Planetary Geology 4460
Homework #1 Solution
Due Friday Sept. 8, 2017

Wood Ch. 1 #1 (10 points)
The moon's orbital period around the earth is 27.3 days. If Earth had a second moon, orbiting twice as far from its center as the moon we do have, what would its period be?

Answer:
Because of Kepler's law where $P^2 \propto a^3$, or $P \propto a^{3/2}$, if you double the semimajor axis of the Moon's orbit the period will increase by $2^{3/2} = 2.8284$, becoming 2.8284×27.3 days = 77.2 days.

Wood Ch. 1 #3 (10 points)
If the heat generating elements are concentrated in the crust then it will be easier for the heat to escape than if they are deeply buried in the mantle. Put another way, when the heat generation is concentrated in the crust there will need to be less heat carried through the mantle (since it is generated above this) and the geothermal gradient in the mantle can be less. Therefore the mantle can be cooler than the other case and there can be less geological activity. When the heat generating elements are distributed throughout the mantle that heat, being buried more deeply, will escape less readily, resulting in a hotter mantle.

RRH-1 (10 points) The three innermost Galilean satellites are in a "resonance" where the innermost, Io, orbits Jupiter almost exactly twice as fast as Europa, and Europa orbits Jupiter almost exactly twice as fast as Ganymede. Give the size (semi-major axis) of Europa's and Ganymede's and Ganymede's orbits in terms of the size of Io's orbit (a_{Io}).

From Kepler's 3rd law $P^2 \propto a^3$ or $a \propto P^{2/3}$ so $a/a_{Io} = (P/P_{Io})^{2/3}$ or $a = (P/P_{Io})^{2/3} \times a_{Io}$ which for Europa becomes $2^{2/3}\ a_{Io} = 1.587\ a_{Io}$ and for Ganymede becomes $4^{2/3}\ a_{Io} = 2.520\ a_{Io}$.