CH8 Exercises

1. (8.1) (a) What is the magnitude of the momentum of a 10,000 kg truck whose speed is 12 m/s? (b) What speed would a 2000 kg SUV have to attain in order to have (i) the same momentum? (ii) the same kinetic energy?

2. (8.5) One 110 kg football lineman is running to the right at 2.75 m/s while another 125 kg lineman is running directly toward him at 2.60 m/s. What are (a) the magnitude and direction of the net momentum of these two athletes, and (b) their total kinetic energy?

3. (8.15) To warm up for a match, a tennis player hits a 57 g ball vertically with her racket. If the ball is stationary just before it is hit and goes 5.5 m high, what impulse did she impart on the ball?

4. (8.17) The expanding gasses that leave the muzzle of a rifle also contribute to recoil. A .30 caliber bullet has a mass 7.2 g and a speed of 601 m/s relative to the muzzle when fired from a rifle that has mass 2.8 kg. The loosely held rifle coils at a speed of 1.85 m/s relative to the earth. Find the momentum of the propellant gasses in a coordinate system relative to the earth as they leave the muzzle of the rifle.

5. (8.23) Two identical 0.9 kg masses are pressed against opposite ends of a light spring of force constant k = 1.75 N/cm, compressing the spring by 20 cm from its normal length. Find the speed of each mass when it has moved free of the spring on a frictionless, horizontal table.

6. (8.25) A hunter on frozen, frictionless pond uses a rifle that shoots 4.2 g bullets at 965 m/s. The mass of the hunter and his gun is 72.5 kg, for which the hunter holds the gun tight after firing it. Find the recoil velocity of the hunter if he fires the rifle (a) horizontally and (b) at 56^{o} above the horizon.

7. (8.33) A 15 kg fish swimming at 1.1 m/s suddenly gobbles up a 4.5 kg fish that is initially stationary. Ignore any drag effects of the water. (a) Find the speed of the large fish just after it eats the small one. (b) How much mechanical energy was dissipated during the meal?

8. (8.39) Jack (mass 55 kg) is sliding due east with speed 8 m/s on the surface of a frozen pond. He collides with Jill (mass 48 kg who is essentially at rest. After the collision, Jack is traveling at 5 m/s in a direction 34^{o} north of east. What is Jill's velocity (magnitude and direction) after the collision? (Ignore friction)

9. A 12 g riffle bullet is fired with a speed of 380 m/s into a ballistic pendulum with mass 6 kg suspended from a cord 70 cm long (see example 8.8). Compute (a) the vertical height through which the pendulum rises, (b) the initial kinetic energy of the bullet, and (c) the kinetic energy of the bullet and pendulum immediately after the bullet becomes embedded in the wood.

10. (8.47) Blocks A (mass 2 kg) and B (mass 6 kg) move on a frictionless, horizontal surface. Initially, block B is at rest and block A is moving toward it at 2 m/s. The blocks are equipped with ideal spring bumpers, as in Example 8.10. The collision is head-on, so all motion before and after the collision is along a straight line. (a) Find the maximum energy stored in the spring bumpers and the velocity of each block at that time. (b) Find the velocity of each block after they have moved apart.

11. (8.53) CENTER OF MASS –Pluto's diameter is approximately 2370 km, and the diameter of its satellite Charon is 1250 km. Although the distances varies, they are often about 19,700 km apart. Assuming that both Pluto and Charon have the same composition and hence the same average density, find the location of the center of mass of this system relative to the center of Pluto.

12. (8.63) ROCKET PROPULSION Assume that a rocket is fired from rest deep in space (no gravity). (a) If the rocket ejects gasses at a relative speed of 2000 m/s and you want the rockets to be $3 \cdot 10^5$ m/s, what fraction of the initial mass of the rocket is not fuel? (b) What is this fraction if the final speed is 3000 m/s?

13. (8.71) An 8 kg block of wood sit at the edge of a frictionless table, 2.2 m above the floor. A 0.5 kg blob of clay slides along the length of the table at 24 m/s, strikes the wood and sticks to it. The combined object leaves the table and travels to the floor. What horizontal distance has the combined object traveled when it reaches the floor?

14. (8.93) You are standing on a concrete slab that in turn is resting on a frozen lake. The weight of the slab is exactly 5X your weight. If you begin to walk forward at 2 m/s relative to the ice, with what speed (relative to the ice) does the slab move?