Metr 201 Quiz #3 Key
100 pts.

A. <u>Short Answer and Definitions</u>. (3 points each for a total of 18 points in this section).

(a) The equation $T=kv^2$ helps understand the relationship between the temperature of a molecule and its __**vibrations**__ .

(b) spectrum -- **a graph that shows the amount of radiation emitted by an object with a temperature greater than 0K and the collection of wavelengths it emits.**

(c) The troposphere is the bottom layer of the atmosphere characterized by a standard lapse rate of about _____**3ºF /1000 ft**_____

(d) summer solstice (N. Hemisphere) -- **the one day in the year when the subsolar point is at the Tropic of Cancer and every latitude north of the Arctic Circle receives 24 h of sunlight.**

(e) When visualized as a wave, radiation can be characterized by the distance from one crest to the next crest. This is known as the _____**wavelength**_____ of the radiation.

(f) subsolar point --- **the latitude at which the sun's rays strike at a 90 degree angle.**

(g) Plane of the Ecliptic --- **the imaginary surface that intersects the center of the sun and the centers of all the planets and generally contains the orbits of all the planets.**

B.   Radiation Laws. (42 pts)

1. Wien's Law is

$$\lambda_{max} = a/T$$

where **lambda$_{max}$** is the peak wavelength of the radiation emitted by an object with a temperature **T**, and **a** is a constant.

The star **Bellatrix** has a temperature of 25000 K, while the star **Betelgeuse** has a temperature of 2400 K. Both stars have spectra a portion of which are in the visible spectrum.

(a) Using Wien's Law, explain which star is emitting, characteristically, the shortest wavelength radiation of the two. (11 points)

Wien's Law states that the warmer an object is, the shorter the wavelength of the radiation emitted. Therefore, Bellatric is emitting radiation with a shorter wavelength.

(b) Using conceptual reasoning, and your knowledge of the visible spectrum, explain which star would appear blue to the naked eye and the other orange. (11 points)

The blue part of the visible spectrum corresponds to the short wavelength end, chiefly 0.4 microns to 0.5 microns, while the red and orange part of the visible spectrum corresponds to the longer wavelength end, around 0.6 to 0,7 microns. Thus, Bellatrix would appear blue and Betelgeuse would appear orange.

2. The Stefan-Boltzmann Law is

$$E* = \sigma T^4$$

where **E*** is the emittance (or irradiance or amount of energy emitted), σ is a constant and **T** is temperature.

The star Bellatrix has a temperature of 25000 K, while the star Betelgeuse has a temperature of 2400 K.

   (a) Using the Stefan-Boltzmann Law, explain which star would be emitting the largest amount of radiation. (10 points)

The Stefan-Boltzmann Law relates the amount of radiation emitted by an object to its temperature.   Thus, Belatric would be emitting the greatest amount of radiation.

(b) Two spectra are shown below. One corresponds to that of the star Bellatrix and the other corresponds to that of the star Betelgeuse. Which is which and provide an explanation. Actual intensity and wavelength information is not provided, however the visible spectrum is shown for reference. (10 points)
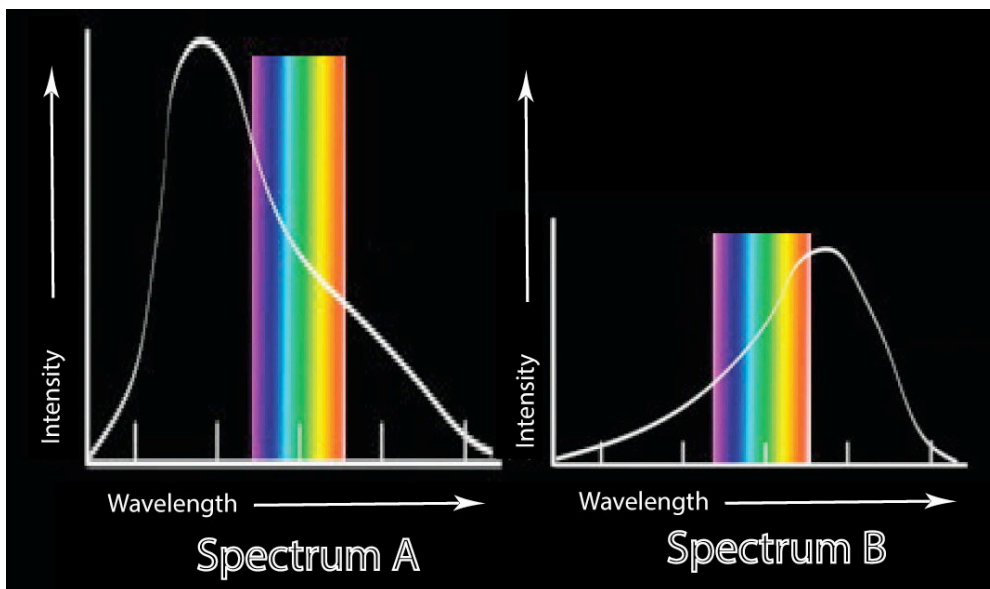
Bellatrix is a much warmer star than Betelgeuse, and warmer than the sun. Betelgeuse is colder than the sun. Thus, Bellatrix would be emitting larger amounts of radiation and of a characteristic wavelength shorter than that emitted by the sun, whose peak radiation lies in the visible spectrum. Betelgeuse would be emitting less radiation than the sun and at a longer wavelength.   Thus, Spectrum A is the spectrum for Bellatrix, and Spectrum B is the spectrum for Betelgeuse.

