Problem T3. Protostar formation *(9 points)*

i. (0.8 pts)

$$n = 8$$

ii. (1 pt)

$$t_2 \approx \sqrt{\frac{0.1 r_0^3}{Gm}}$$

iii. (2.5 pts)

$$t_{r \to 0} = \pi \sqrt{\frac{r_0^3}{8Gm}}$$

iv. (1.7 pts)

$$Q = \frac{3mRT_0}{\mu} \ln \frac{r_0}{r_3}$$

v. (1 pt)

$$T(r) = T_0 \left(\frac{r_3}{r} \right)^{3\gamma - 3}$$

vi. (2 pts)

$$r_4 \approx r_3 \left(\frac{RT_0 r_3}{\mu m G} \right)^{\frac{1}{3\gamma - 4}}$$

$$T_4 \approx T_0 \left(\frac{RT_0 r_3}{\mu m G} \right)^{\frac{3\gamma - 3}{4 - 3\gamma}}$$