Astro 25 week 7b: Homework #09 (5 pts)

Q1) (Time dilation) You are a space traveler with a powerful spaceship. Your pet creature, a Ωتℓem, is suffering a vitamin deficiency and has only 1 year to live. To get a vitamin pack, you leave your space station at 0.85c and head for the creature's home world 1 LY away. (1 point each)

A) To the observers on the space station, how many years does it take for you to reach the home world? (Hint: no special relativity required…just the use rate equation, v=d/t!)

B) Calculate the values of β and γ.

C) How many years do you (the traveler) perceive the travel time to take? (Hint: $t_o=t/\gamma$)

Q2) (Lorentz contraction) You are a space farmer with a barn 10m long. Your mini-spacecraft is 15m long, and so cannot fit in the barn. You attempt to solve the problem by flying at 0.75c into the barn. (1 point each)

A) Calculate the values of β and γ.

B) In the frame of the stationary barn, how long is spacecraft as it flies into the barn? (Hint: $L=L_o/\gamma$)

(It seems you could shut the door after the spacecraft enters, then stop the spacecraft inside the barn. That makes it seem that the barn would blow up! This is another famous relativity paradox.)

Q3) (Velocity addition) You are approaching an asteroid at 0.8c. You fire a probe at the asteroid—the probe leaves your spacecraft at 0.4c. (1 point each)

A) Using the velocity addition law from classical, Newtonian kinematics, calculate the speed at which the probe impacts the surface of the asteroid. (Hint: $v_t=v_1+v_2$)

B) Using the correct, relativistic velocity addition law, calculate the speed at which the probe impacts the surface of the asteroid.