a) $t = \frac{2\pi R_\odot}{v_\odot} = \frac{2\pi \cdot 8.0 \cdot 3.086 \cdot 10^{19}}{220 \cdot 10^3} = 7.05 \cdot 10^{15}\,\text{sec} = \underline{223\ \text{Myr}}$

b) $N = \frac{13.8}{0.223} = \underline{61.9}$

c) $\dot{\theta} = \frac{v}{D} = \frac{250 \cdot 10^3}{750 \cdot 3.086 \cdot 10^{19}} = 1.08 \cdot 10^{-17}\,\frac{\text{rad}}{\text{s}} \hat{=} 2.2 \cdot 10^{-12}\,\frac{\text{arcsec}}{\text{s}} \hat{=} 7 \cdot 10^{-5}\,\frac{\text{arcsec}}{\text{yr}}$

For 1 arcsec: $(7 \cdot 10^{-5})^{-1} = \underline{14{,}222\ \text{yr}}$

For 0.1 arcsec: $\underline{1{,}422\ \text{yr}}$

d) $t = \frac{2.3\,\text{Mpc}}{1000\,\text{km/s}} \cdot \frac{3.086 \cdot 10^{22}}{10^3} = 1.85 \cdot 10^{17}\,\text{sec} \hat{=} \underline{5.9\ \text{Gyr}}$

2) $V = M_V + 5\log(D/10\,\text{pc})$

a) $D = 10\,\text{pc} \cdot 10^{0.2(22.5-0.7)} = \underline{229\ \text{kpc}}$

b) $D = 10\,\text{pc} \cdot 10^{0.2(20.7-0.7)} = \underline{100\ \text{kpc}}$

c) $v = z \cdot c = 30{,}000\,\text{km/s}$ $\quad D = \frac{v}{H_0} = \frac{30{,}000}{68} = \underline{441\ \text{Mpc}}$

3) relative error: $r_D = \frac{1}{2}\sqrt{r_L^2 + r_F^2}$

a) $r_L = 0$ $r_F = 0.1 \Rightarrow r_D = \underline{0.05\ (5\%)}$

b) $r_F = 0.1$, $r_L = 10^{0.4 \cdot 0.25} - 1 = 0.259 \Rightarrow \underline{r_D = 0.139\ (13.9\%)}$

c) $r_L = \sqrt{0.259^2 + (4 \cdot 0.1)^2} = 0.477$, $r_F = 0.1 \Rightarrow \underline{r_D = 0.244\ (24.4\%)}$