Special Relativity Worksheet
College Physics 104

1. A relativistic conveyor belt (reference frame S') is moving at a speed v=0.75c relative to a reference frame, S. Two observers in reference, S, are standing beside the belt 10 m apart. They arrange that each will paint a mark on the belt at exactly the same instant (as measured in S). (From Taylor, Zaffiratos and Dubson's Modern Physics for Scientists and Engineers.)

a) What are the two events?

b) In what reference frame are the two events at rest?

c) find gamma

d) find the distance between the marks as measured by the observers on the belt (in S')

2. A spaceship resting on Earth has a length of 35.2m. As it departs on a trip to another planet, it has a length of 30.5m as measured by the Earthbound observers. The Earthbound observers also notice that one of the astronauts on the spaceship exercises for 22.2 min. (problem 61 from GRR)

a) What is gamma? Think about what distance has the proper length.

b) In which reference frame is the proper time for the exercises measured?

c) How long would the astronaut herself say that she exercises?

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3. A mechanism on earth used to shoot down geosynchronous satellites that house laser based weapons is finally perfected and propels golf balls at 0.9c. (from Thornton and Rex, Modern Physics for Scientists and Engineers)

   a) How far will a detector riding with the golf ball initially measure the distance to the satellite? (Geosynchronous satellites are placed 3.58×10^4 km above the earth.)

   b) How long will it take the golf ball to make the journey to the satellite in the earth's frame?

   c) How long will it take in the golf ball's frame?

   d) Which reference frame has the proper time? Check yourself with a calculation.