

Ch.26 Problems

Name _____

Time Dilation & Length Contraction Note: $\gamma = 1/\sqrt{1-(v/c)^2}$

26.c1 A spherical spacecraft with diameter D moves past an observer on Earth with a speed of $.500c$. What shape does the observer see? Describe the change mathematically. $L=L_p/\gamma$

26.c3 You are in a speedboat on a lake and see a wave front moving ahead and moving away. You accelerate catch up and pass the front. Can this be done if you were in a spaceship and you spotted a light wave ahead of you?

26.c4 What two speed measurements will two observers in relative motion always agree upon?

26.c6 With regards to reference frames how does general relativity differ from special relativity?

26.c9 List some ways daily life would change if light traveled at 50mph.

26.t A hobo on a train going 10.0m/s runs a toy car going 5.0m/s across the floor of a 10.0ft wide boxcar perpendicular to the direction of the train. The toy car hits the wall and returns to the original position. Relative to the hobo how far did the toy car move? Relative to the ground how far did the toy car move?

26.3 A deep space-probe moves away from earth with a speed of $.80c$. It has an antenna that turns at $1/3$ rev/s relative to the probe. How long does 1rev require relative to the Earth? $\Delta t = \Delta t_p \gamma$ (5)

26.4. If a group of astronauts travel to Alpha Centauri, 4.20 light-years away at $.950c$. How long does this take relative to an earth observer? How long does it take relative to the astronauts? How far do the astronauts calculate they have traveled? $\Delta t_p = \Delta t_e / \gamma$ $L = L_p / \gamma$ (1.38, 1.31)

26.5 Your friend goes zooming by in the same model spaceship you are flying. He says your ship is 19.0m long, the manual says it is 20.0m long. How fast is your friend flying? $L = L_p / \gamma$

26.9 A muon formed high in the Earth's atmosphere travels at $.99c$ for a distance of 4.6km before it decays into an electron, neutrino and an antineutrino. How long does it live and how far does it move in its frame of reference? Find Δt from earth = d/v , then use Earth's perceived velocity by muon over Δt .

26.13 A super train 100.0m long enters a tunnel 50.0m long going $.95c$. What does an observer see from a helicopter above the tunnel?

26.15 Extra Credit - In 1963 Mercury Astronaut Gordon Cooper orbited the earth 22 times at a height of 160km. How much younger was he when he landed than those people watching from earth.
(note: since $v \ll c$, $1/(1-x)^{1/2} \sim 1+x/2$)

