Chapter 35: Special Theory of Relativity

1) The idea that force causes acceleration doesn't seem strange. This and other ideas of Newtonian mechanics are consistent with our everyday experience. But the ideas of relativity do seem strange odd and more difficult to grasp. Why is this?

3) A person riding on the roof of a freight train throws a ball forward. (a) Neglecting air drag and relative to the ground, is the ball moving faster or slower when the train is moving than when it is standing still? (b) Relative to the freight car, is the ball moving faster or slower when the train is moving than when the train is standing still?

4) Suppose instead that the person riding on top of the freight car shines a searchlight beam in the direction in which the train is traveling. Compare the speed of the light beam relative to the ground when the train is at rest and when it is moving. How does the behavior of the light beam differ from the behavior of the ball in Exercise 3?

15) Event A occurs before event B in a certain frame of reference. How could event B occur before event A in some other frame of reference?

19) Light travels a certain distance in, say, 20,000 years. How is it possible that an astronaut, traveling slower than light, could go as far in 20 years of her life as light travels in 20,000 years?

22) Is it possible for a son or daughter to be biologically older than his or her parents? Explain.

30) If stationary observers measure the shape of a passing object to be exactly circular, what is the shape of the object according to observers traveling with it?

44) What does the equation \( E = mc^2 \) mean?

47) When we look out into the universe, we see into the past. John Dobson, founder of the San Francisco Sidewalk Astronomers, says that we cannot even see the backs of our own hands now—in fact, we can't see anything now. Do you agree? Explain.