ASTR 367
HW #4

1) $T_c = 1.57 \times 10^7$ K

$P_c = 2.34 \times 10^{16}$ N/m^2

$\rho_c = 1.527 \times 10^5$ kg/m^3

Linear decrease in T. $T = T_c$ @ $R = 0$

Assume $T = 0$ @ $R = R_\odot$

$\Rightarrow T = T_c(1 - R/R_\odot)$

<u>or</u>

Assume $T = 5800$K @ $R = R_\odot$

$\Rightarrow T = (T_c - 5800)(1 - R/R_\odot) + 5800$

Mass $\frac{dM_r}{dr} = 4\pi R^2 \rho(r)$

$\rho(r) = \rho_c (1 - R/R_\odot)^{6.69}$

$dM_r = 4\pi R^2 \rho_c (1 - R/R_\odot)^{6.69} dR$

let $x = R/R_\odot$ so $dR = R_\odot dx$ and $R = R_\odot x$

$dM_r = 4\pi x^2 R_\odot^2 \rho_c (1-x)^{6.69} R_\odot dx$

$M_r = 4\pi R_\odot^3 \rho_c \int_0^x x^2 (1-x)^{6.69} dx$

The integral is ugly. Wolfram gives

$$\int_0^x x^2(1-x)^{6.65}\,dx = \frac{100(70{,}000 - (1-x)^{765/100}(66526x^2 + 153800x + 20000))}{647544909}$$

Pressure

Ideal is just $P = \frac{\rho}{\mu m_H} k T$

What is μ? If we assume $X \approx 0.73$ and $Y \approx 0.77$, and $\mu \approx 0.6$

Hydrostatic

$$\frac{dP}{dR} = \frac{G M_r \rho(r)}{R}$$

$$\Rightarrow dP = \frac{G M \rho(r)}{R} dR$$

can subtract cells