Problem Set 1
(due September 25)

1. The solar diameter is 32 minutes of arc as seen from the Earth. The radiant flux from the Sun, integrated over all wavelengths, at the top of the Earth's atmosphere (known as the "solar constant"), is $F = 1400$ W m^{-2}.

   (a) Calculate the solid angle subtended by the Sun, Ω, in steradians.

   (b) Show that the flux at the solar photosphere is $\pi F/\Omega$.

   (c) Using these data calculate the effective temperature of the Sun.

2. Show that the Virial Theorem is satisfied for the motion of the Earth about the Sun (assume a circular orbit). In terms of the tangential velocity of the Earth, what is the minimum velocity increment that would cause the Earth to escape from the Solar System?

3. What is the radius of a white dwarf having a luminosity $L = 10^{-2}L_\odot$ and an effective temperature $T_e = 10^4$ K? Express your answer in solar radii ($R_\odot$).

4. Consider a hypothetical star of radius R, with density ρ that is constant, i.e., independent of radius. The star is composed of a classical, nonrelativistic, ideal gas of fully ionized hydrogen.

   (a) Solve the equation of hydrostatic equilibrium for the pressure profile, $P(r)$, with the boundary condition $P(R) = 0$.

   (b) Find the temperature profile, $T(r)$.