Home Work #2 Astro 480 Due March 7

Some of the questions have been clarified!

Cluster of galaxies- 10 pts for each question

We shall use for all of the questions in this homework a cluster whose gas density follows a β model with $\beta = 0.7$, central density gas $n(0)=10^{-2}$, effective virial radius (the maximum radius out to which should integrate) of 2Mpc and a core radius a=200kpc, kT-6 keV and the gas density can be described by a β model gas density $n(r)= n(0)(1+(r/a)^2)^{-3\beta/2}$

1) Use the equation of hydrostatic equilibrium (if you need a hint as to which equations(s) to use ask me) and calculate the total mass of the cluster. Assume the cluster is isothermal . Extra credit: what is the mass profile of the cluster and how does it compare to theory.
2) Calculate the gas mass of the above cluster (Using a mean mass per particle of 1.2x the mass of a proton) and compare it to the total mass. Extra credit-:does the ratio of gas mass to total mass change with radius and if so how?
3) How would one estimate the abundance of different elements in the gas? What are the observables and how does one translate these into the abundance? Extra credit-:what are the strongest lines (largest flux and highest equivalent width (I did not define this in class, but it is the ratio of the flux in the line to the flux in the continuum at the same energy)) expected and why?

4) What is the definition of cooling time and what does it mean? Calculate the cooling time in the center of the cluster and at the virial radius. What would be the signatures of cooling in the gas (e.g. what observational properties of the gas would lead you to believe that it is cooling) and (for extra credit) what has been observed in real clusters.