CM FALL 01 A

This problem consists of two unrelated parts.

Part I.

A rocket ship S', of length l' meters in its rest frame, heads toward an observer O at relativistic velocity v as shown in the figure. When the nose of the rocket ship S' reaches O, the nose emits a light pulse in all directions.

Express your answers to parts a), b) and c) in terms of l', v and c, the speed of light.

a) After what time interval t', according to the rocket ship S', does the pulse reach the tail end of rocket ship?

b) After what time interval t, according to observer O, does the pulse reach the tail end of rocket ship?

c) Are the two times in parts a) and b) related by time dilation, $t' = t/\sqrt{1-v^2/c^2}$? If not, why not?

Part II.

A photon rocket uses light as a propellent to travel at relativistic speeds. If the initial and final rest masses of the rocket are M_i and M_f, respectively, find the final velocity of the rocket, relative to its initial rest frame, in terms of M_i, M_f and c.