

1-13. Suppose that an event occurs in inertial frame S with coordinates $x = 75$ m, $y = 18$ m, $z = 4.0$ m at $t = 2.0 \times 10^{-5}$ s. The inertial frame S' moves in the $+x$ direction with $v = 0.85c$. The origins of S and S' coincided at $t = t' = 0$. (a) What are the coordinates of the event in S' ? (b) Use the inverse transformation on the results of (a) to obtain the original coordinates.

1-22. A *nova* is the sudden, brief brightening of a star (see Chapter 13). Suppose Earth astronomers see two novas occur simultaneously, one in the constellation Orion (The Hunter) and the other in the constellation Lyra (The Lyre). Both nova are the same distance from Earth, $2.5 \times 10^3 c \cdot y$, and are in exactly opposite directions from Earth. Observers on board an aircraft flying at 1000 km/h on a line from Orion toward Lyra see the same novas but note that they are not simultaneous. (a) For the observers on the aircraft, how much time separates the novas? (b) Which one occurs first? (Assume Earth is an inertial reference frame.)

1-30. How fast must you be moving toward a red light ($\lambda = 650$ nm) for it to appear yellow ($\lambda = 590$ nm)? Green ($\lambda = 525$ nm)? Blue ($\lambda = 460$ nm)?

1-41. A friend of yours who is the same age as you travels to the star Alpha Centauri, which is $4c \cdot y$ away, and returns immediately. She claims that the entire trip took just 6 years. (a) How fast did she travel? (b) How old are you when she returns? (c) Draw a spacetime diagram that verifies your answer to (a) and (b).

1-58. Two observers agree to test time dilation. They use identical clocks, and one observer in frame S' moves with speed $v = 0.6c$ relative to the other observer in frame S . When their origins coincide, they start their clocks. They agree to send a signal when their clocks read 60 min and to send a confirmation signal when each receives the other's signal. (a) When does the observer in S receive the first signal from the observer in S' ? (b) When does he receive the confirmation signal? (c) Make a table showing the times in S when the observer sent the first signal, received the first signal, and received the confirmation signal. How does this table compare with one constructed by the observer in S' ?