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(1) Luke and his rocket-powered sky-racer are traveling at a constant speed of 2.5×10^8 m/s. He passes Leia, a stationary observer, at time $t = 0$. Consider this time to be zero measured both by Luke and Leia. Later, at time $t = 8.0$ s (in her stationary time-frame), Leia flashes a red signal beacon.

(a) At what time in Leia's frame will she determine that the light from the signal beacon reaches Luke?

(b) At what time in Luke's moving frame will he see the signal beacon?

(c) If the wavelength of the beacon fired by Leia is 700 nm, what is the wavelength as seen by Luke upon receiving the signal?

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(2) An elementary particle has rest mass equal to 0.14 u (atomic mass units). In an accelerator it is given kinetic energy equal to 1.0×10^{-11} J.

(a) What is the velocity of this particle, relative to the speed of light?

(b) What is the inertial mass of the particle as it is moving?

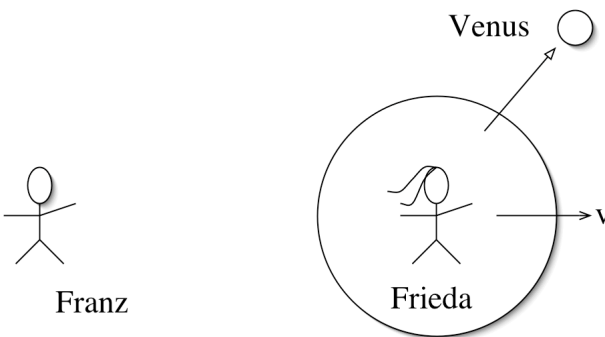
(c) If this particle decays with a half-life of 14 s, measured while the particle is stationary, what is the apparent half life measured in the laboratory frame while the particle is moving in the accelerator?

(3) Frieda is traveling away from the Earth on an interplanetary cruiser, at a speed of $0.50c$ relative to Franz, an observer on Earth. Frieda shines her laser-pointer beam at Venus, which is at an angle of 45° from the forward-velocity direction of her cruiser, measured in her frame of reference.

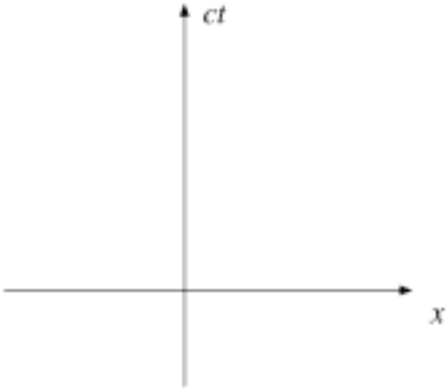
(a) What will be the speed of the laser-beam propagation measured by Franz?

(b) At what angle will the laser-beam be pointed, measured in the Earth frame?

(c) Frieda's cruiser is shaped like a circular saucer, as shown in the figure. Describe the shape of the cruiser as it would be detected by Franz, from Earth. How do its dimensions change, relative to its dimensions in the proper frame?



(4) On the graph below, sketch two possible propagation paths for light rays traveling on the x axis, and passing through the origin. Then, indicate the region(s) of space-time containing points which are in a “space-like” configuration relative to the point at the origin, with $x = 0$ and $ct = 0$.



(5) What are the postulates of Special Relativity?

(6) Show that the relativistic x and y velocity transformations reduce to the classical form if the relative velocity of the observation frames is sufficiently small. Do these also reduce to the classical form if the observed velocity \vec{u} is very small?