EXAM #2
ASTR 1102-002, Fall 2008

1. Which of the four star clusters is the youngest cluster?

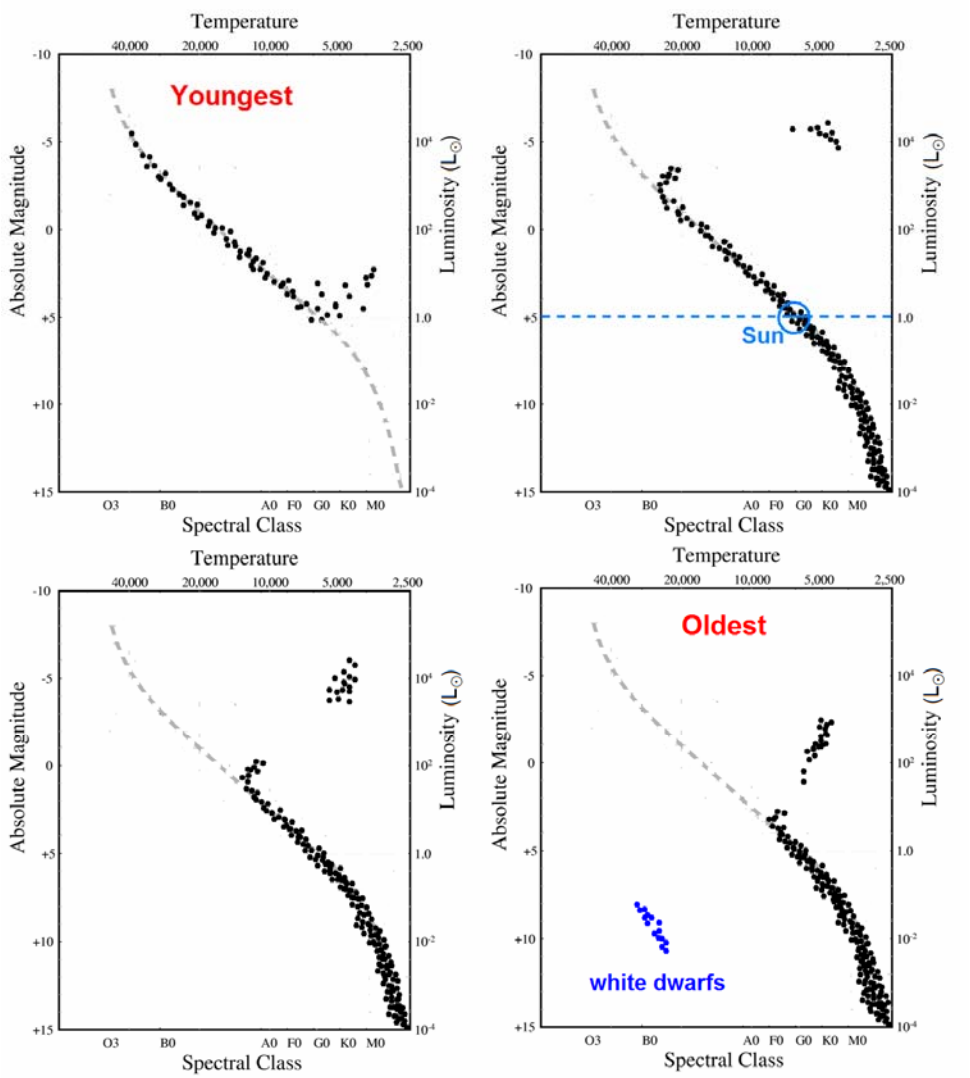
2. Which of the four star clusters is the oldest cluster?

3. Where would a 1 $M_{\odot}$ main-sequence star (like the Sun) be located?

4. Which one(s) of the four star clusters is older than 10 billion years?

   ANS: None of the star clusters is older than 10 billion years.

5. Pick <u>one</u> cluster in which white dwarf stars should exist and illustrate on that cluster's H-R diagram where the white dwarf stars would be found.



6. TRUE: The north and south magnetic poles of the Sun reverse every 11 years.

7. FALSE: The north and south magnetic poles of the Earth reverse every 11 years.

8. By tracking the changing position of sunspots across the surface of the Sun, astronomers have been able to determine that the Sun rotates approximately once every month.

9. Which one of the following properties of the Sun can best be studied during a total solar eclipse?

   ANS: The Solar Corona.

10. How many neutrinos are created when four ^{1}H nuclei combine (via the proton-proton chain, nuclear fusion reaction) to form one ^{4}He nucleus?

    ANS: Two.

11. What are the two most abundant chemical elements in the Sun?

    ANS: Hydrogen & helium.

12. FALSE: Stars on the main sequence that are 5 times more massive than the Sun should live 5 times longer than the Sun because they have more fuel to burn.

13. FALSE: When hydrogen nuclei combine through a thermonuclear reaction to form the nucleus of a helium atom, the process is called “nuclear fission.”

14. TRUE: When a heavy atomic nucleus, such as the nucleus of a uranium atom, spontaneously splits apart into two or more smaller atomic nuclei, the process is called “nuclear fission.”

15. FALSE: The River Bend Nuclear Power plant (in St. Francisville, LA) derives its energy from the fusion of hydrogen into helium.

16. FALSE: The atomic bombs that were developed and used during World War II derived their explosive energies from the fusion of hydrogen into helium.

17. Sunspots appear to be associated with regions of the Sun’s surface where the magnetic field is especially __strong____.

18. FALSE: Sunspots appear to be darker than most of the Sun’s photosphere because sunspots are hotter (have a higher temperature) than the surrounding photosphere.

Table 1 lists the surface temperature & luminosity of stars along the main sequence having 7 different masses. Answer the following three questions based on the information listed in this table and based on the understanding that the Sun is expected to "live" on the main sequence approximately 10 billion years.

19. The expected main-sequence lifetime of a 0.5 $M_\odot$ star is __ Longer than 10 billion years __ .

20. The expected main-sequence lifetime of a 3 $M_\odot$ star is __500 million years __.

21. The expected main-sequence lifetime of a 15 $M_\odot$ star is __15 million years __.

Table 1

Mass ($M_\odot$)	Surface Temperature (K)	Luminosity ($L_\odot$)
25	35,000	80,000
15	30,000	10,000
3	11,000	60
1.5	7,000	5
1.0	6,000	1
0.75	5,000	0.5
0.50	4,000	0.03

22. [Worth 10 points] Fill in the missing information in Table 2. Specify the number of protons and the number of neutrons that are in the nucleus of each listed element/isotope.

^{1}H: 1 proton + 0 neutrons
^{3}H: 1 proton + 2 neutrons

^{3}He: 2 protons + 1 neutron
^{4}He: 2 protons + 2 neutrons

^{12}C: 6 protons + 6 neutrons

23. [Worth 6 points] In the space provided below, briefly explain what is special about the "iron-nickel group" of chemical elements in the context of our discussion of nuclear fusion and nuclear fission reactions.

ANS: Chemical elements that are lighter than the "iron-nickel group" of elements will usually release energy when they participate in a fusion reaction, whereas chemical elements that are heavier than the "iron-nickel group" will usually only release energy when they undergo fission.