Modern physics Chapter 14. Solutions to exercises.

14.2.1.1 The distance to Ursula Mayor I is R = 1.0 x 10^9 light years. Hubble's law v = HR where H = 21 km/s per million light years. The velocity becomes:
$v = HR$ = 21x10^3x 1.0x10^9 / 10^6 m/s = 2.1 x10^7 m/s

14.4.1 From the figure we have when t = 10 days that the luminosity is around 2x$10^3 L_{sun}$

14.8.1 The formula for the red shift $\frac{v}{c} = \frac{(z+1)^2 - 1}{(z+1)^2 + 1} = \frac{(3.5+1)^2 - 1}{(3.5+1)^2 + 1} = 0.906$

Answer: 0.906c = 2.72 x10^8 m/s

14.8.2.1 The red shift parameter $z = \frac{\sqrt{1+\beta}}{\sqrt{1-\beta}} - 1 = \frac{\sqrt{1+0.8}}{\sqrt{1-0.8}} - 1 = 3 - 1 = 2$

14.11.1 M = 70 M_{sol} $r = \frac{2GM}{c^2} = \frac{2 \times 6.66 \times 10^{-11} \times 70 \times 1.989 \times 10^{30}}{\left(3.00 \times 10^8\right)^2} m \approx 210 km$

14.12.1 $T = \frac{\hbar c^3}{8\pi kGM} = \frac{6.63 \times 10^{-34} \left(3.00 \times 10^8\right)^3}{8\pi \times 2\pi \times 1.38^{-23} \times 6.67 \times 10^{-11} \times 70 \times 1.989 \times 10^{30}} \approx 8.9 \times 10^{-10} K$

14.13.1 The lifetime $T = 8.3 \times 10^{-26} \left(10^{11}\right) s \approx 80 s$ (Gone in 80s!)