Sample exam 2 (Chapters 9 through 12)
Open book, exercises, notes; no collaboration. You have 50 minutes.

1. Give the full reference of a new source you will be using for your poster.

2. Match the appropriate term for the definitions shown:

- White dwarf: Degenerate matter star, long after nova stage
- Brown dwarf: Degenerate matter star, just after nova stage
- Black dwarf: Hit British television show, a few years ago
- Red Dwarf: Proto-star which fails to ignite fusion

3. Order the following from greatest mass to least:

   A. Electron        B. Neutrino        C. Alpha particle

4. Place the following chemical species in order from most likely (1) to least likely (3) to be identified using emission spectroscopy:

   Oxygen (O$_2$) molecule
   Oxygen (O) atom
   Hemoglobin (a huge molecule with many oxygen atoms bound within it)

5. Nearly all “large” telescopes, like the Hubble, are reflectors because (pick one):

   a. reflector telescopes are cheaper
   b. refractor telescopes distort light rays more than reflector telescopes
   c. refractor telescopes just don’t get very high magnification
   d. reflector telescopes can have adaptive optics applied to them.

6. True or false:

   a. Polaris, the North Star, is the brightest star in the night sky.
   b. Under no circumstances can a star be seen during the daytime.
7. Equation matching: Match the equation on the left with what the equation explains on the right

\[ T = 3 \cdot 10^6 / l \]  
Stefan-Boltzmann Law for blackbody energy

\[ E = \pi T^4 \]  
Wien’s Law for calculating stellar temperatures

\[ \frac{v}{c} = \frac{Q_{\text{star}} - Q_{\text{laboratory}}}{Q_{\text{laboratory}}} \]  
Doppler equation to determine radial speed

8. Of the equations above, which one shows that there are true green-colored stars?

9. The Hertzsprung–Russell diagram shows that, for Main Sequence stars, as stars’ surface temperatures get ______________________, their ______________________ increases.

10. Which type of star would be the most long-lived?
   a. M-class star  
   b. G-class star  
   c. O-class star

Essay questions — please answer each question in sentence/paragraph format or a drawing, depending on what is asked.

11. Your astronomical research on binary stars has ground to a halt! The telescopes you use cannot resolve these distant pairs of stars with the telescope you use currently. Your two faithful assistants, George and Annie, have suggestions:

   • Annie says, “I have a friend who will let us use a radiotelescope for cheap. With a ‘lens’ diameter that big, we’re bound to be able to resolve those stars.”

   • George says, “Let’s just get a new eyepiece lens with a shorter focal length; that’ll boost the magnification and then we’ll be able to resolve those stars.”

Do you choose Annie’s plan, George’s plan or neither plan? Please explain your answer.

12. Carl Sagan, the famous astronomer at Cornell University, said that “we are all made of starstuff.” How literally true is that statement? Explain what parts of “us” are made of “starstuff”, if any, and what stellar processes made that “stuff” anyway.

13. In the first step of stellar evolution, a solar nebula becomes a young star. On the H–R diagram, this step is indicated by an arrow going down and to the left from the right edge of the graph. In other words, the solar nebula becomes less luminous (bright) but more hot as it becomes a star. Explain how both of these changes could be happening the solar nebula at the same time.

14. You do the spectroscope experiment, as we did in class, but this time, you start with
gaseous helium. You dutifully write down the wavelengths of emission. You notice a power dial on the side of emission lamp and, just for fun, decide to turn up the power. The color of the helium lamp changes and you look through the spectroscope. The emission wavelengths are different! Alarmed, you turn the power back down and the gas emits the original wavelengths. Explain these observations, specifically with regard to the helium gas; in other words, what happened to the helium? You may assume that you did not break the gas discharge tube or lamp!