Linear Momentum (Sample Problems)

1.) Consider the following example: two railroad boxcars weighing 50,000 N each are approaching one another at 5 m/s and 7 m/s. After they collide and couple together, how fast will the combination be moving and in which direction?

2.) The linear momentum of a runner in a 100 m dash is 750 kg m/s. If the runners speed is 10 m/s, what is his mass?

3.) If two protons approach each other with speeds of 400 m/s and 450 m/s, respectively, what is the total momentum of the two-particle system?

4.) A 2.0 kg mud ball drops from rest at a height of 15 m. If the impact between the ball and the ground lasts 0.50 s, what is the average force exerted by the ball on the ground?

5.) 10 g bullet moving horizontally at 375 m/s penetrates a 3 kg wood block resting on a frictionless horizontal surface. If the bullet slows down to 300 m/s after emerging from the block, what is the speed of the block immediately after the bullet emerges.

6.) A 4.0 kg ball with a velocity of 4.0 m/s in the +x direction elastically collides head-on with a stationary 2.0 kg ball. What are the velocities of the balls after the collision?

7.) Two balls with masses of 3.0 kg and 6.0 kg travel toward each other at speeds of 12 m/s and 4.0 m/s, respectively. If the balls have a head-on inelastic collision and the 3.0 kg ball recoils with a speed of 8.0 m/s, how much kinetic energy is lost in the collision?

8.) In an elastic head-on collision with a stationary target particle, a moving particle recoils at one-third of its incident speed. What is the ratio of the particle mass m1/m2? What is the speed of the target particle after collision in terms of the incoming particles initial speed?

9.) A 1.8 kg mass falls vertically downward from a roof 36.5 m high. What is the momentum of the object after 2 s, given that the initial velocity is zero?

10.)A baseball of mass 0.15 kg, moving horizontally with a momentum of 6 kg m/s, is struck head-on by a baseball bat with an impulse of 10 Ns. What is the speed of the ball after it is struck?

11.) An object with velocity 1.4 m/s and mass 0.3 kg collides with an object whose velocity is -2.5 m/s i and whose mass is 0.15 kg. The motion takes place in 1-dimension. What are the final velocities of the objects if the collision is elastic? What is the total kinetic energy in the collision?

12.) A 300 g cart moves on an air track at 1.2 m/s. It collides with and sticks to another cart of mass 500 kg, which was moving in the opposite direction at 0.8 m/s before collision. What is the velocity of the combined cart after collision?