Homework No. 07 (Fall 2020)

PHYS 203A: COLLEGE PHYSICS

Department of Physics, Southern Illinois University–Carbondale

Due date: Thursday, 2020 Oct 22, 12:30pm, on D2L

Instructions

- Describe your thought process in detail and organize it clearly. Make sure your answer has the correct units and the right number of significant digits.
- After completion, scan the pages as a single PDF file, and submit the file on D2L (Assessments → Assignments).

Questions

1. (**10 points.**) A drop of rain and a pellet of hail, of same masses $m = 1.00\,\mathrm{g}$, hits the roof of a car with same speed $v = 5.00\,\mathrm{m/s}$. Rain drop being liquid stays in contact with the roof for 100.0 ms, while hail being solid rebounds (assume with same speed $v = 5.00\,\mathrm{m/s}$) and thus stays in contact for a mere 1.00 ms. Calculate the force exerted by each on the roof of the car.

2. (**10 points.**) A ball having a mass of 150 g strikes a wall with a speed of 5.0 m/s and rebounds with only 50 % of its initial kinetic energy.

   (a) What is the speed of the ball immediately after rebounding?

   (b) If the ball was in contact with the wall for for 8.0 ms, what was the magnitude of the average force on the ball from the wall during this time interval?

3. (**10 points.**) A shooter of mass 90.0 kg shoots a bullet of mass 3.00 g in a direction 60.0° with respect to the horizontal, standing on a frictionless surface at rest. If the muzzle velocity of the bullet is 600.0 m/s, what is the recoil speed of the shooter?

4. (**10 points.**) A car of mass $m_1 = 2000.0\,\mathrm{kg}$ is moving at speed $v_{1i} = 35.0\,\mathrm{m/s}$ towards East. A truck of mass $m_2 = 5000.0\,\mathrm{kg}$ is moving at speed $v_{2i} = 25.0\,\mathrm{m/s}$ towards South. They collide at an intersection and get entangled (complete inelastic collision). What is the magnitude and direction of the final velocity of the entangled automobiles?

5. (**10 points.**) Two masses, $m_1 = 1.0\,\mathrm{kg}$ and $m_2 = 2.0\,\mathrm{kg}$ are hanging off separate strings. Forst mass m_1 is pulled to a height $h_1 = 1.0\,\mathrm{m}$ and dropped. It swings down and collides with the other hanging mass (m_2 at rest) and they stick to each other (complete inelastic collision). See Figure 1. The collision happens in a plane. How high do the masses rise together after the collision.

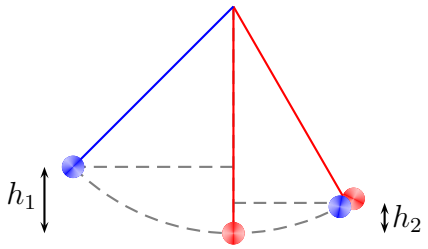

Figure 1: Problem 5.

6. (**10 points.**) What is the ratio of the final kinetic energy to initial kinetic energy in a perfectly inelastic collision involving two particles of masses m and M when the mass M is initially at rest? Express your answer in terms of m and M.

7. (**10 points.**) A mass $m_1 = 100.\,\text{kg}$ moving with a speed $v_{1i} = +10.\,\text{m/s}$ (elastically) collides with another mass $m_2 = 1.0\,\text{kg}$ initially at rest. Determine the magnitude and direction of the final velocities of the masses after collision.