Comprehensive Worksheet: Unit 5 – Momentum and Circular Motion

Worksheet: Momentum and Impulse

1. How much momentum does a 3500 kg truck have when traveling 2.36 m/s?
2. How much momentum does a 66.8 kg bicycle and rider have when traveling 23.5 m/s?
3. If the momentum of a 165.3 kg speed skater is 2475.0 kg m/s, how fast is she traveling?
4. What is the magnitude of the momentum of a 22.1 gram sparrow flying at a velocity of 8.6 m/s?
5. If the sparrow from the previous question hit a branch and stopped fairly abruptly, what average force did the branch apply if it stopped the sparrow in
   a) 0.80 cm
   b) 3.12 cm
6. A 0.06 kg tennis ball, initially at rest, is hit from the racket with a velocity of 33.6 m/s. If the time that the racket and ball were in contact with each other was 0.06 seconds, then what force was required to move the ball?
7. The same ball from the previous question crossed the net towards the awaiting opponent. The ball reached the opponent with the velocity that it left the original players racket with. If the ball was again contacting the racket for 0.06 seconds, what force would the second player now have to impart on the ball to return the ball with a velocity of 27.9 m/s? The second player has the same time of contact.
8. A 0.08 kg baseball is accelerated for 0.28 seconds to a speed of 37.6 m/s. What is the average force applied to the ball during the throwing motion?
9. If the ball from question #8, still traveling at the same velocity, is caught by the catcher is a distance of 7.9 cm, what impulse was imparted by the catcher in catching the ball?
10. This time, the catcher did not catch the ball from question #8. Instead, Ken Griffy Jr. smacked the ball to deep center field. The ball contacted the bat for a total of 0.0042 seconds. If the ball left the bat with a velocity of 40.4 m/s, what impulse was imparted by the bat during the hit?

Extra question:
If the ball from question # 8 left the bat at a 39.0 degree angle to the horizon, would the ball clear the 2 meter high wall that was 430 ft away in dead center? How far would the ball have traveled horizontally, when it returns to height that it was hit from?

Worksheet: Conservation of Momentum

1. A 3500 kg truck slams into the back of a parked car with a velocity of 14.3 m/s. The truck comes to a halt, and the car, of mass 1500 kg has no other forces acting on it. What is the car's velocity?
2. The same truck from question #1 traveling at the same initial velocity again slams into a parked car with the same mass. This time, instead of the truck coming to rest, it rolls forward with a velocity of 1.5 m/s. What is the car's velocity?
3. The driver of the truck from question #1, again, traveling the same speed hits a car of the same mass. This time, the car had been moving with a velocity of 10 m/s. If their bumpers become locked in the collision, what is their collective velocity after the collision?
4. A child in a boat throws a 5.40 kg package out horizontally with a speed of 10.0 m/s. Calculate the velocity of the boat, which was originally at rest, immediately after the boy tossed the package. The mass of the child is 26.0 kg and that of the boat is 55.0 kg.
5. Two rail freight cars are being hitched together. The first car has a mass of 15,750 kg and is moving at a speed of 4.00 m/s toward the second car. The second car is stationary and has a mass of 19,250 kg. Calculate the final velocity of the two hitched cars.
6. Jimmy disobeys his mother's stern orders and plays with a BB gun in the house. The gun accidentally goes off and sends a BB hurling across the room. If the 0.00100 kg projectile traveling at a speed of 89.3 m/s lodges in a 0.203 kg block of cheese on a frictionless table, how fast would the BB/Cheese combo slide across the table?
7. A 9500 kg boxcar traveling at 16.0 m/s strikes a second car at rest. The two stick together and move off with a speed of 6.0 m/s. What is the mass of the second car?
8. Running back, Tiki Barber breaks away from the line. It appears that he will easily score. His brother Ronde, at 85 kg Ronde runs him down and tackles him. Tiki, at 95 kg was running 4.1 m/s when tackled by Ronde, who was running 5.5 m/s. If momentum was conserved, what was their speed, as they collectively fell to the ground?
9. Two 0.123 kg pool balls came off the bunkers headed directly at each other. The one ball had a speed of 4.7 m/s, the fifteen ball was rolling with a speed of 0.014 m/s. After the balls collide, the one ball continues to roll in the same direction that it was originally rolling in, but with a speed of 1.2 m/s. What would be the new speed of the fifteen ball?
10. Sergio Garcia hit a 0.045 kg golf ball off the tee at an initial speed of 45 m/s. The golf club was in contact with the ball for 5 x 10^{-3} seconds. Find
    a) The impulse imparted to the golf ball.
    b) The average force exerted on the ball by the club.
11. A 12,500 kg railroad car travels alone on a level frictionless track with a constant speed of 18.0 m/s. A 5750 kg load is dropped on the empty car. What will the car's speed now be?
12. The car from the previous problem then had part of the load, 5000 kg lifted back from the bed of the train. What would the new velocity of the train be?