ASTR 367

HW #5

1) $L_{ed} = \frac{4\pi G c}{\kappa} M$ or

$L_{ed} \hat{=} 1.5\times10^{31} \frac{M}{M_\odot}$ W (book eqn.)

$M \hat{=} 100\ M_\odot$ (wikipedia)

$L_{ed} \hat{=} 1.5\times10^{33}$ W $= 3.9\times10^{6}\ L_\odot$

$L \sim 4\times10^{6}\ L_\odot$ (wikipedia)

So it's close to L_{ed} and extreme mass loss is expected.

2) M_V nova ~ 4.3 (wikipedia)

$$\frac{F_{GC}}{F_{nova}} = 10^{0.4(4.3-0)} = \frac{L_{GC}}{L_{nova}} = 52.5$$

Since $L_{nova} \hat{=} 4\times10^{6}\,L_{\odot}$, $L_{GC} \hat{=} 2\times10^{8}\,L_{\odot}$

b) $L = E/t$ so $E = Lt$

$t = 20\,yr = 6.3\times10^{8}\,s$

$E = 4.9\times10^{43}\,W$

c) $E = \frac{1}{2}mv^2 = \frac{1}{2}\,3.2\times10^{30}\,kg \cdot (650\times10^{3}\,m/s)^2$

$= 1.3\times10^{47}\,W$

a) $t_{ff} \approx \frac{1}{(G\rho)^{1/2}}$

$\rho = M/V = \frac{1.4 M_\odot}{4/3 \pi R_{earth}^3} = 2.5 \times 10^9 kg/m^3$

$t_{ff} \approx 2.4 s$

b) Assume 2×10^{11} stars in the Galaxy

so $\frac{2 \times 10^{11}}{1 \times 10^6} = 2 \times 10^5$ stars can go SN

If 10^3 SN are visible, they are visible for $\frac{10^3}{2 \times 10^5} \tau$, where τ is the average stellar lifetime.

If $\tau \approx 10^7$ years, we get 5×10^4 yrs.