Physics 20083 – Spring 2007 Exam #5a

Instructions:

1. Answer the following four questions in the space provided. If you need extra space, please use the back of the page and make an appropriate notation on the front of the page so that I will know where to look for your complete answer.

2. Each question is worth a total of 25 points.

3. Each question requires an answer that is typically no more than two or three sentences long or perhaps a diagram and one or two sentences. Some questions do not require explanations. This will always be explicitly stated.

4. You may **not** use your own paper, book, notes or a calculator for this exam.

5. You will have 30 minutes to complete and turn in the exam.

Inverse Square Law: $L_{app} \alpha \frac{L_{abs}}{r^2}$ - X

Mass-Luminosity Relation: $L_{Abs} \alpha M^3$

Self-Gravity and Gravity:

$$F_{SG} \alpha \frac{\text{Mass (M)}}{R^2} \qquad F_{grav} \alpha \frac{M^*}{r^2}$$

$$\tan[\text{Angular Size (A)}] = \frac{\text{Radius or linear size (R)}}{\text{Distance to object (r)}}$$

Equations of Orbital Velocity and Escape Velocity:

$$v_{orbit} = \sqrt{\frac{G M^*}{r}} \qquad M^* = \text{Mass enclosed}, \quad r = \text{Distance to center of M}$$

$$v_{escape} = \sqrt{\frac{2GM^*}{r}} \qquad M^* = \text{Mass enclosed}, \quad r = \text{Distance to center of M}$$

1. One possible candidate to explain the dark matter is black holes. Explain (a) why gravitational lenses caused by black holes would be so rare compared to lenses caused by macho's and (b) why it is (virtually) impossible to determine the mass of a lensing object so as to distinguish between macho-caused and black-hole-caused lenses.

2. Name and briefly explain two reasons why Astronomers believe that galactic fountains are the source of the so-called IVC's (Intermediate Velocity Clouds) that we have observed above and below the disk of the Milky Way galaxy.

3. Cepheid variables are located in the high end of the mass range for stars, and they are an important tool for Astronomers trying to determine the distances to nearby galaxies.

a) (10 pts) Explain how we find the distance to Cepheid variables, including a brief discussion of what we have to measure and how we use these quantities.

b) (15 pts) The upper limit to the mass range of stars is called the Eddington limit. Explain why there is an upper limit for stellar masses. As part of your answer, address the following: why does the process that prevents very high mass stars from being stable not similarly affect stars like the sun?

4. Sirius is a main sequence star with a mass of approximately 6 times the mass of our own Sun. Explain (a) how and why the metallicity of a star is related to its age and (b) how and why we would expect the metallicity of Sirius to differ from the Sun.