

PHYS 200: Mid-Term Review

10 February 2005

1. A 5 m long semitrailer truck is traveling at 100 km/hr. How long will the truck appear to a stationary observer standing by the side of the highway?
2. 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?
3. A woman and a man are on separate rockets, which are flying parallel to each other and have a relative speed of $0.940c$. The woman measures the same value for the length of her own rocket and for the length of the man's rocket. What is the ratio of the value that the man measures for the length of this own rocket to the value he measures for the length of the woman's rocket?
4. The crew of a rocket that is moving away from the earth launches an escape pod, which they measured to be 45 m long. The pod is launched toward the earth with a speed of $0.55c$ relative to the rocket. After the launch, the rocket's speed relative to the earth is $0.75c$. What is the length of the escape pod as determined by an observer on earth?
5. Because of the rotation of the earth, a point on the equator has a speed of 460 m/s relative to a point at the North Pole. According to the time-dilation effect, by what factor do the rates of two clocks differ if one is located on the equator and the other at the North Pole? After 1 year has elapsed, by how many seconds will the clocks differ? Which clock will be ahead?
6. At $11^h0^m0^s$ A.M. a boiler explodes in the basement of the Museum of Modern Art in New York City. At $11^h0^m0.0003^s$ A.M. a similar boiler explodes in the basement of a soup factory in Camden, New Jersey, at a distance of 150 km from the first explosion. Show that in the reference frame of a spaceship moving at a speed greater than $v = 0.60c$ from New York toward Camden, the first explosion occurs *after* the second.