Engineering Physics I
PHYS 1210

Name _____
Spring 2015

Discussion 7 – Momentum (Ch 8)

Momentum

$$\vec{p}_o = \vec{p}_f$$

$$m_1 v_{1ox} + m_2 v_{2ox} = m_1 v_{1fx} + m_2 v_{2fx}$$

$$m_1 v_{1oy} + m_2 v_{2oy} = m_1 v_{1fy} + m_2 v_{2fy}$$

$$\vec{F} = \frac{d\vec{p}}{dt}$$

$$\vec{J} = \Delta\vec{p}$$

Center of Mass

$$M_{tot} X_{CM} = m_1 x_1 + m_2 x_2 + \ldots = \sum_i m_i x_i$$

My Problem Solving Approach (for Momentum)

1. Draw a picture
2. List Know/Need
   a. Split into x/y coordinates if needed
3. Find formulae
   a. Start with momentum, can also use energy if elastic
4. Do Math
5. Sanity Check

Problems (Giancoli, 4e)

9. (I) A 7700-kg boxcar traveling 18 m/s strikes a second car. The two stick together and move off with a speed of 5.0 m/s. What is the mass of the second car?

Is this collision elastic, partially inelastic, or completely inelastic?

64. (II) Three cubes, of side ℓ_0, $2\ell_0$, and $3\ell_0$, are placed next to one another (in contact) with their centers along a straight line as shown in Fig. 9–44. What is the position, along this line, of the CM of this system? Assume the cubes are made of the same uniform material.

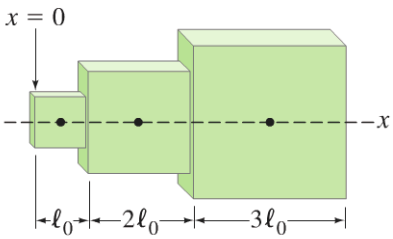

FIGURE 9–44
Problem 64.

56. (II) Two billiard balls of equal mass move at right angles and meet at the origin of an xy coordinate system. Initially ball A is moving along the y axis at $+2.0\,\text{m/s}$, and ball B is moving to the right along the x axis with speed $+3.7\,\text{m/s}$. After the collision (assumed elastic), the second ball is moving along the positive y axis (Fig. 9–43). What is the final direction of ball A, and what are the speeds of the two balls?

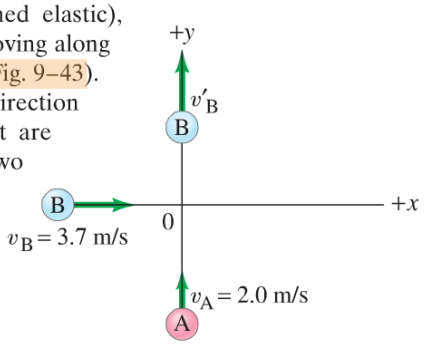

FIGURE 9–43 Problem 56.
(Ball A after the collision is not shown.)

Hint: Draw which way A is going after the collision, with v'_A and θ. Those are your two unknowns, find two equations.

66. (II) A uniform circular plate of radius $2R$ has a circular hole of radius R cut out of it. The center C′ of the smaller circle is a distance $0.80R$ from the center C of the larger circle, Fig. 9–45. What is the position of the center of mass of the plate? [*Hint*: Try subtraction.]

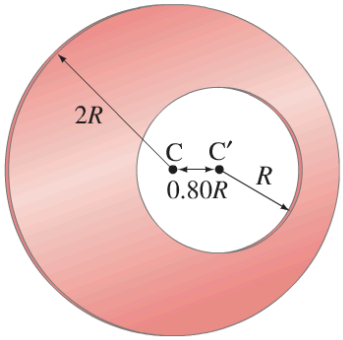

FIGURE 9–45
Problem 66.

Hint: In the definition of center of mass, have the big circle (radius 2R) be the M_{tot} , the small circle (R) be the m_1, and the funny shape be the m_2. And the below may also be useful.

Density	**Symbol**	**Formula**	**SI Units**
Volume Density	ρ	$\rho = M / V = dm / dV$	kg/m^3
Surface Density	σ	$\sigma = M / A = dm / dA$	kg/m^2
Linear Density	λ	$\lambda = M / L = dm / dl$	kg/m