

PHY 504

Problem Set #11

due 23 November 2008

1. Steady rain comes down with velocity u . You drive into it with velocity v .
 - (a) At what velocity and angle to the horizontal do you see the rain come down?
 - (b) Repeat for relativistic velocities.

2. Starting from rest, a spaceship leaves Earth and flies to Proxima Centauri, 4.2 light-years away. For the first half of the journey, the ship maintains a steady acceleration of 9.8 m/s^2 in its own reference frame. For the second half, it decelerates at the same rate.
 - (a) What is the maximum velocity relative to Earth attained by the ship?
 - (b) How long in ship time does it take the ship to get there?
 - (c) How long in Earth time?

3. Problem 7.23. [Review Problem 2, PS #1 first.] What minimum fraction of its rest mass must the spaceship of problem #2 expend in order to complete its journey, assuming the rocket gases are expelled with perfect efficiency at the speed of light? Compare with the nonrelativistic (Newtonian) answer.

4. A charged relativistic particle enters a uniform electric field oriented perpendicular to its motion.
 - (a) Write down the Lagrangian and Lagrange's equations.
 - (b) Solve. What is the nonrelativistic limit of your solution?
 - (c) Express your solution parametrically as a function of the proper time.
 - (d) Repeat for a charged particle in a uniform magnetic field.