PHYS 301 Practice Problems

1. A clock moves along an *x* axis at a speed of 0.600*c* and reads zero as it passes the origin. (a) Calculate the clock's Lorentz factor. (b) What time does the clock read as it passes *x* = 180 m?
2. The length of a spaceship is measured to be exactly half its rest length. (a) To three significant figures, what is the speed parameter *β* of the spaceship relative to the observer's frame? (b) By what factor do the spaceship's clocks run slow relative to clocks in the observer's frame?
3. As you read this page (on paper or monitor screen), a cosmic ray proton passes along the left-right width of the page with relative speed *v* and a total energy of 14.24 nJ. According to your measurements, that left-right width is 21.0 cm. (a) What is the width according to the proton's reference frame? How much time did the passage take according to (b) your frame and (c) the proton's frame?
4. Quasars are thought to be the nuclei of active galaxies in the early stages of their formation. A typical quasar radiates energy at the rate of 1041 W. At what rate is the mass of this quasar being reduced to supply this energy? Express your answer in solar mass units per year, where one solar mass unit (1 smu = 2.0 × 1030 kg) is the mass of our Sun.