

PHY 3010 – Fall 2007
Homework Set #8
DUE: Tuesday, 11/20/2007 by 5:00pm

In chapter 9, we're skipping sections 9.6 – 9.11 but we are using concepts such as Q-value and restitution coefficient (page 359) on occasion – we'll define and use these terms (because they're so common) but you won't be responsible for the other material.

1. T&M, 9-1
2. T&M, 9-7
3. T&M, 9-9. Don't answer the second part of the problem that asks "What is the ratio m_1/m_2 when m_1 is a maximum?" Note that it is beneficial to define the "initial" velocity as the velocity of the system right before the explosion in which all velocity is in the y-direction (here, the y-axis runs horizontally and the z-axis runs vertically):

$$v_{0y} = \frac{v_0}{\sqrt{2}}$$

But since the total energy is initially all kinetic and expressible in terms of v_0 :

$$E = \frac{1}{2}(m_1 + m_2)v_0^2$$

we can write:

$$v_{0y} = \frac{v_0}{\sqrt{2}} = \frac{\sqrt{\frac{2E}{m_1 + m_2}}}{\sqrt{2}} = \sqrt{\frac{E}{m_1 + m_2}}$$

So now define your initial and final (right after the explosion) momenta in all directions (which is conserved in all dimensions) and write out your energy balance equation and solve for the unknowns.

4. T&M, 9-15. The amount of mass that contributes to the gravitational force is time-dependent, so...

$$\dot{m} = \lambda \dot{x} \quad \text{where } \lambda \text{ is the mass per unit length and } x \text{ is the direction of motion.}$$

When you apply Newton's 2nd Law

$$\dot{p} = m\dot{v} + \dot{m}v = mg$$

You will get an equation that looks like this:

$$xg = xv \frac{dv}{dx} + v^2$$

Try a “power law” solution...

$$v = Cx^n; \quad \frac{dv}{dx} = nCx^{n-1} \quad \text{where } C \text{ is just a constant.}$$

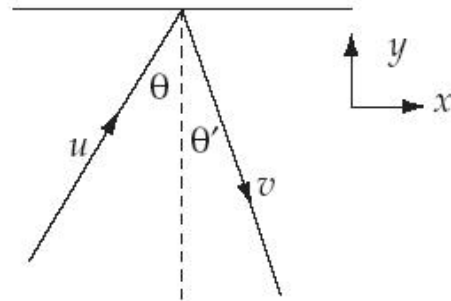
5. T&M, 9-39. Note that the component of velocity parallel to the wall is unchanged.

$$v_x = u_x = u \sin \theta$$

and use the definition of restitution coefficient

$$\varepsilon = \frac{|v_y|}{|u_y|}$$

and solve for v and θ' in terms of ε and θ .



Read section 9.8 and understand the coefficient of restitution and the “Q” factor – you will be responsible for these concepts.

6. Calculate the differential cross section $D(\theta)$ and the total cross section σ_t for the elastic scattering of a particle from an impenetrable sphere:

$$U(r) = \begin{cases} 0, & r > a \\ \infty, & r < a \end{cases}$$

See class notes for assistance.

