P354 — Problem Set 1

Due Jan. 8

1. Calculate the approximate angular separation of Vega and Sirius.

2. The precession of the Earth is due to the tidal torque produced by the gravitational pull of the Sun and moon. Calculate the torque produced by each of these to see which is larger. Then go ahead to use the moon to calculate the precessional period of the Earth. The torque arises from the unequal pull on the equatorial bulge of the Earth. Find a useful density profile for the earth and use that to estimate the mass of the spherical core. Make any simplifications you like to make the problem tractable. Use the following numbers as necessary:

Earth's polar radius: 6.356912x106 m

Earth's equatorial radius: 6.378533x106 m

Earth moon separation: 3.84403x108 m

Earth Sun separation: 1.4957x1011 m

Mass of Earth: 5.9790x1024 kg

Mass of Sun: 1.991x1030 kg

Mass of moon: 7.354x1022 kg

3. At what locations on earth could you see the sun at the zenith? Describe how often and when you would see the sun at the zenith at these locations.

4. Make appropriate simplifying approximations to estimate the maximum and minimum durations of the solar day, noting the difference between the two. Look up sunrise and sunset times over the next week or so at the equator and use them to make an argument about roughly where we are in our orbit around the sun.

5. Carroll & Ostlie 2.14

6. Carroll & Ostlie 3.1