140-kg baseball is dropped from rest from a height of 2.2 m above the ground. It rebounds to a height of 1.6 m. What change in the ball's momentum occurs when the ball hits the ground?**

**A) 1.70 kg∙m/s upwards**

**B) 0.350 kg∙m/s upwards**

**C) 0.350 kg∙m/s downwards**

**D) 0.117 kg∙m/s downwards**

**E) 0.117 kg∙m/s upwards**

**15) A batter hits a 0.140-kg baseball that was approaching him at 40.0 m/s and, as a result, the ball leaves the bat at 30.0 m/s in the direction of the pitcher. What is the magnitude of the impulse delivered to the baseball?**

**A) 9.80 Ns B) 7.00 Ns C) 4.90 Ns**

**D) 1.40 Ns E) 5.60 Ns**

**16) Two ice skaters push off against one another starting from a stationary position. The 45-kg skater acquires a speed of 0.375 m/s. What speed does the 60-kg skater acquire?**

**A) 0.500 m/s B) 0.281 m/s**

**C) 0.750 m/s D) 0 m/s E) 0.375 m/s**

**17) A 500-kg cannon fires a 4.0-kg projectile with a velocity of 500 m/s relative to the ground. What is the recoil speed of the cannon?**

**A) 2.0 m/s B) 4.0 m/s C) 6.0 m/s**

**D) 8.0 m/s E) 1.0 m/s**

**18) A 900-kg car traveling east at 15.0 m/s collides with a 750-kg car traveling north at 20.0 m/s. The cars stick together. What is the speed of the wreckage just after the collision?**

**A) 6.10 m/s B) 17.3 m/s C) 35.0 m/s**

**D) 12.2 m/s E) 25.0 m/s**

**19) A 2.0-kg mass moves with a speed of 5.0 m/s. It collides head-on with a 3.0 kg mass at rest. If the collision is perfectly inelastic, what is the speed of the masses after the collision?**

**A) 2.5 m/s B) 0, since the collision is inelastic**

**C) 10 m/s D) 2.0 m/s**

**20) A 2.0-kg mass moving to the east at a speed of 4.0 m/s collides head-on in a perfectly inelastic collision with a stationary 2.0-kg mass. How much kinetic energy is lost during this collision?**

**A) 8.0 J B) 4.0 J C) zero D) 16 J**

**1) B**

**2) A**

**3) A**

**4) A**

**5) D**

**6) D**

**7) C**

**8) C**

**9) A**

**10) C**

**11) B**

**12) D**

**13) D**

**14) A**

**15) A**

**16) B**

**17) B**

**18) D**

**19) D**

**20) A**