# PHY151H1F – Practice Problem Set 6

### Ch. 6, Q. 57

57. You toss a 0.40-kg ball at 9.0 m/s to a 14-kg dog standing on an iced-over pond. The dog catches the ball and begins to slide on the ice. (a) Measured from the Earth reference frame, what is the velocity of the dog immediately after he catches the ball? (b) Measured from the Earth reference frame, what is the velocity of an inertial reference frame in which the ball's kinetic energy does not change? (c) Measured from the Earth reference frame, how much of the original kinetic energy of the system is convertible? (d) Measured from the reference frame described in part b, how much of the original kinetic energy of the system is convertible? ••

### 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. 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. ••