AST 250 Spring 2010
HOMEWORK #4

Due Monday March 1

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(1) Calculate the average density of the Sun, the red giant Betelgeuse ($M = 20\ M_{sun}$, $R = 1000\ R_{sun}$), and the white dwarf Sirius B ($M = 0.98\ M_{sun}$, $R = 0.0084\ R_{sun}$).

(2) Using the virial theorem, determine how small the Sun would have to shrink from its present size to output as much energy as the Sun has radiated over its lifetime. What would the average density of the shrunken Sun be? Compare to problem 1.

(3) Approximately 10^{38} neutrinos are produced by the p-p chain in the Sun every second. Calculate the number of neutrinos from the Sun that are passing through your brain every second.

"Mr. Osborne, may I be excused? My brain is full."

(4) Hydrogen burns in the center of the Sun predominately by the p-p chain. The rate of energy produced by the p-p chain is $dE/dt \sim T^4$. For an increase of 10% in the central temperature of the Sun, what percentage change in the energy generated occurs for the p-p chain ?

(5) If the Sun is 74% Hydrogen by mass, estimate the percentage of the Sun's hydrogen that has burned by fusion over its lifetime if it has burned Hydrogen at the same rate as it burns Hydrogen today?