Exam 2: Stars	
Name _____	Score _____/ 75 pts
Star Name _____	Date: _____

Introduction

Each of you has your very own star. By the end of this exam, you be an Astronomy 101V expert on that one star. I expect your work to be complete, accurate, and above all, representative of your best effort. Answer all questions as explicitly and specifically as possible. Supply all information in the spaces provided on these sheets. Please make sure I can easily read your writing; otherwise, I will assume you really didn't want me to.

In some cases, you will have to estimate some qualities or quantities for your star. (For example, you cannot find any definite information about the evolutionary stage of your star. Would a star of exact or similar spectral type and luminosity class do as a reference?) As is the case for the labs this quarter, just make sure that you spell out the logic you used. Original and/or sound reasoning is just as important as getting the "right" answer. You may find conflicting values for your star in the sources you use. Please reference outside sources in your work.

Over 50 per cent of the stars in the sky are part of a binary system. If your star is a binary, note that in your work, and then **pick one of the stars** to go into greater detail.

Important Links, References, and Equations

Links

- Constellations and an alphabetical star list by Chris Dolan.
- Portraits of Stars and Their Constellations, by Dr. James B. Kaler.
- A listing of stars from Your Sky that includes Bayer Designation ("Identity") and star fields.

References

- Burnham's Celestial Handbook
- Various figures, tables, graphs, and text in the chapters assigned
- Lab exercises, activities, and review questions
- The Naming of Stars

Equations

The book has figures that will tell you the approximate numbers to use:

- Figures 6.4, 6.10, 6.23, 13.9, 13.10, 14.6 (brief edition)
- Figures 7.5, 7.12, S2.18, 15.1, 15.12, 16.6, 16.8 ("big book")
- Plus others

For a more accurate answer, it is better to use an equation:

Magnitude equation: $m - M = 5\log(d) - 5$

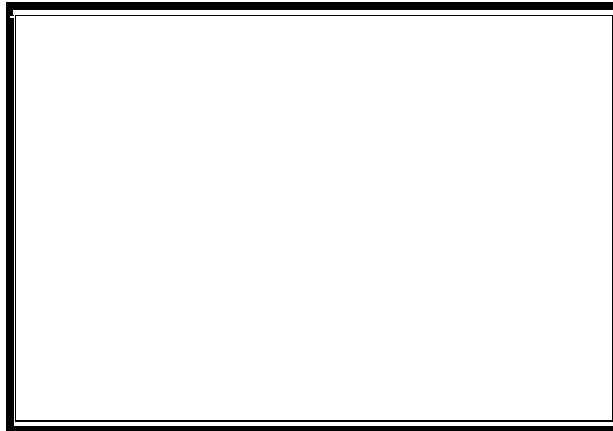**Peak wavelength of thermal radiation curve:** $\lambda_{peak} = \dfrac{2.9 \times 10^6}{T}$ **nm**

(T = temperature)

Lifetime of a star on the main sequence: $\tau_{star} = \left(10^{10}\,\text{yrs}\right)\left[\dfrac{M_{star}}{M_{Sun}}\right]^{-2.4}$

Questions

1. **Identifying Your Star**

   (5 pts) Find a star map of your constellation and reproduce that map here. Include at least 6 stars (name 4 of them), include the outline of the constellation and identify which star is **your star**.

2. **Stellar Parameters (7 pts)**

| Star Name	Bayer Designation	Spectral Type	Luminosity Class	Apparent Magnitude	Absolute Magnitude	Distance (Parsecs)

3. **Observing your Star**
   a. (2 pts) Which season would be the best one to observe your star?

b. (2 pts) Calculate the wavelength (or use the appropriate figure in the book) at which your star radiates most of its energy (peak wavelength of the star's thermal spectrum). Show all work or reference the figure you used.

c. (4 pts) Consider the wavelengths at which your star radiates most of its energy. Should you apply for time on the Hubble Space Telescope or will a ground-based telescope be sufficient? Explain your answer.

