Homework 1- Due Tuesday Sept 17

1. Black Body Spectrum 10 points
A neutron star radiates as a black body with T = $3x10^6$K. Give an estimate of the characteristic wavelength of the radiation and the luminosity of the source (assume a radius of 10km). For a neutron star at a distance of 100pc what is its total flux at the earth?
Extra credit: Why is the estimate of 10km for the emitting region reasonable/unreasonable.

2. Instrumentation question 10 points
i) What sort of instrument (telescope, detector or combination) should one use to observe this neutron star and why (numbers please). In other words given the bandpass and effective area curves of modern x-ray observatories (Swift, XMM, Chandra, RXTE, Suzaku etc) which one should you use and why. (use the additional material on the class web site or the HEASARC web site for details on the satellites).
ii)Estimate how far away Chandra can detect such a neutron star for a 10ks observation? Is it this object detectable in the optical (3000-7000 A) band assuming that all the radiation in the V band is from the black body ? (Assume HST can reach 27^{th} mag in V- need to look up the conversion from ergs to magnitudes)? (use a conversion factor of 1 Chandra count/sec=$5x10^{-12}$ ergs/cm^2 in the .5-10 keV band)

3. What is high energy astrophysics ? (this is a short essay question) 10 points
What sort of objects are in the purview of high energy astrophysics and why. For one of these objects/areas describe what could only be learned from high energy observations. Please keep answer to 2 paragraphs.

4) 15 points
a) Why do we believe that the Crab nebulae emits primarily via synchrotron radiation across the entire electromagnetic spectrum from radio to GeV γ-rays? (5 points)
b) What is the relative lifetime of the particles radiating at 1Gev, 10 keV and at 100 Mhz if they come from the same population of particles radiating in a magnetic field of 1 microgauss (use the formula from the class notes, or look it up. Since the Crab is an extended source in the radio and x-ray with a radus of $\sim$1.7 pc should it be one in the γ-ray? (e.g. assume that the particles are being transported at some fraction of the speed of light into the nebulae).). Is the value of magnetic field reasonable based on what you know about the Crab? (10 points)