## Relativity Review

1. What are the two postulates that Einstein based the theory of relativity on?
2. Explain why Einstein's equations make it impossible to travel faster (or even reach) the speed of light.
3. A group of cosmic tourists rockets away from Earth at 0.75 c toward another distant planet. You measure that it takes them 5 years to get to the new planet. a) For the people on the ship, how much time do they measure has passed? b) Calculate the proper distance and the relativistic distance between Earth and the new planet.
4. The LHC (Large Hadron Collider) at CERN (Centre for European Nuclear Research) in Switzerland is an extremely large tube in which high speed subatomic particles collide with one another in order to "see" what matter consists of. The radius of the tube in which the particles move is 4.3 km . An electron (which has a rest mass of $9.11 \times 10^{-31} \mathrm{~kg}$ ) is accelerated so that it travels around the loop 10,000 times in one second. a) What is the mass of the electron in the laboratory frame. b) the mass of the electron in the electron's frame.
5. The dimensions of a box at rest are given below. Calculate the dimensions of the box when travelling at $2.89 \times 10^{8} \mathrm{~m} / \mathrm{s}$ to the right. (Do the calculation and write it on the diagram supplied). Also, calculate the gamma factor.


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6. A red Toyota Echo goes flying past a stationary car on highway 7 just outside Georgetown. The Echo has a rest mass of 1200 kg (including the occupant).
a) Determine the relativistic mass and momentum of a red Echo hatchback if it is travelling at 0.97.
b) The stunned occupants of the stationary car quickly measure the length of the relativistic Echo and record it as 0.7293 m . What is the actual rest length of the Echo?
7. A car is travelling at ridiculous speed where the gamma factor is found to be 2.5 . Calculate the speed that the car is travelling at.
8. Superman, in saving Earth again, throws a $500-\mathrm{g}$ bomb into space, where it will safely explode. If he throws it with a speed of 0.52 c , calculate the bombs relativistic momentum.
9. If a proton moves at 0.750 c , calculate the kinetic energy of the proton in the laboratory frame of reference in $\mathrm{MeV} .\left(m_{p}=1.67 \times 10^{-27} \mathrm{~kg}\right)$

