King Fahd University of Petroleum and Minerals
Physics Department
Phys-212: Modern Physics
Spring 2006

Assignment # 1

Date: Wed. Feb.22.2006
Due Date: Wed. Mar.1.2006

I encourage group discussion, but not copying (cheating).

Problem. 1

Positive kaons (K^+) are unstable elementary particles with a lifetime of 0.1237 μs when measured in the rest frame of kaon. If a positive kaon has a speed of 0.990c relative to a laboratory reference frame when it is produced, how far can it travel in that frame during its lifetime according to classical physics, and special relativity?

Problem. 2

The mean lifetime of stationary muons is measured to be 2.2 μs. The lifetime of high-speed muons in a burst of cosmic rays observed from Earth is measured to be 16 μs. Find the speed pf these cosmic-ray muons relative to Earth.

Problem. 3

Two observers, A on Earth and B in a spacecraft whose speed is 2.00×10^8 m/s, both set their watches to the same time when the ship is abreast of the earth. How much time must elapse by A's reckoning before the watches differ by 1.00 s. To A, B's watch seems run slow. To B, does A's watch seem to run fast, run slow, or keep the same time as his own watch.

Problem. 4

A spacecraft antenna is at an angle of 10^o relative to the axis of the spacecraft. If the spacecraft moves away from the earth at a speed of 0.70c, what is the angle of the antenna as seen from the earth?

Problem. 5

An electron's speed is doubled from 0.2c to 0.4 c. By what ratio do its momentum and its kinetic energy increase? What happens to the momentum and the kinetic energy ratio when the speed is doubled again from 0.4c to 0.8c?

Problem. 6

A particle has a kinetic energy of 62 MeV and a momentum of 335 MeV/c. Find its mass (in MeV/c2) and its speed (as a fraction of c).

Problem. 7

An observer detects two explosions, one that occur near him at a certain time and another that occurs 2.0 ms later 100 km away. Another observer finds that the two explosions occur at the same place. What time interval separates the explosions to the second observer?