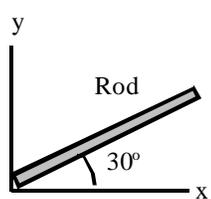


Extra Questions on Relativity

1. I am at rest in frame A and I measure the length of an object to be 2m. A person in another frame (B) measures its length to be 1.5m. In a third frame, D, its length is measured to be 3m.
 - a) If one of these frames is the rest frame of the object, which is the rest frame? (**Give a reason for your choice!**)
 - b) Which frame is moving the fastest relative to the rest frame and what is its speed?
2. Two events occur in my frame, frame A, $1\mu\text{s}$ apart. They are at $x = 0$ and $x = 200\text{m}$, the one at 0m occurring first in my frame. A person in another frame, frame B, is moving in the $-x$ direction relative to me with a speed of $0.8c$.
 - a) What is the time interval between the events in frame B, i.e. Δt_B ?
 - b) How far apart are they in frame B, i.e. Δx_B ?
 - c) If there is a third frame, frame D moving with a speed of $0.8c$ in the $+x$ direction relative to frame A, what would Δx_D and Δt_D be for that frame?
3. A meter stick is making an angle of $\theta = 30^\circ$ with respect to the x axis in my frame, A, and is at rest in my frame. Another frame, B, is moving in $+x$ direction with a speed of $v = 0.6c$ relative to my frame. What does the rod make with respect to the x axis in frame B? (Assume the y axis in B is parallel to the y axis in A.) Hint: What appears to change in B, the Δx_B , the Δy_B , or both?



in my
the
angle
 x axis
frame
4. In frame A two events occur and they are 400m apart and the time interval (in A) is $2\mu\text{s}$.
 - a) Is there a frame where they occur at the same place? (**Explain!**)
 - b) Is there a frame where they occur at the same time? (**Explain!**)
 - c) If there is a yes to either or both of these, what is the velocity of that frame with respect to A?
5. In frame A two events occur and they are 400m apart and the time interval (in A) is $1\mu\text{s}$.
 - a) Is there a frame where they occur at the same place? (**Explain!**)
 - b) Is there a frame where they occur at the same time? (**Explain!**)
 - c) If there is a yes to either or both of these, what is the velocity of that frame with respect to A?
6. A particle of mass $400\text{MeV}/c^2$ is at rest in my frame. It decays into two particles. Particle one has a rest mass of $m_1 = 200\text{MeV}/c^2$ and particle two of mass $m_2 = 50\text{MeV}/c^2$.
 - a) What quantities will be conserved in this decay?
 - b) How much energy is “released” in this decay?
 - c) What do you know about the relationship between the magnitudes of the momenta $|\mathbf{p}_1|$ and $|\mathbf{p}_2|$.
7. A person in a car, Dave, is traveling between two intersections with a constant velocity of v in the $+x$ direction relative to an observer, Sue, who is on the sidewalk at rest relative to the earth. The person in the car passes the first intersection at time t_{1D} and the second at t_{2D} . For the observer on the sidewalk, Sue, they occur at t_{1S} and t_{2S} respectively. For Sue the distance between the intersections is L_S and for Dave in the car the distance is L_D . The time interval for Dave is $\Delta t_D = t_{2D} - t_{1D} = 2 \times 10^{-6}\text{s}$, and the length for Sue is $L_S = 600\text{m}$.
 - a) What is v ? (Give it as a fraction times c , the speed of light.)
 - b) What is the time interval $\Delta t_S = t_{2S} - t_{1S}$ for Sue? Which is the proper time interval for those two events, Δt_D or Δt_S and **why** is it the proper time?
 - c) What is the length for Dave, L_D ?