Your solutions should be neat, correct and complete. Same instructions as Mission 1 apply here.

Recommended Homework from Textbook: problems:

Chapter 38 $\#'s$ 3, 13, 23, 29, 31

Suggested Reading the following resources may be helpful:

(a.) Chapter 38 of the required text.

Problem 73: (2pts) What famous null result helped make many lose faith in the concept of aether ?

Problem 74: (2pts) What are the two basic Axioms of Einstein's Theory of Special Relativity ?

Problem 75: (2pts) What is General Relativity and how is it different than Special Relativity ? What technology requires a General Relativitistic correction for accuracy ?

Problem 76: (2pts) Suppose a space train going $v = c/2$ with respect to frame S. This space train has a bike rider who rides on the train at $v_2 = c/2$ with respect to the frame of reference of the train. What is the observed velocity of the bike with respect to S ?

Problem 77: (2pts) A given elementary particle is seen to last an average of 20 times as long as its usual lifetime as it is shot with high speed v from a particular high energy accelerator. What is the typical speed v of these particles ? (give answer in terms of speed of light c)

Problem 78: (2pts) A proton has $v = c/9$ find the relativistic kinetic energy of the proton and find its relativistic momentum.

Problem 79: (2pts) If a particle has relativitic kinetic energy which is 100 times its rest energy then how fast is the particle moving ?

Problem 80: (2pts) Suppose event $E1$ has $t_1 = 10\,s$ and $x_1 = 10\,m$ and event $E2$ has $t_2 = 20\,s$ and $x_2 = 10\,m$. Consider a frame of reference $S' : (t', x')$ which moves in the usual way at a velocity of $v = c/99$. Find the spacetime coordinates of $E1$ and $E2$ with respect to the S'-observer. Of what is this an example ?

Problem 81: (2pts) Suppose event $E1$ has $t_1 = 10\,s$ and $x_1 = 10\,m$ and event $E2$ has $t_2 = 10\,s$ and $x_2 = 20\,m$. Consider a frame of reference $S' : (t', x')$ which moves in the usual way at a velocity of $v = c/99$. Find the spacetime coordinates of $E1$ and $E2$ with respect to the S'-observer.

Problem 82: (2pts) Show time dilation with the appropriate spacetime diagram

Problem 83: (2pts) Show length contraction with the appropriate spacetime diagram

Problem 84: (2pts) In the study of Spacetime in Special Relativity most physical equations are based on using the Minkowski metric. It is defined by:

$$g(\overline{v}, \overline{w}) = -v_0 w_0 + v_1 w_1 + v_2 w_2 + v_3 w_3$$

where $\overline{v} = \langle v_0, v_1, v_2, v_3 \rangle$ and $\overline{w} = \langle w_0, w_1, w_2, w_3 \rangle$.

(a.) If $\overline{v} = \langle ct, ct, 0, 0 \rangle$ then show $g(\overline{v}, \overline{v}) = 0$.

(b.) Let E_1, E_2 be events as observed in frame S and E_1', E_2' be the events observed in a frame S' which moves with velocity v in the x-direction in the S-frame. Show $g(E_2 - E_1, E_2 - E_1) = g(E_2' - E_1', E_2' - E_1')$ where $E_1 = (ct_1, x_1, y_1, z_1)$ etc.