

Homework Assignment #4

Due Date: February 8, 2018 (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.

$$\mathbf{velocity = \beta c}$$

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 $\frac{p}{m_0 c}$ 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 $105.658 \text{ MeV}/c^2$ (page 14)
 assume the mass of the neutrino (ν_μ) is zero.
 Mass of the π^\pm is found on page 25.
 Mass of the ρ^0 is found on page 27. $775.26 \text{ MeV}/c^2$

These masses can also be obtained from Mathematica

a. $\rho^0 \rightarrow \pi^- \pi^+$

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