

3. **ssm** A law enforcement officer in an intergalactic "police car" turns on a red flashing light and sees it generate a flash every 1.5 s. A person on earth measures that the time between flashes is 2.5 s. How fast is the "police car" moving relative to the earth?

4. Suppose that you are traveling on board a spacecraft that is moving with respect to the earth at a speed of $0.975c$. You are breathing at a rate of 8.0 breaths per minute. As monitored on earth, what is your breathing rate?

* 6. An astronaut travels at a speed of 7800 m/s relative to the earth, a speed that is very small compared to c . According to a clock on the earth, the trip lasts 15 days. Determine the *difference* (in seconds) between the time recorded by the earth clock and the astronaut's clock. [Hint: When $v \ll c$, the following approximation is valid: $\sqrt{1 - v^2/c^2} \approx 1 - \frac{1}{2}(v^2/c^2)$.]

8. A tourist is walking at a speed of 1.3 m/s along a 9.0-km path that follows an old canal. If the speed of light in a vacuum were 3.0 m/s, how long would the path be, according to the tourist?

11. **ssm** A UFO streaks across the sky at a speed of $0.90c$ relative to the earth. A person on earth determines the length of the UFO to be 230 m along the direction of its motion. What length does the person measure for the UFO when it lands?

** 15. **ssm www** A rectangle has the dimensions of $3.0 \text{ m} \times 2.0 \text{ m}$ when viewed by someone at rest with respect to it. When you move past the rectangle along one of its sides, the rectangle looks like a square. What dimensions do you observe when you move at the same speed along the adjacent side of the rectangle?

17. At what speed is the magnitude of the relativistic momentum of a particle three times the magnitude of the nonrelativistic momentum?

24. Suppose one gallon of gasoline produces $1.1 \times 10^8 \text{ J}$ of energy, and this energy is sufficient to operate a car for twenty miles. An aspirin tablet has a mass of 325 mg. If the aspirin could be converted completely into thermal energy, how many miles could the car go on a single tablet?

27. **ssm** How much work must be done on an electron to accelerate it from rest to a speed of $0.990c$?

32. Galaxy A is moving away from us with a speed of $0.75c$ relative to the earth. Galaxy B is moving away from us in the opposite direction with a relative speed of $0.55c$. Assume that the earth and the galaxies are moving at constant velocities, so they are inertial reference frames. How fast is galaxy A moving according to an observer in galaxy B?