

Astronomy 304, STARS

Homework # 9, Due Wednesday, March. 26, 2003

Show All Your Work

1. Derive the approximate Mass – Radius relation, Mass – Luminosity Relation and the Main Sequence Luminosity – Effective Temperature relation for both massive and low mass stars as we did in class. Neglect radiation pressure, so this derivation does not apply to the most massive stars. The relevant approximate expressions for the energy generation and opacity are:

$$\begin{aligned}\epsilon_{\text{pp}} &\approx 0.107\rho X^2 T_7^4 \text{ erg/g/s} \\ \epsilon_{\text{cno}} &\approx 6.55 \times 10^{-4} \rho X X_{\text{cno}} T_7^{19.9} \text{ erg/g/s} \\ \kappa_{bf+ff} &\approx (13.7Z + 0.012(1 - Z))(1 + X)\rho T_7^{-3.5} \text{ cm}^2/\text{g}\end{aligned}$$

Compare your results with those of detailed calculations.