HW 1 A2020 Out 1/19/2010 Due 01/26/2010

1. (3 pts). You are contracted to prepare a model of the universe centered at the Ritter observatory here on campus. You use a scale where 1 centimeter in your model equals an actual distance of 1 light year. In your model, give the distances (in centimeters, meters or kilometers) of the nearest star, the galactic center, the Andromeda galaxy, and the most distant galaxies known. Could they all be placed in Ohio? Could they fit on the North American continent? Could they all fit on the planet Earth?

2. (3 pts) Why are the ages of moon rocks and meteorites important to finding the age of the solar system? How are the ages of such rocks measured? How old was the Universe when our solar system formed? How old was our galaxy when the solar system formed?

3. (4 pts) Calculate the distances of the four brightest stars in the constellation of Orion objects using their observed parallaxes (see flipside of this homework set for picture of Orion):

   Betelgeuse– parallax 0.00763 arcseconds

   Bellatrix – parallax 0.01342 arcseconds

   Rigel - parallax 0.00422 arcseconds

   Saiph – parallax 0.00452 arcseconds

4. (1+1+3 pts extra credit) Calculate the age of the Universe! In lecture 2, we learned that the velocities of galaxies followed the Hubble Law: V = Ho D

where Ho is Hubble's constant and D is the distance to the galaxy. The age of the universe is then given by:

D/V = 1/Ho where Ho = 22 km per second per million l.y.

(l.y. = light year, km = kilometer). To calculate the age, perform the following 3 steps:

First: (1 pt) How many seconds in a year? Approximately $\pi \times 10^7$! Can you show this?

Second: (1pt) How many kilometers in 1 million light years?

1 million l.y. = (1×10^6) c $(\pi \times 10^7)$ km, where c (speed of light) = 3×10^5 km/s

Finally (3pts) calculate the age and express the answer in units of billions of years.

age = 1/(22 km per second per million l.y.) x number of km per million l.y.

Put your answer on a separate piece of paper and staple to this homework set. Display your work (you will get partial credit for doing the problem partly right!).

Below: The constellation of Orion (which you can see now on a clear night)