PHY151H1F – Practice Problem Set 6

(Based on material similar to **Problem Set 5**)

Ch. 14, Q. 60

60. At what speed must a particle move in your reference frame so that its kinetic energy is equal to its internal energy? •

[Note "internal energy" is the rest energy due to the particle's mass $E_{int} = mc^2$.]

Ch. 6, Q. 65

A 0.20-kg softball is traveling at a velocity of 20 m/s to the east relative to Earth. It collides head-on with a 0.40-kg rubber ball traveling at a velocity of 10 m/s to the west. (*a*) If the system's kinetic energy, as measured from the Earth reference frame, decreases by 20% because of the collision, what are the final velocities of the balls? (*b*) What change in internal energy has occurred? (*c*) An observer watches this collision from a reference frame moving at a velocity of 15 m/s to the east relative to the Earth reference frame. What changes in kinetic and internal energies does this observer measure? (*d*) What changes in kinetic and internal energies would be measured by an observer in a reference frame traveling at 20 m/s east relative to the Earth reference frame? ••

Ch. 5, Q. 29

29. Show that in an elastic collision between two objects of inertias m_1 and m_2, with initial x components of velocity $v_{1i} > 0$ and $v_{2i} = 0$, the final x components of velocity are

$$v_{1x,f} = \left(\frac{m_1 - m_2}{m_1 + m_2}\right) v_{1x,i}$$

$$v_{2x,f} = \left(\frac{2m_1}{m_1 + m_2}\right) v_{1x,i}.$$

Discuss the cases $m_1 \ll m_2$, $m_1 = m_2$, and $m_1 \gg m_2$. Using everyday objects, give an example of each of these three cases. ••

[**Hint:** Start by working through Example 5.5 from Principles page 112.]

Challenge Problem (If you have finished all of page 1) Ch. 14 Q. 67

67. At the Large Hadron Collider in Switzerland, two high-energy protons collide to create new particles. Prior to collision, each proton is accelerated to an energy of 7000 GeV in the Earth reference frame. (*a*) What is the speed of each proton? (*b*) What is the maximum mass possible for any particle created in the collision? The proton mass is 938 MeV/c_0^2; 1 GeV = 1000 MeV. ●●