Homework #10 (10 points) - Show all work on the following problems:

Problem 1 (2 points): In a laboratory experiment, a muon travels 800 meters before decaying. The lifetime of a muon at rest is 2×10^{-6} s. What was the speed of the muon relative to the laboratory, expressed as a fraction of the speed of light?

Problem 2 (2 points): A boat has a mast that is tipped backward from vertical, making an angle of θ with respect to the horizontal deck. If the boat travels at speed v past a dock, what angle between the mast and the deck does a stationary observer on the dock report?

Problem 3 (2 points): Solve the Lorentz transformations for x',y',z',t' in terms of x,y,t,z (Eq. 12.18) to obtain the reverse transformation for x,y,t,z in terms of x',y',z',t' (Eq. 12.19).

Problem 4 (2 points): Find the Lorentz velocity transformation for velocities in the y and z direction (perpendicular to the relative velocity v).

Problem 5 (2 points): Consider two events: Event A taking place at (x,y,z) = (5,3,0) at time t =15/c, and Event B taking place at (x,y,z) = (10,8,0) at time t = 5/c, both in reference frame S.

2a (0.5 points): What is the invariant interval between Events A and B?

2b (0.5 points): Is there an inertial system S' in which they are simultaneous? If so, what is its velocity relative to S?

2c (1 point): Is there an inertial system S' in which they take place at the same point? If so, what is its velocity relative to S?