PHYS 182 Fall 2019 Prof. R. Brandenberger

Readings and Homework for Week of Sept. 23 2019

Readings

Textbook, Chapters 3, 4 and 5 (Chapter 3 will not be discussed in class). (same chapters in “The Essential Cosmic Perspective”)

Problems (due Sept. 30 in class)

1. Explain why constellations of stars in the sky do not appear to us to be at the same position every night.

2. Have a look at the first equation in the *Mathematical Insight 3.2* box in the textbook (the current edition). Compare with the corresponding equation I wrote on the board in class. What is wrong with the equation in the textbook?

3. Idealize the surface of the early to be a single ocean with a single small island. If it is full moon, then at what time(s) is there a high tide.

4. In the same idealization as in the previous problem, discuss at what phases of the moon do you expect the highest tides.

5. Consider a cube of the expanding universe of side length 10^2Mpc. How much energy is the microwave background radiation losing in each second in this volume?

6/7. The Earth’s surface obtains most energy from the sun (per unit area) when the sun is overhead. At the corresponding latitudes the surface and air heat up more than in other places. The air expands and rises. In the upper regions of the atmosphere the air then flows north and south, leading to low pressure at the surface of the Earth. Explain why this leads to the hurricane season in the Northern hemisphere being late summer and early fall. At what latitude do you expect hurricanes to be born? When and where does the corresponding occur in the Southern hemisphere?

8. Mars orbit: Find the perihelion an aphelion distances of Mars (Hint: You will need data from Appendix E of the textbook).
9. Astronauts are weightless when in orbit in the Space Station. Are they also weightless during launch in the station? How about during their return to the Earth? Explain.
10. Fusion power: No one has yet succeeded in creating a commercially viable way to produce energy through nuclear fusion. Suppose we could build a fusion power plant using the hydrogen in water as a fuel. Based on the data in Table 4.1 in the textbook, how much water would we need each minute to meet the US energy needs? Could this need be met by fusing water flowing from a kitchen sink faucet (assume 1 liter per minute)?