

Homework No. 11 (Fall 2024)

PHYS 205A-002: UNIVERSITY PHYSICS

School of Physics and Applied Physics, Southern Illinois University–Carbondale

Due date: Monday, 2024 Nov 4, 2:00 PM, on D2L

Instructions

- You are encouraged to use any of the resources to complete this homework. However, the extent to which you depend on resources while doing this homework is a measure of how much extra work you need to put in to master the associated concepts. Solutions should be the last resource.
- Links to solutions are provided. Further, links to few variations of the problem are provided that serve as practice problems.
- Describe your thought process in detail and organize it clearly. Make sure your answer has units and right number of significant digits.
- Additional problems, with hyperlinks to exams, are available in [Lecture Notes](#).
- After completion, scan the pages as a single PDF file, and submit the file on D2L (under Assesments → Assignments). You can replace your PDF file, only the last file is graded.

Problems

1. **(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 8.0 ms, what was the magnitude of the average force on the ball from the wall during this time interval?

[\[Solution\]](#)

2. **(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?

[\[Solution\]](#)

3. (10 points.) A car of mass $m_1 = 2000.0$ kg is moving at speed $v_{1i} = 35.0$ m/s towards East. A truck of mass $m_2 = 5000.0$ kg is moving at speed $v_{2i} = 25.0$ 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?

[Solution]

4. (10 points.) Two masses, $m_1 = 1.0$ kg and $m_2 = 2.0$ kg are hanging off separate strings. First mass m_1 is pulled to a height $h_1 = 1.0$ 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.

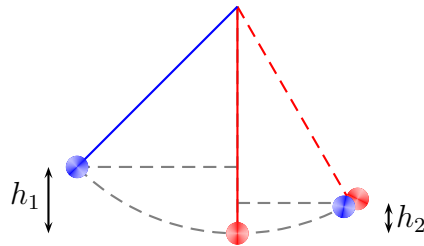


Figure 1: Problem 4.

[Solution]

5. (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 .

[Solution]

6. (10 points.) A mass $m_1 = 100.$ kg moving with a speed $v_{1i} = +10.$ m/s (elastically) collides with another mass $m_2 = 1.0$ kg initially at rest. Determine the magnitude and direction of the final velocities of the masses after collision.

[Solution]

7. (10 points.) Consider a thin rod of length $L = 1.0$ m placed on the positive x -axis with one end at the origin. It has mass per unit length, dm/dx , described by

$$\rho(x) = a + bx + cx^2, \quad a = 0 \quad b = 1.0 \frac{\text{kg}}{\text{m}^2}, \quad c = -0.80 \frac{\text{kg}}{\text{m}^3}, \quad (1)$$

where x is the distance from end placed at the origin. At what distance from the end placed at the origin is the center of mass of the rod?

[Solution]