Impulse (ANSWER KEY)

Solve the following problems

1. Make sure you have the correct equations on your equation sheet

$$p = mv \qquad \Delta p = J \qquad J = Ft$$

2. A car moving at 10 m/s crashes into a barrier and stops in 0.050 sec. There is a 20-kg child in the car. Assume that the child's velocity is changed by the same amount as the car's in the same time period. What impulse is needed to stop the child? Using the impulse-momentum theorem, what is the average force exerted on the child?

 F= 4000 N

 J= 200 Ns

3. A force of 420 N is applied on a large rock for 4 seconds. What is the impulse on the rock?

 1680 Ns

4. An 845-kg drag racer accelerates from rest to 100 km/h in 0.90 sec. What is the change in momentum of the dragster? What is the average force exerted on the car? What agent exerts that amount of force on the car?

 26 080 N

5. A steamer ship of mass 34 350 kg is traveling at 10 m/s. At this moment, what is the ship's momentum? If the ship's velocity is reduced to 4 m/s, what is its momentum now? What impulse was required to change the ship's momentum from part (a) to part (b)? After 95 seconds, the ship comes to a complete stop from its initial velocity and momentum. What force was required to stop the ship?

 206 100 Ns

 3615 N

6. A 10 000-kg freight car is rolling along a track at 3.00 m/s. Calculate the time needed for a force of 1000 N to stop the car.

 30s

7. A large bus of mass 1,421 kg is traveling at 25 m/s. At this moment, what is the bus' momentum? If the bus slows down to a velocity of 7 m/s, what is its momentum now? What impulse was required to reduce this velocity? After 9 seconds, the bus comes to a complete stop from its initial velocity. How much force was required to stop the ship?

 35525 kg m/s

 9947 kg m/s

 25578 kg m/s

 3947N

8. A skydiver is just about to jump out of a plane. His mass is 50 kg. What is his momentum right before he jumps? If he is falling at 20 m/s, what is his momentum? He pulls his parachute which slows him down to 5 m/s in a time of 2s. What force did the parachute exert on him? What impulse was applied by the parachute?

 0 Ns

 1000 Ns

 375 Ns

9. A minivan of mass 2,875 kg is traveling down the road at a velocity of 11m/s. What is its momentum at this instant? If the minivan decreases its velocity to 6m/s over a time of 18 seconds, what force was exerted to accomplish this? If, from its initial velocity, a force of 42 N is exerted on the minivan to bring it to a stop, how long in seconds would this take?

 31625 Ns

 749 N

 342 s

10. A 747 jet with a mass of 9,750 kg is traveling along at 140 m/s. What is the jet's momentum at this instant? If the jet decreases speed to 97 m/s in order to begin landing, what is its momentum now? What impulse was necessary to decrease the jet's momentum from part (a) to (b)?

   1 365 000 *kg m/s*

   945750 *kg m/s*

   419 250 *kg m/s*

11. What is the momentum of a car of mass 3426 kg parked in a parking lot. If the same car starts to drive home, and its momentum is equal to 47,964 N*s, what is the car's velocity? If the increases from part (a) to part (b) was done in 28s, what force was exerted?

   14 m/s

   1713 N

12. Super Bob the stuntman, who has a mass of 66 kg, wants to jump off a bridge attached to a bungee cord. Answer the following questions about his jump. What is Bob's momentum right before he jumps? If his initial velocity is 42 m/s, what is Bob's initial momentum? (this will be his momentum until the cord starts slowing him down) Eventually the cord starts slowing Bob down, and after 5s, his velocity is now 25 m/s. What was the net force exerted on Bob by the cord? After 14 s from the start of his jump, the cord is fully stretched and Bob temporarily comes to a stop at the bottom of his fall. What was the net force exerted on Bob by the cord to get him to stop?

   0 Ns

   2772 Ns

   224 N

   198 N

13. The velocity of a 600-kg car is changed from 10.0 m/s to 44.0 m/s in 68.0 sec by a constant force. What change in momentum does the force produce? Calculate the force needed to accomplish this change in speed.

   20400 *kg m/s*

   30 N

14. A hockey player makes a slap shot, exerting a force of 30.0 N on the hockey puck for 0.16 s. Find the impulse given to the puck. If the puck has a mass of 0.115 kg and was at rest before the shot, with what speed does it head toward the goal?

   4.8 Ns

   41 m/s

15. The engine of a rocket launches it upward with a net force of 9.3×10^6 N. The engine burns for 250 seconds. The rocket's mass is 2.9×10^5 kg.

   a. What is the impulse delivered to the rocket during the time that the engine burns?

   2.3×10^9 N s

   b. Assuming that it starts from rest on the ground, how fast is the rocket traveling after 250 seconds?
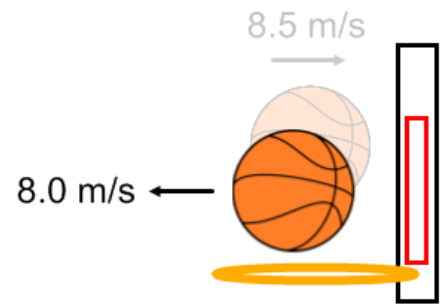
   8000 m/s

16. A 0.14-kg basketball is thrown toward the backboard with a speed 8.5 m/s. It rebounds with a speed of 8.0 m/s after being in contact with the backboard for 0.25 seconds.

    c. What was the basketball's change in momentum in this scenario?

        2.3 N s toward the left

8.5 m/s

8.0 m/s ⟵

    d. How much force does the backboard exert on the basketball?

        9.2 N