Physics 108 – Introduction to Cosmology

Spring 2012 Myers

Homework 8

Please write all your work and answers on separate paper. (You can turn in this page with the questions or not, as you wish). Show all your work on calculations and explain your reasoning whenever you can.

1. **Hertzsprung-Russell Diagrams:** Construct a Hertzsprung-Russell (H-R) diagram similar to Figure 16.19, using the list of the brightest stars in Appendix 13. For the horizontal axis use the spectral type, from O to M. Remember that there are 10 levels for each letter labeling the spectral types. For the vertical axis use the Absolute Visual Magnitude. Remember that brighter stars have more negative magnitudes.

2. **Off the Main Sequence:** In the H-R diagram constructed in the previous problem, which stars are not on the Main Sequence?

3. **It must be density:** The average density of a planet or star, represented by the greek letter ρ (rho), can be computed by dividing the mass of the object in kilograms (kg) by the volume in cubic meters (m^3). That is, $\rho = M/V$. The volume of a spherical object can be computed from the radius r using the formula $V = \frac{4}{3}\pi r^3$. Compute the average density, in kg/m^3, for the following objects:
   a. the Earth
   b. the Sun
   c. a white dwarf star which has the mass of the Sun but the radius of the Earth
   d. a neutron star which has the mass of the Sun but a radius of 13 km.

   Remember to express the radius in meters so that the units of density are correct. For comparision it may help to know that the density of liquid water is 1000 kg/m^3.

4. **These dice are loaded:** To get a better feeling for the meaning of the density values computed in the previous problem, use those values to compute the mass of one cubic centimeter (a cube a little smaller than a standard gambling die) from the following objects:
   a. the Earth
   b. the Sun
   c. a white dwarf star
   d. a neutron star

   Recall that 100 cm=1 m and hence $(100\text{ cm})^3 = 10^6\text{ cm}^3 = 1\text{ m}^3$, so that $1\text{ cm}^3 = 10^{-6}\text{ m}^3$. For comparision, a cubic centimeter of liquid water has a mass of 1 g = 0.001 kg.