vi) The principle of relativity states that physical laws can be written in the same form in all inertial frames. Newtons second law and his intuitive ideas of space and time imply that masses and their magnitudes of lengths, accelerations and forces are identical for all inertial observers. The Galilean transformation relating velocities in different inertial frames, part of the Newtonian system, allows velocity terms in force laws, since velocities, so forces and accelerations, would be changed in magnitude under the Galilean transformation ie between inertial frames.

However, we have just calculated different lengths for the same rod in different inertial frames, and using the Lorentz force law and assuming charge invariance between inertial frames, calculated different forces acting on the same object in different inertial frames. Also, the Lorentz force law contains two terms: an electric force and a velocity dependant magnetic force (both also dependent on linear charge density ie the length of the rod). The Galilean transformation implies different velocities, so different forces and accelerations in different inertial frames, and this is in conflict with Newtons second law assuming the principle of relativity and the Lorentz force law.

If the Lorentz force law is accepted as a law of physics in this particular inertial frame, then other other laws apply in other inertial frames, so that the principle of relativity is abandoned, or different accelerations appear in other inertial frames, so that Newtons second law is abandoned.

10

38