Outline

- Exam will be draw from material in Chapters 1, 2, 3, 4 and 5.
- There will also be one or more dimensional analysis problems.
- The following problems are mostly on the topics of chapters 1-3.
- It may be useful to study these problems, the previous set of practice problems, and the homework problems.

Binary stars

- An eclipsing binary star system has a period of 6.31 years. The maximum radial velocities are 5.4 km/s and 22.4 km/s. The time between the start of the eclipse and minimum light is 0.58 days and the duration of the primary minimum is 0.64 days. Assume the orbit is circular. Find the:
- ratio of stellar masses
- sum of stellar masses (state assumptions)
- individual stellar masses
- individual stellar radii

Blackbody spectra

- At what energy and wavelength does the blackbody emission from an object at room temperature (20 C) peak?
- The wavelength midpoints of the standard UBVRI filter set are U = 365 nm, B = 445 nm, V = 551 nm, R = 658 nm, and I = 806 nm. In which band does the spectrum of the Sun peak?

Luminosity and Flux

- A star with a surface temperature of 6000 K is in orbit around a 10 solar mass black hole accreting at its Eddington luminosity. At what orbital separation will the energy flux from the surface of the star equal the energy flux received by the star from the black hole's accretion disk? Assume that the radiation from the accretion disk is isotropic.

Angular resolution

- Estimate the angular resolution of your eye for green light. Assume your pupil has a diameter of 5 mm.

Stellar structure

- Construct a "polytropic" model of a star. Assume that the pressure (P) depends on density (ρ) as $P = b\rho^{\gamma}$, where b is a constant γ is the polytropic index (also a constant). Then, starting from the equations of stellar structure, find a second order differential equation for the density as a function of radius. The pressure should not appear in your final equation.

Fusion

- The de Broglie wavelength, λ, can be used to give a crude estimate of the temperature needed for fusion to occur via quantum mechanical tunneling. Assume that a proton must approach within λ of another proton for quantum mechanical tunneling to occur. Use the classical formula for Coulumb potential energy and estimate the kinetic energy required for two protons to approach within λ. What temperature is required to produce this as the average particle energy and how does it compare with the temperature at the core of the Sun?