Homework Assignment #4

Due Date: February 7, 2019 (Thursday)

Mass $\rightarrow MeV/c^2$ not kilograms !!

Momentum $\rightarrow MeV/c$ not kilograms·meters/sec !!

Energy $\rightarrow MeV$ not joules !!

unless otherwise specified.

When you are asked for velocities, always quote your answers in units of "c," the speed of light.

velocity = $\boldsymbol{\beta c}$

2.29 For what range of velocities of a particle of mass m can we use the classical expressions for KE . . . .

2.32 Use the binomial expansion to show that Eq. 2.34 for the relativistic kinetic energy . . . .

Problem 3: Using the relativistic relationship between momentum and kinetic energy to make a plot of $\frac{p}{m_o c}$ vs. $\frac{K}{m_0 c^2}$. Let the independent variable $\left(\frac{K}{m_0 c^2}\right)$ span the domain from $0 \rightarrow 2$.

a. Draw the plot

b. What values of γ does the domain $(0 \rightarrow 2)$ cover?

2.33 According to observer O, a certain particle has momentum of 817 MeV/c and a total relativistic energy of 1125 MeV.

2.34 An electron is moving at a speed of $0.81c$. By how much must its kinetic energy increase to raise its speed to $0.91c$?

Problem 6: At what velocity does the classical kinetic energy begin to deviate from the relativistic kinetic energy by 2%?

Problem 7: Calculate the outgoing momentum of the two-body decays shown below.

Note: You can look up the masses of these particles at the following URL:

http://pdg.lbl.gov/2014/download/rpp-2014-booklet.pdf

For example: the mass of the muon is 105.658 MeV/c^2 (page 14)
assume the mass of the neutrino (ν_μ) is zero.
Mass of the $\pi^\pm$ is found on page 25.
Mass of the ρ^o is found on page 27. 775.26 MeV/c^2

These masses can also be obtained from Mathematica

a. $\rho^o \rightarrow \pi^- \, \pi^+$

b. $\pi^+ \rightarrow \mu^+ \, \nu_\mu$

From Homework #3

Problem 7*: (Extra Credit—2 points) A particle of mass M at rest decays into two unequal masses m_1 and m_2. Show that the square of the momentum of each of the final particles is given by:

$$p^2 = \frac{[M^2 - (m_1 + m_2)^2]\,[M^2 - (m_1 - m_2)^2]}{4M^2}\, c^2$$