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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 $c=3.0 \times 10^8$ m/s]

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2. [10 pts] Two events in reference frame S occur $20\ \mu\text{s}$ apart at the same point in space. The distance between the two events is 2000 m in reference frame S'.

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

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1. [10 pts] The sun radiates energy at the rate of 4.0×10^{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 2.0×10^{30} kg.
 - a. [6 pts] How much mass does the sun lose each year? [note that 1 year = 3.15×10^7 sec and the speed of light is $c=3.0 \times 10^8$ m/s]
 - b. [4 pts] Estimate the lifetime of the sun.

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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, 9.11×10^{-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]