Physics 3210, Spring 2019 — Homework #10

Due *in class* Thursday April 18^{th}

1. *K&K* Problem 12.7.
2. *K&K* Problem 12.9.
3. A lightweight pole 20 m long lies on the ground next to a barn 15 m long. An Olympic athlete picks up the pole, carries it far away, and runs with it towards the end of the barn at a speed of 0.8 c. Her friend remains at rest, standing by the barn door.
   (a) How long does the friend measure the pole to be, as it approaches the barn?
   (b) The barn door is initially open, and immediately after the runner and pole are entirely inside the barn, the friend shuts the door. How long after the door is shut does the front of the pole hit the other end of the barn, as measured by the friend?
   (c) In the reference frame of the runner, what is the length of the barn and the pole?
   (d) Does the runner believe that the pole is entirely inside the barn when it hits the end of the barn? Can you explain why, and the apparent contradiction between what is seen by the runner and what is seen by her friend?
4. *K&K* Problem 12.19.
5. A rocket flies between two planets that are one light-year apart. What should the rockets speed be so that the time elapsed on the captain's watch is one year?
6. A train of length 15 $c \cdot$sec moves at speed $3c/5$. How much time does it take to pass a person standing on the ground (as measured by that person)? Solve this by working in the frame of the person, and then again by working in the frame of the train.
7. A train of proper length L and speed $3c/5$ approaches a tunnel of length L. At the moment the front of the train enters the tunnel, a person leaves the front of the train and walks (briskly) toward the back. She arrives at the back of the train right when it (the back) leaves the tunnel.
   (a) How much time does this take in the ground frame?
   (b) What is the person's speed with respect to the ground?
   (c) How much time elapses on the person's watch?