Theory of Relativity – Quiz
July 10, 2012

Names of group:____________________________________

Below are short questions and problems. Answer to the best of your ability. Each question is worth 1 point.

1. In Newton's theory inertial observers are related by a Galilean coordinate transformation ($t' = t$, $x' = x - wt$). (a) In special relativity what is the name or equations relating inertial observers? (b) True or false: there is a special coordinate transformation relating observers in general relativity.

(a) Lorentz (b) False

2. A rocket is moving away from you. According to special relativity, compared to its length on the ground you will measure its length to be (a) shorter, longer, or the same? Compared to the passage of time on your watch, the passage of time on the rocket's clock is (b) faster, slower, or the same? (c) Will any of your answers change if the rocket comes towards you.

(a) shorter (b) slower (c) no

3. General relativity is based on the strong (gravitational fields and accelerated motion are indistinguishable by an observer) and weak (gravitational and inertial masses are the same) equivalence principles. (a) Suppose an experiment found the weak equivalence principle to be false, what would this mean for the strong equivalence principle and why? (b) Suppose an experiment found the strong equivalence principle to be false, what would this mean for the weak equivalence principle and why?

(a) Strong is false (b) Nothing, weak not logically based on strong

4. Suppose you have a very long (10^8 meter) stick which you push. Relativity says nothing can travel faster than the speed of light, so the other end of the stick cannot move for about 1 second. Explain how this is possible (Hint: think about the atoms in the stick).

Force transmitted between atoms (slower than light)

5. Calculate the energy of two photons (the particle of light) produced by the annihilation of an electron and positron, both of which are at rest.

Use $E = mc^2$ to find each photon's mass is about 10^{-13} Joules

6 . (BONUS) Using Einstein's strong equivalence principle what can you deduce about two clocks at different points in a gravitational field, explain your reasoning.

Clocks go slow in a gravitational field. Place a clock at the bottom of a spaceship and a receiver at the top. If the bottom one sends pulses to the top one, then the top will receive at longer intervals because it is receding from the source, and hence observe the bottom clock to be running slow.