Do the following problems and be prepared to discuss them in class.

1. Compute the ratio of energy emitted to energy received (absorbed) by the Sun for:
a) Venus assuming a surface temperature of 737 K.
b) Saturn assuming a surface temperature of 95.0 K.
c) Neptune assuming a surface temperature of 59.3 K.
d) Use your results to estimate the rates at which Saturn and Neptune must shrink, in units of cm per century, if gravitational contraction accounts for the excess thermal energy.

2. Compute the cyclotron frequencies of:
a) electrons near the surface of Neptune.
b) protons near the surface of Saturn.

3. Estimate the (sunward) extent of Jupiter's magnetosphere. By "sunward" I mean in the direction of the Sun. A few things are needed to get you started:
• The magnetosphere starts where the Solar Wind pressure equals Jupiter's B field pressure.
• The Solar Wind pressure at Earth is $\sim$1 nPa; it drops as d^{-2} with distance d from the Sun.
• Magnetic pressure is $\frac{B^2}{2\mu_0}$.
• Look up Jupiter's surface B field in Dobson's relevant Chapter 9 table.
• Clearly explain in your solution how magnetic fields drop with distance x. Hint: The field of a magnetic dipole $B \propto (x^2 + a^2)^{-1.5}$ (Sears & Zemansky's Equation 28.18 or OpenStax's Equation 12.16) and take the limit as $x \gg a$.
• Use this scaling along with the other pieces of information to solve for the Sunward extent of Jupiter's magnetosphere.