Astronomy I
Test #3b
Mr. James

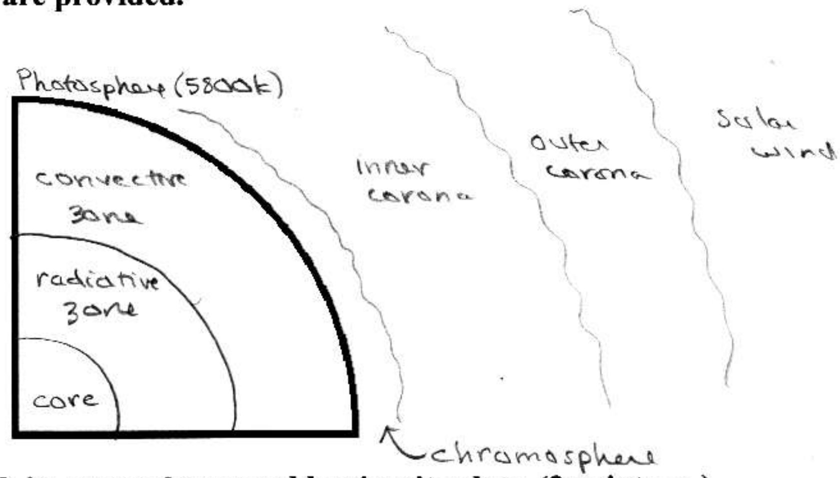
Name__________________

Date__________________

The following measures your progress learning the physics of the sun and stars. Answer each as completely as you can. Formulas are provided.

1. In the space at right, make a sketch of the sun, a "typical star", showing its internal and external structures. You must name each part and provide the surface temperature. **(10 points)**

(1 ea)



2. Matching: identify each star with its spectral type and luminosity class. (3 points ea.)

Arcturus, a giant whose temperature ~ 4500	M6 V
α Centauri A, a star very similar to the sun	B0 I
Wolf 359, a red dwarf of very low luminosity	White Dwarf
Deneb, a hot star of high luminosity	G2 V
Procyon B, a very hot star of very low luminosity	K2 III

3. True or False. (22 points)

a. The sun does not rotate because it is made of gas. F
b. Stars of spectral type M have molecular bands in their spectra. T
c. Red stars are hotter than blue stars. F
d. Spectral lines are caused when electrons change energy levels. T
e. An emission spectrum is also called a bright line spectrum. T
f. Some A2 stars have the same temperature as the sun. F
g. Sunspots look dark because they are rich in iron and carbon. F
h. The only way to directly measure a star's distance is by parallax. T
i. Supergiants are about as common as the sun. F
j. Spectroscopic parallax cannot be applied to stars farther than 100 pc. F
k. According to recent research most stars are not in binary systems. T

4. Fill in the blank. (3 points each)

a. The most common stars are type M (MS <-1>).
b. Sunspots show the Zeeman effect indicating strong magnetic fields exist on the sun.
c. In the H-R diagram, 90% of all stars are on the main sequence.
d. The most important part of an A spectrum is Balmer lines.
e. The temperature of a gas is a measure of the average speed (energy) of its atoms.
velocity <-1>
heat <-1>

5a) Observing parallax from Mars would be easier because Mars has a larger orbit which, in turn, would make the parallax larger. Mars' thin atmosphere would add a minor improvement to the measurement.

b) Absolute magnitude is the magnitude of a star if it were observed at a distance of 10pc.
Luminosity is the total energy output of a star, often expressed in terms of the sun's luminosity.

c) White dwarfs have very dim absolute magnitudes which indicate low luminosity. This is in spite of fairly high temperatures. Since $L = 4\pi R^2 \sigma T^4$, we can be sure that white dwarfs have small surface areas, and therefore are very small.

6a) $T = \frac{3000\,000}{\lambda_{max}} = \frac{3000\,000}{430} \approx 7000K$.

Strong Calcium lines and the presence of Balmer lines indicate that our star is type F0.
Broad spectral lines are indicative of luminosity class V.
Therefore, our star is type F0V.

b) $M_V \sim +3$

c) $L = 2.512^{4.78-M} = 2.512^{4.78-3} \approx 5L_\odot$

d) $d = 10^{\frac{m-M+5}{5}} = 10^{\frac{4.5-3+5}{5}} \approx 20pc$

e) $p = \frac{1}{d} = .05''$

f) $R = \sqrt{L}\left(\frac{5800}{T}\right)^2 = \sqrt{5}\left(\frac{5800}{7000}\right)^2 = 1.5 R_\odot$

g) $M \sim L^{2/7} = 5^{2/7} = 1.6 M_\odot$

<u>BONUS</u>: If $M_1 = M_2 = 1.6 M_\odot$, and if $P = 1$ year, then

$$P^2 = \frac{a^3}{M_1 + M_2}$$

$$\Rightarrow \quad 1^2 = \frac{a^3}{1.6+1.6}$$

$$\Rightarrow \quad 3.2 = a^3$$

$$\Rightarrow \quad a = \sqrt[3]{3.2} = 1.5 \text{ au}$$