PHYSICS 11 ASSIGNMENT 3C
Momentum and Impulse

$$p=mv \qquad F\Delta t = \Delta p$$

1) Find the momentum of (a) a 0.50 kg ball traveling at 8.0 m/s and (b) a 1500 kg car traveling at 100 km/h.

2) The momentum of a runner who is moving at 20.0 km/h is 479 kg·m/s. What is the runner's mass?

3) How fast would a car of mass 900 kg have to be going to have the same momentum as a truck having a mass of 2 metric tons and traveling along a straight road with a constant speed of 30 km/h?

4) Find the momentum of a 50 g bullet whose kinetic energy is 250 J.

5) A 4.0 kg seagull flies at 15 m/s into the windshield of an airplane flying in the opposite direction at 180 m/s. If the impact lasts 1.0 ms, find the average force on the windshield.

6) A car with a momentum of 3.2×10^4 kg·m/s is brought to a stop in 2.0 s. What is the average braking force?

7) During a snowball fight, a 0.15 kg snowball traveling at a speed of 12 m/s hits a student in the back of the head.
   a. What is the impulse?
   b. If the contact time is 0.10 s, what is the average impulse force on the student's head?

8) For a typical drive, the golf club and the ball are in contact for about 0.50 ms, and the ball leaves the tee with a speed of 70 m/s. What is the average force exerted by the club on the ball? (The official weight of a golf ball is 0.451 N)

9) A car weighing 15680 N and moving at 20.0 m/s is acted upon by a 6.40×10^2 N force until it is brought to a halt.
   a. What is the car's mass?
   b. What is its initial momentum?
   c. What is the change in the car's momentum?
   d. How long does the braking force act on the car to bring it to a halt?

10) What is the final velocity of a rocket of mass 2.0×10^4 kg, starting from rest, if a net force of 1.5×10^5 N acts upon it 15.0 s?

PHYSICS 11 ASSIGNMENT
Conservation of Momentum (Collisions)

1) A 50 kg girl throws a 5.0 kg pumpkin at 10 m/s to a 50 kg boy, who catches it. If both are on a frictionless frozen lake, how fast does each of them move backward?

2) An astronaut outside an orbiting spacecraft uses a pistol in order to maneuver in space. Suppose the astronaut and her space suit have a total mass of 100 kg and the pistol ejects 12 g of gas per second at a speed of 650 m/s. How long should the astronaut operate the pistol in order to have a speed of 1.0 m/s?

3) A spacecraft moving at 10.0 km/s breaks apart into two pieces of equal mass, one of which moves off at 4.0 km/s in a direction opposite to the original direction. Find the speed and direction of the other piece.

4) A neutron of mass 1.67×10^{-27} kg and speed 1.00×10^5 km/s collides with a stationary deuteron of mass 3.34×10^{-27} kg. The two particles stick together. What is the speed of the composite particle (called a triton)?

5) A 3.0 g bullet moving at 4.0 km/s strikes an 8.0 kg wooden block resting on a frictionless table. The bullet passes through the block and comes out with a speed of 0.20 km/s. What is the speed of the block?

6) A meteor crater is formed when a meteorite crashes into the earth. It is estimated that one meteorite had a mass of 10^{10} kg and was traveling at 10^4 m/s when it collided with the earth. Determine the earth's change in velocity as a result of the collision. Assume the earth's initial velocity is zero.

7) An experiment is performed in a physics laboratory to find the mass of a stationary particle, **B**. A proton, **A**, of mass 1.7×10^{-27} kg, traveling at 4.0×10^6 m/s, strikes **B** and bounces back at a speed of 2.0×10^6 m/s. If **B** moves ahead at 1.0×10^6 m/s, calculate **B**'s mass.

8) A bullet of mass 50.0 g strikes a wooden block of mass 5.0 kg and becomes embedded in the block. The block and bullet then flies off at 10.0 m/s. What was the original velocity of the bullet?