1. [10 pts] A 50-m long rocket train is traveling from Rome to Moscow at 0.6c when a light at the center of the train flashes. When the light reaches the front of the train, it immediately ignites a green flare. Light reaching the back of the train immediately ignites a red flare.

Is the ignition of the red and green flare simultaneous events for a pedestrian waiting to cross the tracks? If not, which event occurs first and by how much time? [Hint: Finding the space-time coordinates of the events in the train’s reference frame is recommended to tackle this problem. Note the speed of light is c=3.0 x 10^8 m/s]
2. [10 pts] Two events in reference frame S occur 20 $\mu$s apart at the same point in space. The distance between the two events is 2000 m in reference frame S’.

[Note that 1 $\mu$s is $10^{-6}$ sec and the speed of light is \( c=3.0 \times 10^8 \text{ m/s} \)]

   a. What is the time interval between the events in reference frame S’?

   b. What is the velocity of S’ relative to S?
1. [10 pts] The sun radiates energy at the rate of $4.0 \times 10^{26}$ W. The source of this energy is fusion, a nuclear reaction in which mass is transformed into energy. The mass of the sun is $2.0 \times 10^{30}$ kg.
   
a. [6 pts] How much mass does the sun lose each year? [note that 1 year = $3.15 \times 10^7$ sec and the speed of light is $c=3.0 \times 10^8$ m/s]

b. [4 pts] Estimate the lifetime of the sun.
1. [10 pts] An electron moving to the right at 0.95c collides with a positron moving to the left at 0.95c. The two particles annihilate and produce two identical photons. What is the wavelength of the photons?

[Note that a positron and electron have the same mass, $9.11 \times 10^{-31}$ kg, the speed of light is $c=3.0 \times 10^8$ m/s, and Planck’s constant is $h=6.63 \times 10^{-34}$ J sec]