Problem Set 1

Problem 1: Linear stellar model

Suppose that the density varies linearly from a maximum $\rho = \rho_c$ at the center of the star at $r = 0$ to zero at the edge of the star $r = R$.

Solve the (Newtonian) equation of hydrostatic equlibrium to obtain expressions for the central density ρ_c, the central pressure P_c, and the pressure distribution $P(r)$ in terms of the star's mass M and radius R.

Problem 2: Zeros of the Lane-Emden equation

Find the first zero ξ_1 of the Lane-Emden equation as well as the quantity $-\xi_1^2[d\theta/d\xi]_{\xi_1}$ for values of the polytropic index $n = 0, 1, \frac{3}{2}, 2, 3, 4, 5$.