1. Either by hand or using a computer plot the functions

$$e^{(-E/kT)}$$

$$e^{(-bE^{-1/2})}$$

over the energy range, E, from 1 to 20 KeV. Assume that T = 15 million degrees. The first term represents the maxwell-boltzmann tail of particle energies and the second term represents the quantum penetration probability. Arbitrarily adjust the constant b so that your two functions are on roughly the same scale.

Now, multiply these two functions and derive at what energy, this product is a maximum. You should find:

$$E_o = \left(\frac{bkT}{2}\right)^{2/3}$$

2. A white dwarf has one solar masses of material in a radius equal to the radius of the earth. A neutron star has 2 solar masses of material in a radius of 10 km.

a) calculate the average densities of the white dwarf and neutron stars

b) using the hdyrostatic equation, estimate the pressure at 1/2 of the radius in both stars.

c) using the ideal gas law, calculate the equivalent temperature

d) compare the pressure you found in part b with the what you derive using the expression for degenerate pressure (to be derived in class on Tuesday)

3. Show that the event horizon of a black hole is given by the expression $2GM/c^2$ (hint: use conservation of energy). Calculate the size of the event horizon for a 1 solar mass object. What mass of object would have an event horizon or R = 1 fermi?

4. Show that the density of a black hole rapidly decreases with increasing Mass. What mass of black hole would have a density of 1 g/cm^3.

5. Starting with the equation for gravitational force between two bodies, show why the tidal forces exerted on the two bodies by each other is a differential force that depends on r^{-3} and not r^{-2}. Now let's imagine that the sun has turned into a 1 solar mass black hole and you throw your roomate at the sun. Calculate the tidal force on your roommate at a distance of 100,000 km from the event horizon and at a distance of 10 meters from the event horizon.