4. **The Evolution of Your Star**

a. (4 pts) Reproduced here is Fig. 14.15 of your text. Fill in the life track of a 1 solar-mass star from main sequence to red-giant stage. Do the same for a 3 solar-mass star and a 6 solar-mass star assuming the evolution off of the main sequence follows their birth to the main sequence (Fig. 14.8). Using this chart (or another appropriate figure), and the spectral type and luminosity of your star, find an approximate mass for your star. If you use an outside source for the mass, then reference that source.
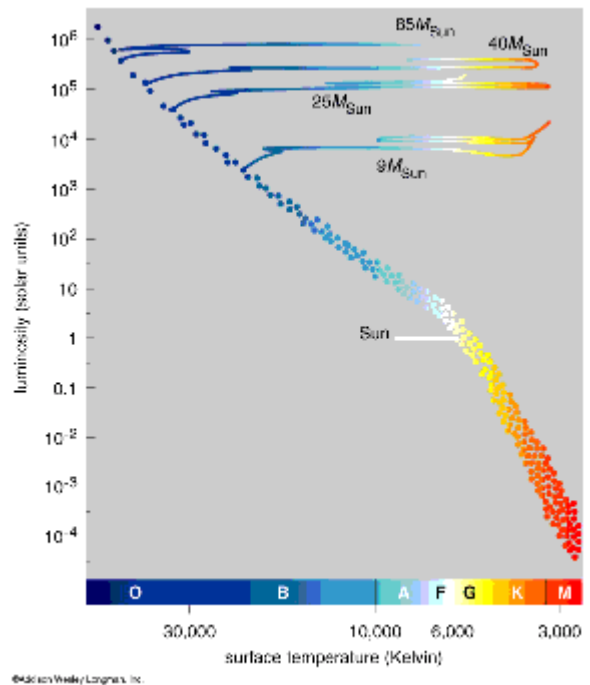
b. (2 pts) Mass:

c. (2 pts) Uncertainty:

d. Based on the mass of your star and where your star is on the HR Diagram:
   ▪ (2 pts) What is probably happening in its core?

   ▪ (2 pts) How is the rest of the star being supported?

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- (2 pts) Approximately how long did (will) your star spend on the main sequence? **(Show all work or reference the figure used.)**

e. Peer into your crystal ball (oops, astronomers don't have crystal balls -- substitute mathematical model):
   - (2 pts) What is probably the next stage for your star?

   - (2 pts) How will your star die?

f. (2 pts) Name two things that characterized the birth of your star.

5. **General Questions Concerning Stars** (This portion of the exam quizzes you on your general knowledge of stars.)
   a. (3 pts) Briefly describe how the idea of gravitational equilibrium implies that pressure must increase with depth in any planet or star.

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b. (3 pts) How does the idea of gravitational equilibrium explain why the Sun's core temperature and fusion rate are self-regulating like a thermostat?

c. (3 pts) Explain why the same idea (from the previous question) ensures that the Sun's rate of fusion must gradually rise over billions of years.

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d. *Stellar Data.* Consider the following data table for the 15 brightest stars in the sky:

BSC No.	Name (ID)	Apparent Magnitude	Parallax (arcsec)	Spectral Type Luminosity Class	Absolute magnitude
2491	Sirius	-1.46	0.375	A1 V	1.41
2326	Canopus	-0.72	0.028	F0 II	-3.48
5340	Arcturus	-0.04	0.090	K1.5 III	-0.27
5459	Rigil Kentaurus	-0.01	0.751	G2 V	4.37
7001	Vega	0.03	0.123	A0 V	0.48
1708	Capella	0.08	0.073	G5 III + G0 III	-0.60
1713	Rigel	0.12	0.013	B8 I	-4.31
2943	Procyon	0.38	0.288	F5 IV	2.68
0472	Achernar	0.46	0.026	B3 V	-2.47
2061	Betelgeuse	0.50	0.005	M1 I	-6.01
5267	Hadar	0.61	0.009	B1 III	-4.62
7557	Altair	0.77	0.198	A7 V	2.25
1457	Aldebaran	0.85	0.048	K5 III	-0.74
6134	Antares	0.96	0.024	M1.5 I + B4 V	-2.14

	(1 pts) Which star has the greatest luminosity?
	(1 pts) Which star has the smallest luminosity?
	(1 pts) Which star has the highest surface temperature?
	(1 pts) Which star has the lowest surface temperature?
	(1 pts) Which of the spectral type **B** stars have finished fusing hydrogen in their cores?
	(1 pts) Among the main-sequence stars listed, which one is the most massive?
	(1 pts) Among the main-sequence stars listed, which one has the longest lifetime?
	(1 pts) Which star is the closest?
	(1 pts) Which star is the farthest?

(2 pts) Antares is a binary star. What is the spectral type of the more massive star? How do you know?

6. Star Death

    a. (2 pts) Why will the Sun never collapse into a black hole?

    b. (4 pts) What is the difference between electron degeneracy pressure and neutron degeneracy pressure? Why is a neutron star so much smaller than a white dwarf?

    c. (3 pts) What is a pulsar? Why do we know that pulsars must be neutron stars?

    d. (2 pts) What is the event horizon of a black hole?

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e. (4 pts) In anger, you tell your best friend to "Go jump into a black hole." You are pleasantly surprised to learn that she is really going to do so. List 4 things that you see happen as she plunges in.

Bonus Points

(2 pts) Find something notable about your star that relates to something you have learned in class or from the text. State it here and then explain it to your non-science roommate.