Homework problems for Quiz 2: AY5 Spring 2013

1. **What element would result from adding 40 neutrons to $^{56}_{26}$Fe and then having 10 of the neutrons "β-decay" (that is, eject an electron each)?**

2. **The Sun will eventually go through which of the following phases?**

   ___planetary nebula

   ___Red Giant Branch

   ___SNII

   ___White dwarf

3. **In the fusion of four protons into helium, 4.7×10^{-26} grams of matter is turned into energy. How much energy does this amount of matter produce?**

4. **How long will a $4M_\odot$ star with $L = 5000L_\odot$ spend on the main-sequence? (Hint, the main-sequence lifetime of the Sun is 10 billion years).**

5. **Label the following True (T) or False (F)**

   ___More massive stars have lower temperatures in their cores

   ___The reason main-sequence stars do not collapse due to gravity is the thermal pressure of the gases they are composed of

   ___The fuel that provides the energy source for main-sequence stars is mass

   ___A star that is not in hydrostatic equilibrium with react by changing its radius

6. **How much energy is produced by nuclear fusion in the core of the Sun each second?**

7. **For a SN II, list the important events, in chronological order, leading to the explosive ejection of stellar envelope. Start with the fusion of light elements to produce an iron core.**

8. **Which of the following reactions** *release* **energy?** (Note that not all these reactions actually occur...)

   ___H + H → He

   ___O + He → Ne

   ___Cr + Ca → Ru

   ___Th → Rh + Rh

9. **The lowest luminosity white dwarfs in the Galaxy have a luminosity of around $10^{-5}L_{\odot}$. Why are there no white dwarfs with lower luminosities than this?**

10. **What is the average density in kg/cm^3 of a 1M$_{\rm Sun}$ White Dwarf with a radius of 6000km?**

11. **Given that hydrogen fusion produces 10^{18} ergs per gram of hydrogen:**

    A. How much energy can the Sun produce with the 2×10^{32} grams of hydrogen in the core region where it is hot enough for fusion?

    B. How long could the Sun produce energy via this mechanism at its luminosity of 4×10^{33} ergs/second?

12. **Which of the following are True (T), which False F?**

    ___The fraction of the Sun composed of helium is larger than it was 1 billion years ago.

    ___The Sun is losing mass every day

    ___The fraction of the Sun composed of Fe is larger than it was 1 billion years ago

    ___The Luminosity of the Sun decreases a small amount every day as it uses up its hydrogen fuel

13. **Calculate the spin rate of a neutron star assuming it forms from the collapse of the Fe core of a 25 solar mass star. The original core was spinning at 1 revolution per day and had a radius of 500,000km. The final radius of the neutron star is 10km.**