Notes: $c = 3 \times 10^8 m/s$ = 1 lightyear/year, 1 nanometer = 10^{-9} meters,

There are 10 points in total.
Remember to write your quiz code # and your name on the front of your blue book,
student ID number is not needed.

----------------*Please write clearly. Show your work for problems 1&2.*----------------------

1. An observer on earth sees a spacecraft and a comet moving in the same direction towards earth. The earth observer measures the spacecraft moving with a velocity of 0.45c and the comet with a velocity of 0.80c.

(a) [2 points] What is the speed of the comet as measured by an observer in the spacecraft?

(b) [2 points] The observer in the spacecraft measures the tail of the comet to be 1000 meters long. How long would the comet's tail be to an observer standing on the comet?

2. An astrophysicist measures the distance to the nearest star, Alpha Centauri, to be 4 lightyears away. She also knows that Alpha Centauri is not moving relative to her observation point on earth. She watches an astronaut travel away from earth at a velocity of .99c towards this star.

(a) [1 points] According to the astrophysicist on earth, how long does it take the astronaut to reach Alpha Centauri in years?

(b) [2 points] According to the astronaut, how long does it take for him to reach the star in years?

(c) [1point] The astronaut shines a green laser with a wavelength 500 nanometers towards earth as he is traveling away. In nanometers, what wavelength does the astrophysicist on earth measure?

------------*You do not need to show your work for these multiple-choice problems*-----------

3. [1 point] In problem number 2, if both the astrophysicist on earth and the traveling astronaut are measuring how long it takes for the astronaut to reach Alpha Centauri from earth, who is taking the "proper time" measurement?

a. The astrophysicist on earth
b. The traveling astronaut
c. Both
d. Neither

4. [1 point] A die is measured to have a volume of 1 cm^3 to observer A who is not moving with respect to the cube. A second observer, observer B, is moving parallel to one of the die's edges at a relative velocity of .3c. The observer B will measure the volume of the die to be

a. zero cm^3
b. less than 1cm^3
c. greater than 1cm^3
d. infinite