Checklist For Special Relativity Book Part 1

Statement of the Principle of Relativity and Invariance of Speed of Light

Arguments (Derivations)

1. Deriving The Lorentz Transformation ( Use the Principle of Relativity and Invariance of the speed of light to prove (a)-(d) )
   1. Invariance of Length’s Measured Perpendicular to Relative Motion
   2. Time Dilation
   3. Length Contraction
   4. De-synchronization
   5. Synthesis of Lorentz Transformation from (a)-(d) to find

1. Adventures with The Lorentz Transformation
   1. Use the properties of cosh and sinh functions to show that a general Lorentz transformation (1 space and 1 time dimension form) can be written as where ξ is called the boost parameter.
   2. The Space-time Interval between any two events
      1. Use the Lorentz Transformation to prove that the space-time interval between any two events is measured to be the same in all inertial frames
      2. Show that an inertial clock measures the space-time interval between events that happen at the location of the clock
      3. Show that a ruler at rest in an inertial frame measures the interval between events that occur at the ends of the ruler at the same time in the frame in which the ruler is at rest
      4. Use the Lorentz Transformation to show that if the space-time interval between two events is time-like that there always is an inertial clock that measures this interval.
      5. Use the Lorentz Transformation to show that if the space-time interval between two events is space-like then there exists a ruler that measures this space-time interval.
   3. Using Composition of Lorentz Transformations to Prove the Velocity Addition Formula : and prove that if both ( where all the betas are relative velocities scaled by the factor of the speed of light; i.e.
2. Doppler Shift – Prove the (Longitudinal) Relativisitic Doppler Shift Formulae by considering a series of light pulses emitted from an inertial clock at regular time intervals (as measured by the inertial clock). Show by direct argument using the invariance of the speed of light and time dilation that the frequency of the pulses measured by another inertial clock moving directly away (or toward) the first clock are red (blue) shifted by the redshift (blue-shift) factor.