Physics 200 Relativity Challenge Problems

Each problem worth 5 points that can be added to any assignment grade.

Problem 1

A train of length L moves at velocity v along a track. A photographer standing at a distance y from the track takes a photo of the train as it passes. How long does the train appear to be in the photo (e.g. suppose there is a big ruler sitting beside the track that we can compare with) if the front of the train in the photo is at the point on the track nearest the camera? What is the answer in the two limits $y \gg L$ and $y \ll L$?

Problem 2

A rocket is initially stationary in the frame of the Earth at $x = 0$. The rocket then turns on its thrusters so that the acceleration *in its own frame* is always A. Determine the velocity $v(t)$ as a function of time and the trajectory $x(t)$ of the rocket in the Earth's frame.

Problem 3

A spherical ball of radius R moves at velocity v along a trajectory that passes a distance L from an observer. Describe the observed shape of the ball (i.e. what the observer actually sees) as a function of time.
    Warning: I haven't tried this one yet, so I'm not sure how hard it is.