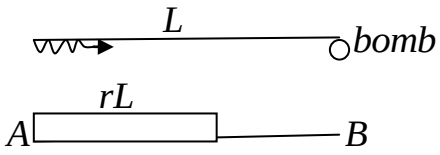
Homework 14 for GP1

（Use L-T as much as you like）

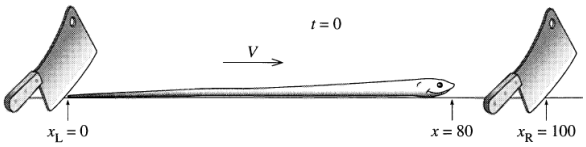
1. KK 12.2 （12.8）
2. Considering simultaneous events in S frame, i.e. t=0, x_1=0 for event 1; t=0,x_2=A. (A>0) Now for the S' frame which travels with v along +x direction, what is the time difference and order of the event (which event happens first)? For another observer in S" frame which is traveling –v with respect to S (along –x), what is the time difference and order? First base your argument by LT, then use Minkowski diagram to qualitatively show the time ordering (*Optional for this Minkowski part)*.
3. Use the LT to derive the velocity relations: Suppose 3 inertial frames: S, S',S''. S' is moving with v_1 relative to S; S" is moving with v_2' relative to S'. From the LT between S-S' and S'-S", we can work out the transform relation between S-S" (In matrix representation, will be product of matrix). Find out the transform between S-S" through S-S' and S'-S" and show the v_2, the relative velocity between S-S" from the transformation you just calculated in terms of v_1, v_2'.
4. Refer to the figure below:



A tunnel (proper length L)and a train (proper length is rL), the train is running with velocity v through the tunnel. A bomb was planted at the far-end (B) of the tunnel and it is going to explode when the head of train reaches B. As the tail of the train first enters the tunnel (A), a deactivation light signal is sending out to disarm the bomb. Find the requirement of length of the train, i.e. the value of r that can safely pass this tunnel. Work this A) using algebra method. B) using the Minkowski diagram. (You can pick any frame of your preference, for example I worked this problem using train frame in algebra method; and using tunnel frame as the orthogonal one in Minkowski diagram)

5. Here is one interesting paradox (chopping of snake, adapted from example 15.3 in Taylor's book): A snake with proper length of 100 cm is moving with $\beta = 0.6$. You are

holding two clippers 100cm apart and chop them down simultaneously when the snake's tail coincides with the left clipper (the downward distance is so small that the time taken by the clippers to come down is negligible). The figure below is the reasoning in your frame, and it will do no harm to the snake.



a) Is the reasoning in the figure above correct?

b) What happened in the snake's point of view? Will it be harmed? Solve this by doing calculation using LT transform, i.e. what are the events (clippers come down) viewed in snake's frame.

6. Another popular paradox (very similar to the above):

A hole and a rod(both are very thin in thickness), the proper length of the rod and radius of the hole are both L. The rod is moving with v and at the moment the rod head reaches the ring of the hole (as in the figure right above), the hole is lifted and question is: will the rod goes under the hole? Answer this in both hole's frame and rod's frame.

7. KK 12.7 （12.15）
8. KK 12.8 （12.13）
9. KK 12.9 （12.14）