

Physics 20083 – Spring 2007 Exam #5b

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: $L_{\text{app}} \propto \frac{L_{\text{abs}}}{r^2} - x$

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

Self-Gravity and Gravity:

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

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

Equations of Orbital Velocity and Escape Velocity:

$$v_{\text{orbit}} = \sqrt{\frac{GM^*}{r}} \quad \begin{array}{l} M^* = \text{Mass enclosed} \\ r = \text{Distance to center of M} \end{array}$$
$$v_{\text{escape}} = \sqrt{\frac{2GM^*}{r}} \quad \begin{array}{l} M^* = \text{Mass enclosed} \\ r = \text{Distance to center of M} \end{array}$$

1. By using the relationship between the period and absolute luminosity for Cepheids, we can deduce their distances, even if they are in other (nearby) galaxies.

a) (15 pts) Suppose two Cepheids, Alpha and Beta, have the same apparent luminosity, but Cepheid Alpha has a shorter period. Assume no interstellar material is along your line of sight to either star, which of the two stars is closer to Earth? Explain your answer.

b) (10 pts) The Cepheid P-L method is only useful in galaxies that are relatively close to our own. Explain why we cannot use this technique for the most distant galaxies visible in the night sky.

2. Regarding Gamma Ray Bursts (GRB's), please answer the following:

a) (10 pts) Before Astronomers managed to measure the (high) redshifts of GRB's, we knew they were at very large distances from the Earth. Explain how Astronomers knew this without knowing their redshifts.

b) (15 pts) Explain what evidence tells us that GRB's grow to a very large size quickly shortly after they become visible to us.

3. Explain (a) how the standard ruler (SR) method works for finding the distances to other galaxies. Then (b) explain why it is not considered to be very reliable as a distance indicator. Finally, (c) explain how and why statistical techniques can be used to improve the accuracy of this method.

4. Two possible candidates for dark matter are black holes and very low mass stars.

a) (10 pts) Explain the evidence recently discovered by the Hubble Space Telescope that tells us very low mass stars probably do not make up a substantial fraction of the dark matter.

b) (15 pts) When looking for black holes, the only way we can find them is via gravitational lensing, but it is impossible to distinguish between lenses caused by black holes and lenses caused by ordinary macho's. Explain why.