ASTR367 - HW7
October 27, 2023, Due November 3, 2023
2 pts each question part

1) There are many ways to estimate the age of our Galaxy. One of them is by white dwarf cooling. Since a white dwarf has no internal source of energy, it simply radiates away the energy it had at formation.

a) Suppose that the white dwarf is at a constant temperature T. The thermal energy is mostly in the nondegenerate monatomic gas that is formed by the baryons. The luminosity is almost that of a blackbody, but instead goes as is $L \propto T^{7/2}$. Assuming that the initial temperature was much greater than the current temperature, determine how the current age τ scales with the current luminosity. Don't worry about the factor in front, but just the dependence on luminosity. Hint: calculate the total energy E of a monatomic gas.

b) For $L \simeq 10^{-3}L_\odot$, $\tau = 10^9$ yr. There seems to be a dropoff in white dwarfs with luminosities $L < 10^{-4.5}L_\odot$. Estimate the age of the galaxy from this. Does it make sense?

2) Pulsar J1748−2446 is the fastest known rotator in the Universe, with an orbital period of almost $0.001\,\mathrm{s}$. The surface rotation is what fraction of the speed of light?

3) Redshifts and NS
a) What is the gravitational redshift of light from a neutron star (change in frequency over rest frequency)?

b) What is the rotational redshift, if the period of rotation is 1s? Assume you are looking tangential to the star.

c) What is the peak wavelength of blackbody emission from a neutron star? Assume a reasonable temperature.

d) How would you expect this radiation peak to shift as a result of the combined effects of the gravitational and rotational redshift?

Because its good for you. Equate the gravitational escape speed with the speed of light to derive the radius of a black hole.

4) Because its good for you. Equate the gravitational escape speed with the speed of light to derive the radius of a black hole.

5) What would happen to the Earth if the Sun were to suddenly transform into a black hole (no SN)? In your answer, please calculate the Schwartzchild radius.