Make sure you answer every part of the question. Write out your answers (neatly!) and bring them to class on Tuesday. Some of these questions are closely related to questions from SZE but they are not identical—be sure that you are doing the right question!

A. Draw space-time diagrams for each of the four stages of Newton's bucket experiment, indicating the world lines of an atom in the bucket and an atom of the water. You will need to include two dimensions of space and clearly mark which atom is which. The four stages are: (i) The bucket and the water are at rest; (ii) The bucket is rotating and the water is at rest; (iii) The bucket and the water are rotating at the same rate; (iii) The bucket is at rest and the water is still.

B. Draw a space-time diagram that illustrates the collision of two billiard balls, each in inertial motion, from an inertial frame in which neither is at rest. Now draw a second diagram in which one of the balls is at rest. What is the difference between these two descriptions? Consider an inertial observer for whom neither of the balls is at rest. In Galilean space-time, how would you represent her time axis on one of these diagrams?

C. One of Einstein's postulates is that the speed of light is the same in every inertial frame. Draw a space-time diagram that represents a race between a light ray and a rocket ship traveling at half the speed of light, each passing the Moon at the same time. Draw three world lines for the Moon, the light ray and the rocket ship. (Use the convention that light rays follow a diagonal path at 45°.) Now draw another diagram from the reference frame of the rocket ship. Make sure that Einstein's postulates are obeyed. How would you represent the time axis of an inertial observer on the rocket ship in the first diagram? How would you represent the time axis of an inertial observer on the Moon in the second diagram?

D. Explain how Galilean space-time (SZE 10.4) is consistent with Galilean Relativity, and why Newtonian space-time (SZE 10.3) is not. Are Newton' Laws compatible with Galilean Relativity? Would the same apply to a theory of electrodynamics with a privileged frame of rest for the aether? Why (not)?