

NYU Physics I—Problem Set 13

Due Thursday 2016 December 8 at the beginning of lecture.

Problem 1: From the notes at <http://cosmo.nyu.edu/hogg/sr/>, Problem 3–4.

Problem 2: From the notes at <http://cosmo.nyu.edu/hogg/sr/>, Problem 2–14.

Problem 3: (a) What is γ to first order in β^2 for $\beta \ll 1$? That is, construct a Taylor Series for γ in terms of β^2 and give the zeroth-order term (1) and then the first-order term.

(b) What are β and γ for a person walking (relative to the sidewalk), a driver on the freeway (relative to the road), a commercial jet (relative to the air), and an astronaut in the ISS (relative to the center of mass of the Earth)? Use the first-order expression from part (a) to compute the γ values.

(c) Computing the full time dilation effect in gravity is complicated! However, the pure kinematic part of the time dilation only depends on γ . Two twins part. One gets on the ISS for a year, and one stays on Earth. When they are reunited in a year, how much younger is the astronaut than the homebody?

Extra Problem (will not be graded for credit): If the total energy (rest mass plus kinetic) of a point particle is $\gamma m c^2$, use the result from Problem 3 above to get an approximate expression for the kinetic energy at low speeds.