Physics 370 Homework #1

5 problems

Due by August 29

▷ **1.**

You are gliding over Earth's surface at a high speed, carrying your high-precision clock C. At points X and Y on the ground are similar clocks, synchronized in the ground frame of reference. As you pass over clock X, it and your clock both read 0.

(a) According to you, do clocks X and Y advance slower or faster than clock C?

(b) When you pass over clock Y, does it read the same time, an earlier time, or a later time than C, according to you?

(c) Answer the same question (b) from the point of view of an observer on the ground.

(d) Reconcile any seeming contradictions between your answers to parts (a) and (b).

▷ **2.**

Through a window in Carl's spaceship, passing at $v = 0.5c$, you watch Carl doing an important physics calculation. By your watch it takes him 1 minute. How much time did Carl spend on his calculation?

▷ **3.**

According to an observer on Earth, a spacecraft whizzing by at $0.6c$ is 35 m long. What is the length of the spacecraft according to passengers on board?

▷ **4.**

The variable γ_v is a reasonable measure of the size of relativistic effects. Roughly speaking, at what speed would observations deviate from classical expectations by 1%?

▷ **5.**

A pole-vaulter holds a 16 ft pole. A barn has doors at both ends, 10 ft apart. The pole-vaulter on the outside of the barn begins running toward one of the open barn doors, holding the pole level in the direction he's running. When passing through the barn, the pole fits (barely) entirely within the barn all at once.

(a) How fast is the pole-vaulter running?

(b) According to whom—the pole-vauler or an observer stationary in the barn—does the pole fit in all at once?

(c) According to the other person, which occurs first: the front end of the pole leaving the barn or the back end entering, and

(d) what is the time interval between these two events?