Assignment sheet: Week 2 (Jan 20)

After the second week of class you should be able to answer each of the following questions thoroughly, and with confidence.

You should have this sheet completed by: Tuesday, Jan 27

1. In what sense are we “flat” in the time dimension?

2. Identify three facts from geometry that are different when done on a curved surface.

For questions 3, 4 and 5 imagine that you are out in space in the latest model XJ–1 space ship, and I go flying past you in an identical XJ–1 space ship. Assume that we each have a clock in our space ship, and that each of us is able to see the other’s clock as I fly by.

3. Describe three ways in which my space ship and/or my clock will appear differently to you, as compared to your space ship and/or your clock.

4. From your perspective, how would the rate at which my clock is ticking compare to the rate at which your clock is ticking?

5. From my perspective, how would the rate at which your clock is ticking compare to the rate at which my clock is ticking?

6. Why is special relativity required to explain how muons can get from Earth’s upper atmosphere all the way to the ground? Is this an example of time dilation or length contraction—or both?

7. What do the $E$, $m$ and $c$ stand for in the equation $E = mc^2$? Give an example of how the equation works.

8. According to general relativity, how does the rate at which your clock is ticking right now compare to the rate at which the clocks in the space shuttle are ticking?

9. According to general relativity, why is the Moon in orbit around the Earth?

10. Describe how, using special relativity, a wormhole can be turned into a time machine.