ASTR 705

HW 10

1)

$B_0 = 0$ | n_s

n_0 | T_s

$T_0 = 0$

v_s

a) For strong shock, $x \to \frac{\gamma+1}{\gamma-1} = 4$ for $\gamma = 5/3$

$n_s = 4 n_0$

b) For strong shock, $T_s \to \frac{2(\gamma-1)}{(\gamma+1)^2} \frac{\mu v_s^2}{k}$

If $\gamma = 5/3$, $\mu = 1$, $T_s = \frac{3}{16} \frac{v_s^2}{k}$

c) $\frac{n_s k T_s}{n_0 \mu v_s^2} = \frac{4 n_0 k \cdot 3/16 \, v_s^2/k}{n_0 \mu v_s^2}$

$= \frac{3}{4}$ for $\mu = 1$

2) Kinetic energy $= \frac{1}{2} M v_s^2$

$M = \frac{4\pi}{3} \rho_0 R^3$ for spherical

$v_s = \frac{2}{5} \frac{R}{t}$ from Figure 39.1

Problem says half the energy is kinetic

$\frac{1}{2} E = \frac{1}{2} \cdot \frac{4\pi}{3} \rho_0 R^3 \left(\frac{2}{5}\right)^2 \left(\frac{R}{t}\right)^2$

$= \frac{2\pi}{3} \cdot \frac{4}{25} \cdot \rho_0 \; R^5 t^{-2}$

From dimensional analysis, $R = A E^{1/5} \rho_0^{-1/5} t^{2/5}$

$\frac{1}{2} E = \frac{8\pi}{75} \rho_0 t^{-2} A^5 E \rho_0^{-1} t^2$

$\Rightarrow A^5 = \frac{75}{16\pi}$

$A = \left(\frac{75}{16\pi}\right)^{1/5} = 1.0833$

Close to $A = 1.15167$ expected!