PHYS 211 Homework Assignment

Chapter 9

Problem 1 A 0.35 kg plastic cart and a 18 kg steel cart can both roll without friction on a horizontal surface. Equal forces are used to push both carts forward for a time of 1 second, starting from rest. After the force is removed at $t = 1$ s, is the momentum of the plastic cart greater than, less than, or equal to the momentum of the steel cart? Explain.

Problem 2 A 0.25 kg rubber ball is dropped from a height of 20 m and undergoes a perfectly elastic collision with the Earth ($M_E = 5.98 \cdot 10^{24}$ kg).

(a) What is the Earth's velocity after the collision? Assume the Earth was at rest before the collision.

(b) How many years would it take the Earth to move 1.0 mm at this speed?

Problem 3 A 20 g ball is fired horizontally with a speed v_0 towards a 100 g ball hanging motionless from a 1.0 m long string. The balls undergo a head-on, perfectly elastic collision, after which the 100 g ball swings out to a maximum angle $\theta_{max} = 50°$. What was v_0?

Problem 4 Two astronauts, Alice and Bob, are floating in space at rest. All of a sudden they push off of each other. Bob has been snacking heavily on freeze-dried potato chips and has a much larger mass than Alice.

(a) Which astronaut, if either, has a greater momentum after the push off? Explain.

(b) Which astronaut, if either, has the greater speed after the push off? Explain.

Problem 5 A 5000 kg open train car is rolling on frictionless rails at 22 m/s when it starts pouring rain. A few minutes later, the car's speed is 20 m/s. What mass of water has collected in the car?

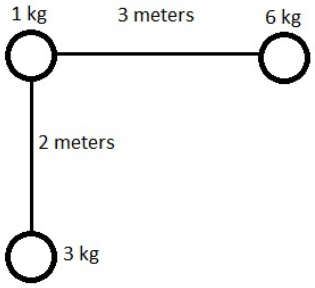
Problem 6 A baseball player swings his 2 kg bat with a speed of 15 m/s. He hits a 0.142 kg baseball which was approaching at a speed of 40 m/s. the ball rebounds in the other direction at 45 m/s.

(a) How fast is the bat moving immediately after the impact? (You can ignore the interaction of the bat with the player's hands for the brief duration of the impact.)

(b) If the baseball and bat are in contact for 5 ms, what is the average force the bat exerts on the ball? How does this compare to the gravitational force on the ball?

Problem 7 There is a 5 kg lump of clay traveling west at a constant 12 m/s. There is also a 2 kg lump traveling north at 5 m/s. If the two lumps collide and stick together, what is their final velocity? (speed and direction)

Problem 8 Find the center of mass of the masses in the figure below.


1 kg
3 meters
6 kg
2 meters
3 kg