

Physics 310/610 – Cosmology  
**Homework Set X**

1. One of the least luminous stars is the obscure red dwarf 2MASS J0523-1403. It has a luminosity of  $L = 1.26 \times 10^{-4} L_{\odot}$  and a mass probably around  $M = 0.080 M_{\odot}$ .
  - (a) Assuming the star is undergoing nuclear fusion,  $4 {}^1\text{H} + 2e^{-} \rightarrow {}^4\text{He} + 2\nu + 26.73 \text{ MeV}$ , what mass of  ${}^1\text{H}$  is being consumed every second to keep this star powered?
  - (b) Assuming the star has constant luminosity and starts as 75%  ${}^1\text{H}$ , in how many years will it run out of fuel?
  
2. Black holes evaporate according to formulas provided in the lectures. Find each of the following for a black hole of mass (i)  $10 M_{\odot}$  and (ii)  $10^{11} M_{\odot}$ :
  - (a) The Schwarzschild radius in m.
  - (b) The Hawking temperature in K.
  - (c) The luminosity in W.
  - (d) The approximate time in yr for the black hole's energy  $Mc^2$  to be completely evaporated.

**Graduate Problems:** There are no graduate problems for this homework.