Problem Set # 2

(On Special Relativity Theory)

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"The first principle is that you must not fool yourself and you are the easiest person to fool."
— Richard P. Feynman

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1. Using relativistic velocity addition rules obtain the acceleration transformation (of a body) between two inertial frames moving with a constant speed relative to each other.

2. Obtain length of a moving rod defined in terms of the product of its velocity by the time interval between the instant that one end point of the rod passes a fixed marker and the instant that the other end point passes the same marker. Show that result leads to the same form of length contraction formula as we have obtained using Lorentz transformation equations.

3. Two event occur 150m apart with an intervening time interval of $0.60\mu s$. What is the speed of reference frame in which they occur at the same coordinate?

4. An observer notices that a moving clock runs slow by a factor of exactly 20. What will be the speed of clock?

5. A rod moves sideways at 0.90c. What will be its length for the laboratory frame observer?

6. Observer O_1 measures the velocity of a rocket as $\mathbf{v}$ and a comet as $\mathbf{u}$. Here $\mathbf{v}$ and $\mathbf{u}$ are parallel and in the direction of the observer's positive axis. What will be speed of comet as measured by observer O_2 on the rocket?

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7. An event occurs at $x = 500m$, $t = 0.90\mu s$ in one frame of reference. Another frame is moving at 0.90c in the negative x direction. The origins coincides at $t = 0$ and clocks in the second frame are zeroed when the origins coincide. What will be the coordinate and time of event in the second frame?

8. Frame S' moves in the positive x direction at 0.60c relative to frame S. An object moves in the positive x direction at 0.4c as measured by an observer in S'. What will be the speed of particle as measured by an observer in S frame?

9. Two electron move in opposite directions at 0.70c as measured in laboratory. What will be speed of one electron as measured from the other?

10. A rocket ship of rest length 100m is moving at speed 0.80c past a timing device that records a time interval between the passage of the front back ends of the ship. Obtain its time interval.