

**Homework Assignment #7**

Due Thursday, May 25  
70 points total

Homework assignments may be turned in to me during class or in my office by the end of my office hours on the due date. I'll be happy to help you tie up the loose ends during my office hours.

Unless otherwise indicated, problems are from Griffiths, *Introduction to Electrodynamics*. All problems will be graded on a scale of 0 to 10.

1. Problem 12.16. Twin paradox.
2. Problem 12.17. Verifying that the scalar product is invariant.
3. Problem 12.19. Rapidity.
4. Problem 12.23. Space-time diagram and velocity addition. You must use graph paper, or else measure carefully with a ruler. Free-hand work is not acceptable.
5. Problem 12.30. Velocity of the center-of-momentum frame. (This should be a one or two liner). Also do the following calculation, which is an extension of Example 12.8: A particle of mass  $m_A$  is at rest when it decays into two particles, of masses  $m_B$  and  $m_C$ . Show that the energy of particle  $B$  is given by

$$E_B = \frac{(m_B^2 + m_A^2 - m_C^2)c^2}{2m_A}$$

6. Problems 12.36 and 12.40. Acceleration of a particle from electromagnetic fields.
7. A pilot of a spaceship, according to his watch, accelerates at 1 g for 5 years going away from earth, then decelerates for 5 years, reverses direction and returns to earth in the same manner. How far does he get away from earth? 20 years elapses on the spacecraft during this journey. How much time elapses on Earth? To do this, you can start with Equation 12.61 for the velocity of the ship as a function of time, which lets you convert from earth time intervals  $dt$  to proper time (time in the spaceship rest frame) intervals  $dt$  at each instant. Then you must integrate to get the relation between elapsed time and elapsed proper time for each leg of the journey.