Ex.1

Suppose to have two inertial frames: S and S', which moves with respect to S with velocity $\mathbf{v} = v\hat{ß}$ (i.e. in the x direction). Consider a bar of lenght l_0 in S' lying along the x axis. Show that the lenght of the bar as seen from S is smaller than l_0 (contraction of lenghts).

Ex.2

Suppose to have S and S' as in the previous ex. Show that, if an observer measure an interval of time $\Delta t'$ between two events in S', the observer in S measures a $\Delta t > \Delta t'$ (dilatation of time).

Ex.3

Bruno Rossi experiment. Muons decay with the following reaction

$$\mu^- \to e^- + \bar{\nu}_e + \nu_\mu \,. \tag{1}$$

The number of muons that at the time t are not decayed, on a population of N_0 muons, is given by the exponential law

$$N(t) = N_0 \, e^{-\frac{t}{\tau}} \,, \tag{2}$$

with $\tau = 2.16\ \mu s$ in the rest frame of the muon.

In the laboratory frame the muons move with a speed $v = 0.995\, c$ (almost the speed of light c). If one detects 560 muons/h on top of a mountain at $h = 2000$ m, how many muons should detect on earth ($h = 0$) in case of Newtonian mechanics? And in the case of Special Relativity?