***\*\*Please consider significant figures and if possible, draw visual graphics\*\****

**Problems**

***(The Impulse Momentum)***

* A golfer, driving a golf ball off the tee, gives the ball a velocity of +38 m/s. The mass of the ball is 0.045 kg, and duration of the impact with the golf club is 3.0 x 10-3 s. (a) what is the change in the momentum of the ball by the club.
* A volleyball is spiked so that its incoming velocity of +4.0 m/s is changed to an outgoing of **-**21 m/s. The mass of the volleyball is 0.35 kg. What impulse does the player apply to the ball?

***(The Principle of Conservation of Linear Momentum)***

* A 5.5-kg swimmer is standing on a stationary210 kg floating raft. The swimmer then runs off the runs off the raft horizontally with a velocity of +4.6 m/s relative to the shore. Find the recoil velocity that the raft would have if there were no friction and resistance due to the water.

***(Collisions in One Dimension and Collisions in Two Dimensions)***

* Kevin has a mass of 87 kg and skating with in-line skates. He sees his 22-kg younger brother up ahead standing on the sidewalk, with his back turned. Coming up ahead standing on the sidewalk, with his back turned. Coming up from behind, he grabs his brother and rolls off at a speed of 2.4 m/s. Ignoring friction, find Kevin’s speed just before he grabbed his brother.
* A 1055-kg van stopped at a traffic light, is hit directly in the rear by a 715 –kg car traveling with a velocity of +2.25 m/s Assume that the transmission of the van is neutral, the brakes are not being applied and the collision is elastic. What is the final velocity of (a) the car and (b) the van?
* A 2.50 gram bullet, traveling at a speed of 425 m/s strikes the wooden block of a ballistic pendulum, such as the figure below. The block has a mass of 2.15 gram. (a) Find the speed of the bullet/block combination immediately after the collision. (b) How high does the combination rise above its initial position?

***The Physics of measuring the speed of a bullet***

 (a) *A bullet approaches a ballistic pendulum*

m1

M2

v01

 (b) *The block and the bullet swing upward after the collision*

 Hf = **0.650 m**

m1 + m2

 h

 vf

* A car (mass = 1100 kg) is traveling at 32 m/s when it collides head-on with a sport utility vehicle (mass = 2500 kg) traveling in the opposite direction. In the collision, the two vehicles come to a halt. At what speed was the utility vehicle traveling?
* A 5.00-kg ball, moving to the right at a velocity of +2.00 m/s on a frictionless table, collides heads-on with a stationary 7.50 –kg ball. Find the final velocities of the balls if the collision is (a) elastic and (b) completely inelastic.

**Conceptual Questions:**

* Two identical automobiles have the same speed, one traveling east and one traveling west. Do these cars have the same momentum? Explain.
* Two objects have the momentum. Do the velocities of these objects necessarily have (a) the same directions and (b) the same magnitudes? Give your reasoning at each case.
* Can a single object have kinetic energy but no momentum? (b) Can a single object have a kinetic energy nut no momentum? (b) Can a system of two or more objects have a total kinetic energy that is not zero but a total momentum that is zero? Account for your answer.
* A satellite explodes in outer space, far from any other body sending thousands of pieces in all directions. How does the linear momentum of the satellite before the explosion compare with the total linear momentum of all the pieces after explosion? Account for your answer.
* In an elastic collision, is the kinetic energy of each object the same before and after the collision? Explain.