HW4

Reading assignment: Feynman chapter 4.1 for what relativity is and is not.
For the problems below, please show all work!

1. A rocket is flying towards Earth at a speed $v = .9c$. The observer on Earth measures the rocket to be $1000km$ above ground. (a) Draw a diagram of this situation. (b) What is the distance to Earth as measured by someone on the rocket?

2. A rocket is flying towards Earth. The observer on Earth measures the rocket to be $1000km$ above ground while the observer on the rocket measures the distance to be $100km$. (a) Draw a diagram of this situation. (b) What is the rocket's speed?

3. A muon has a half-life of about $10^{-6}s$. Suppose you start with 100 muons. (a) Draw a graph showing number of muons vs time. (b) Now draw a similar figure for 100 muons moving at $v = .999c$.

4. (optional – if you know about vectors) Read Feynman Chapter 3.7. Feynman indicates that the Lorentz coordinate transformation is analogous to a roation of space and time. In general rotations can always be written as a matrix vector product. (a) Write the equations $x' = x\cos\theta + y\sin\theta$ and $y' = y\cos\theta - x\sin\theta$ as a matrix vector product. (b) Write the Lorentz transformation relating two observers K and K' in relative motion along the $x-$axis as a $4D$ matrix vector product relating the vectors $V' = [ct', x', y', z']^T$ and $V = [ct, x, y, z]^T$ by $V' = MV$ (c) Find the spacetime distance $x^2 + y^2 + z^2 - (ct)^2$ in terms of primed coordinates (NOTE: this is a rewording of the original HW handout which was too vague).