Your Name_____Section_____

HOMEWORK #14 - 8.01 MIT - Prof. Kowalski

Not Due 4:00PM Thursday Jan. 41, 2005 - Practice ONLY

Topics: Relativity

Since not everyone has the Special relativity supplement from Young and Freedman 11th edition, this assignment will be posted only in Mastering Physics.

37.20 Two particles in a high-energy accelerator experiment are approaching each other head-on, each with a speed $0.9520c$ as measured in the laboratory. What is the magnitude of the velocity of one particle relative to the other?

37.44 Creating a Particle. Two protons (each with rest mass $M = 1.67 \times 10^{-27}$ kg) are initially moving with equal speeds in opposite directions. The protons continue to exist after a collision that also produces an η^0 particle (Chapter 44). The rest mass of the η^0 is $m = 9.75 \times 10^{-28}$ kg. a) If the two protons and the η^0 are all at rest after the collision, find the initial speed of the protons, expressed as a fraction of the speed of light. b) What is the kinetic energy of each proton? Express your answer in MeV. c) What is the rest energy of the η^0, expressed in MeV? d) Discuss the relationship between the answers to parts (b) and (c).

***37.71 The Pole and Barn Paradox.** Suppose a *very* fast runner ($v = 0.600c$) holding a long, horizontal pole, runs through a barn open at both ends. The length of the pole (in its rest frame) is 6.00 m and the length of the barn (in *its* rest frame) is 5.00 m. In the barn's reference frame, the pole will undergo length contraction and can all fit inside the barn at the same time. But in the runner's reference frame, the *barn* will undergo length contraction and the entire pole can *never* be entirely within the barn at any time! Explain the resolution of this paradox.

37.72 The French physicist Armand Fizeau was the first to measure the speed of light accurately. He also found experimentally that the speed, relative to the lab frame, of light traveling in a tank of water that is itself moving at a speed V relative to the lab frame is

$$v = (c/n) + kV$$

where $n = 1.333$ is the index of refraction of water. Fizeau called k the dragging coefficient and obtained an experimental value of $k = 0.44$. What value of k do you calculate from relativistic transformations?