

Physics 20083 – Spring 2007 Exam #3b

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 questions 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.

Density Equation: Density (ρ) $\propto \frac{\text{Mass (M)}}{R^3}$

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

Pressure: $p \propto \rho T$

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

Self-Gravity and Gravity:

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

Period Equation: $2\pi r_{\text{orbit}} = v_{\text{orbit}} * \text{Period}$

$$v_{\text{orbit}} = \sqrt{\frac{GM}{r_{\text{orbit}}}} \qquad \begin{array}{l} M = \text{Mass of central object} \\ r_{\text{orbit}} = \text{distance from center} \end{array}$$

1. Suppose we are studying binary stars and looking at the constellation Taurus to find examples.

a) (12 pts) Give the altitude and azimuth of Taurus at this time of year, and also name the two brightest stars in Taurus.

b) (13 pts) Suppose one of these stars is actually a spectroscopic binary, viewed edge-on, and we can see the spectral lines shifting back and forth over time. Describe how we could use this information, measured precisely, to estimate the mass of the central star.

2. Why do forbidden spectral lines only occur in regions of extremely low density gas?

3. Two things that interfere with Astronomers' observations of stars and galaxies are cosmic rays and the Interstellar Medium (ISM).

a) (13 pts) Despite the fact the cosmic rays are thought to come from distinct sources (such as individual stellar explosions), they seem to come in toward the Earth from all directions. Explain why.

b) (12 pts) Explain how and why the spectral absorption lines from the ISM differ from stellar spectral absorption lines.

4. During the main sequence (Hydrogen-burning) portion of a star's life, it is in Hydrostatic Equilibrium (HSE). Suppose a star in this phase undergoes a sudden increase in the rate of fusion reactions for some reason. Describe, in a step-by-step fashion, using the principles of HSE, what would happen to restore the equilibrium in the star. Mention what happens to the density and temperature during the process!