ASTRONOMY 101 – 103 **Prelim #2**

Sample #1

STUDENT IDENTIFICATION NUMBER _____

SIGNATURE of Student _____

PRINTED Name of Student _____

Course: (**circle one**) 101 or 103

Discussion Section: (**circle one**) 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12

TA NAME _____

For calculations, you must show your work to receive full credit.
Please use a pen to answer all questions.

PART A

Answer **ALL** of the following questions. Each correct answer is worth 4 points.

1. Suppose an atomic nucleus, which is initially lighter than iron, is split into two nuclei. Does this reaction need energy from its surroundings or does it release energy into its surroundings? Explain why.

2. Give two reasons why bigger telescopes are better.

3. List the stellar spectral sequence and indicate the directions of increasing luminosity and temperature for the main sequence.

4. Suppose an experiment can measure parallaxes of stars to 0.01 arcseconds. Can this experiment measure the distance to a star that is 1000 pc away? Show how you arrived at this conclusion.

5. When you look through a telescope you can see stars that are much fainter than without one. Explain why this is the case.

6. A star has an absolute magnitude of -5. Suppose there is a nearby galaxy located 100,000 pc from us. What would the apparent magnitude of this star be if it were located in this galaxy?

7. The peak of the spectrum of a star measured to occur at 0.29 μm. What is the temperature of the star? Roughly, what is its spectral class?

8. When the sun ends its life (after the red giant stage) it will become a white dwarf. Roughly how big will the sun be then? Will the white dwarf-sun be spinning faster or slower than the sun is now? Explain why.

9. Circle all of the following that are true for main-sequence stars?

   K stars live longer than M stars

   F stars are bigger than B stars

   A stars are hotter than G stars

   M stars are more massive than O stars

10. You are an astronomer and you observe a cluster of stars. You determine that there are no O or B stars, but all other spectral types are present. Explain how this gives you information on the age of the cluster. How old do you think the cluster is?

11. Give two properties that distinguish population I and II stars.

12. Two stars are observed to have an orbital period of 6 years. If their separation is 6 AU, what is the mass of the system?

13. A telescope operating at a wavelength of 0.5 μm has a spatial resolution of 3 arcseconds. Suppose the telescope now operates at 1.5 μm. What is the spatial resolution of the telescope operating at this new wavelength? (Ignore any atmospheric effects.)

14. A spectral line in a star is observed to be at 4800 A. It is known that this line is normally located at 5000 A. Is the star moving towards or away from us? What is its velocity?

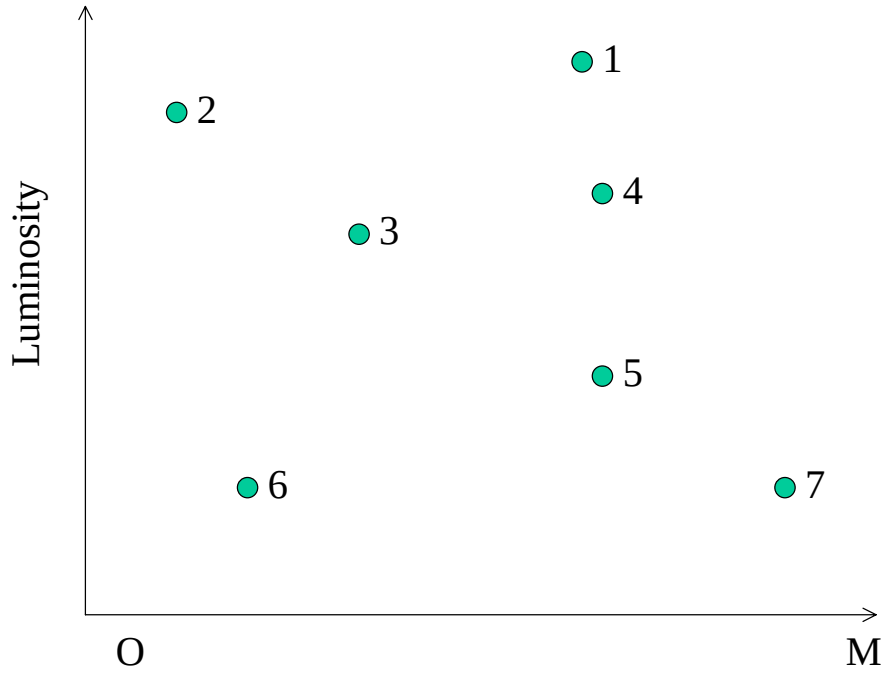
15. What is the energy source of main-sequence stars? What are the two methods that are responsible for this energy production?

PART B

Answer **ALL** of the following questions. Each correct answer is worth 10 points.

1. List the three different types of binary star systems discussed in class and explain each briefly.

2. Below is a sketch of the H-R diagram. Answer the questions appropriately.



Which star has the highest luminosity? _____

Which star(s) are on the main-sequence? _____

Which star is the largest? _____

What kind of star is star 6? _____

What kind of star is star 4? _____

Which star is smallest? _____

Which star is larger, star 3 or star 4? _____

Which star will live the longest? _____

Which star is most like the sun? _____

3. As seen from the earth the parallax to a star is measured to be 0.02 arcseconds. Suppose you travel in a spaceship to reach a new orbit around the sun. In this new orbit it takes 8 years for you to go once around the sun.

   a) What is the period of the orbit?

   b) What is the radius of the orbit?

   c) What parallax would you now measure for the star from this orbit?

   d) How far away is the star?

4. Sketch the evolutionary path of a 20 solar mass star from birth to death in the H-R diagram. Label the axes and important steps along the path. Indicate the location of the main sequence on your sketch.

END!

1.____ 2. ____ 3. ____ 4. ____ 5. ____ 6. ____ 7. ____ 8. ____ 9. ____ 10. ____ 11. ____ 12. ____

13. ____14. ____ 15. ____ B1. ____ B2 ____ B3 ____ B4 ____

PRINTED Name of Student _____

Most equations and some conversions:

$$F = G\frac{m_1 m_2}{d^2} \qquad m = \rho \times V$$

$$F = ma \qquad E = hf = \frac{hc}{\lambda}$$

$$\lambda = \frac{2900\,\mu\,\mathrm{m}}{T} \qquad f = \frac{L}{4\pi r^2}$$

$$L = 4\pi R^2 \sigma T^4 \qquad F = \sigma T^4$$

$$m_A - m_B = 2.5\log(f_B / f_A) \qquad \frac{f_B}{f_A} = 10^{\frac{m_A - m_B}{2.5}}$$

$$\frac{\Delta\lambda}{\lambda} = \frac{\mathrm{v}_r}{c} \qquad \theta \propto \frac{\lambda}{D}$$

$$d = \frac{1}{p} \qquad m - M = -5 + 5\log[d(pc)]$$

$$P^2 = \frac{a^3}{M_A + M_B} \qquad A = m\,\mathrm{v}\,r$$

$$E = mc^2$$

1 Angstrom = 10^{-10} meters
1 μm = 10^{-6} meters

1 year = 3×10^7 seconds