

## **Assignment # 11**

### **Modern Physics VI**

#### **Chapter 37: Relativity**

##### **Important Formulas and Concepts:**

Principles of Relativity, Galilean Coordinate Transformation, Relativistic Momentum, Relativistic Work and Energy

##### **Question 1:**

The positive muon  $\mu^+$ , an unstable particle, lives on average  $2.20 \times 10^{-6}$  s, which is measured in its own frame of reference before decaying.

- (a) If such a particle is moving, with respect to the laboratory with a speed of  $0.900c$ , what average lifetime is measured in the laboratory?
- (b) What average distance, measured in the laboratory, does the particle move before decaying?

##### **Question 2:**

A spacecraft of the Trade Federation flies past the planet Coruscant at a speed of  $0.600c$ . A scientist on Coruscant measures the length of the moving spacecraft to be 74.0 m. The spacecraft later lands on Coruscant, and the same scientist measures the length of the now stationary spacecraft. What value does she get?

##### **Question 3:**

Electromagnetic radiation from a star is observed with an earth-based telescope. The star is moving away from the earth with a speed of  $0.600c$ . If the radiation has a frequency of  $8.64 \times 10^{14}$  Hz in the rest frame of the star, what is the frequency measured by an observer on earth?

##### **Question 4:**

What is the speed of a particle whose kinetic energy is equal to

- (a) its rest energy and
- (b) five times its rest energy?

##### **Question 5:**

A proton (rest mass  $1.67 \times 10^{-27}$  kg) has total energy that is 4.00 times its rest energy.

- (a) What is the kinetic energy of the proton?
- (b) The magnitude of the momentum of the proton
- (c) The speed of the proton?