C. Weather Charts

I. Surface Weather Map

Questions are below. Answer in complete sentences where appropriate. (20 points)
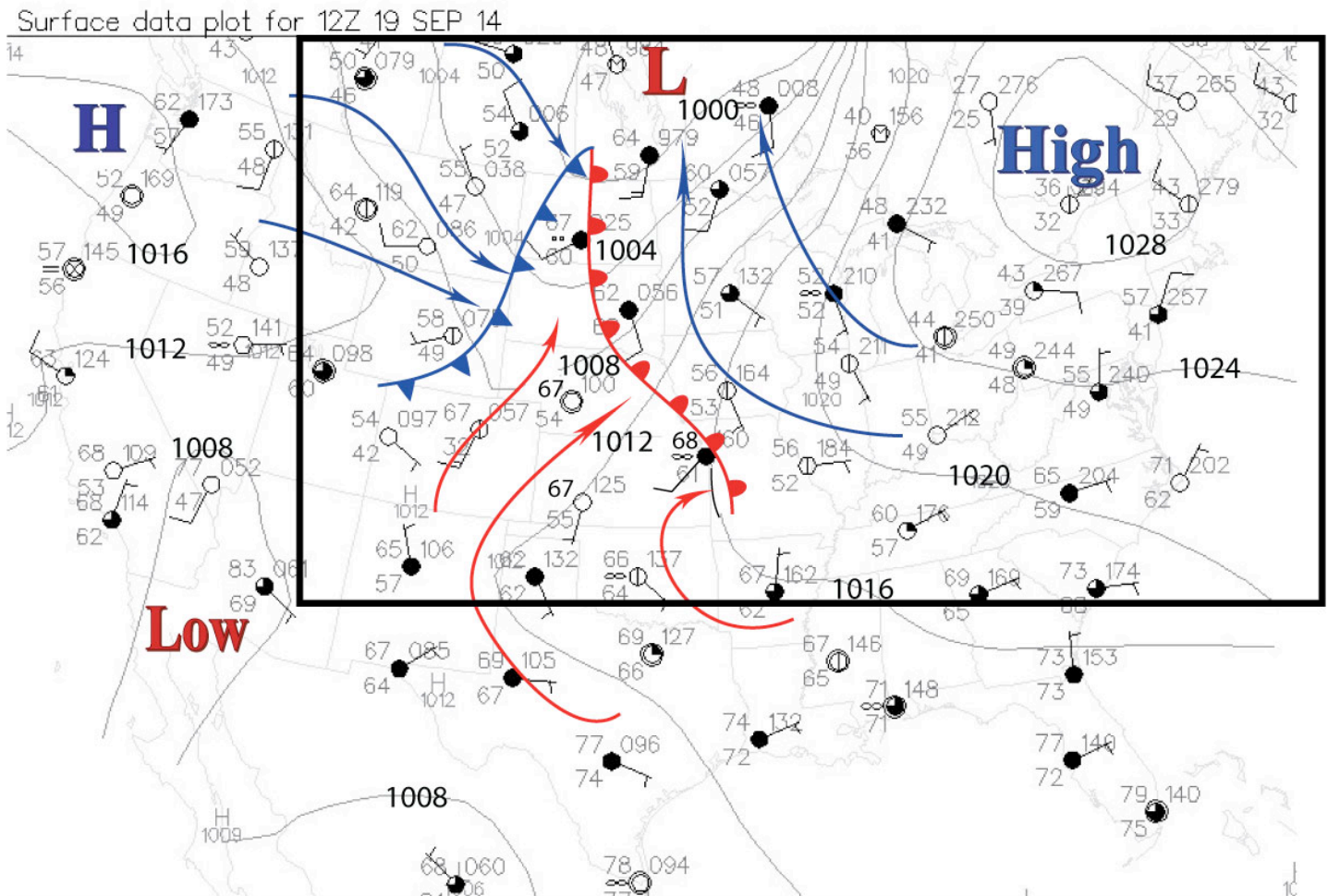

Figure 1. Surface weather map for 12 UTC 19 September 2014. The box surrounds the area of interest.

1. Label the two pressure systems indicated by the question marks. Use the correct symbols and colors. (5 pts each for 10 points)

2. Notice the frontal boundaries shown by the bold solid lines. Draw the correct symbols on the fronts, using proper symbols and colors. Note that you should probably draw some streamlines to help you decide the type of fronts. (5 points for each front for 10 points)
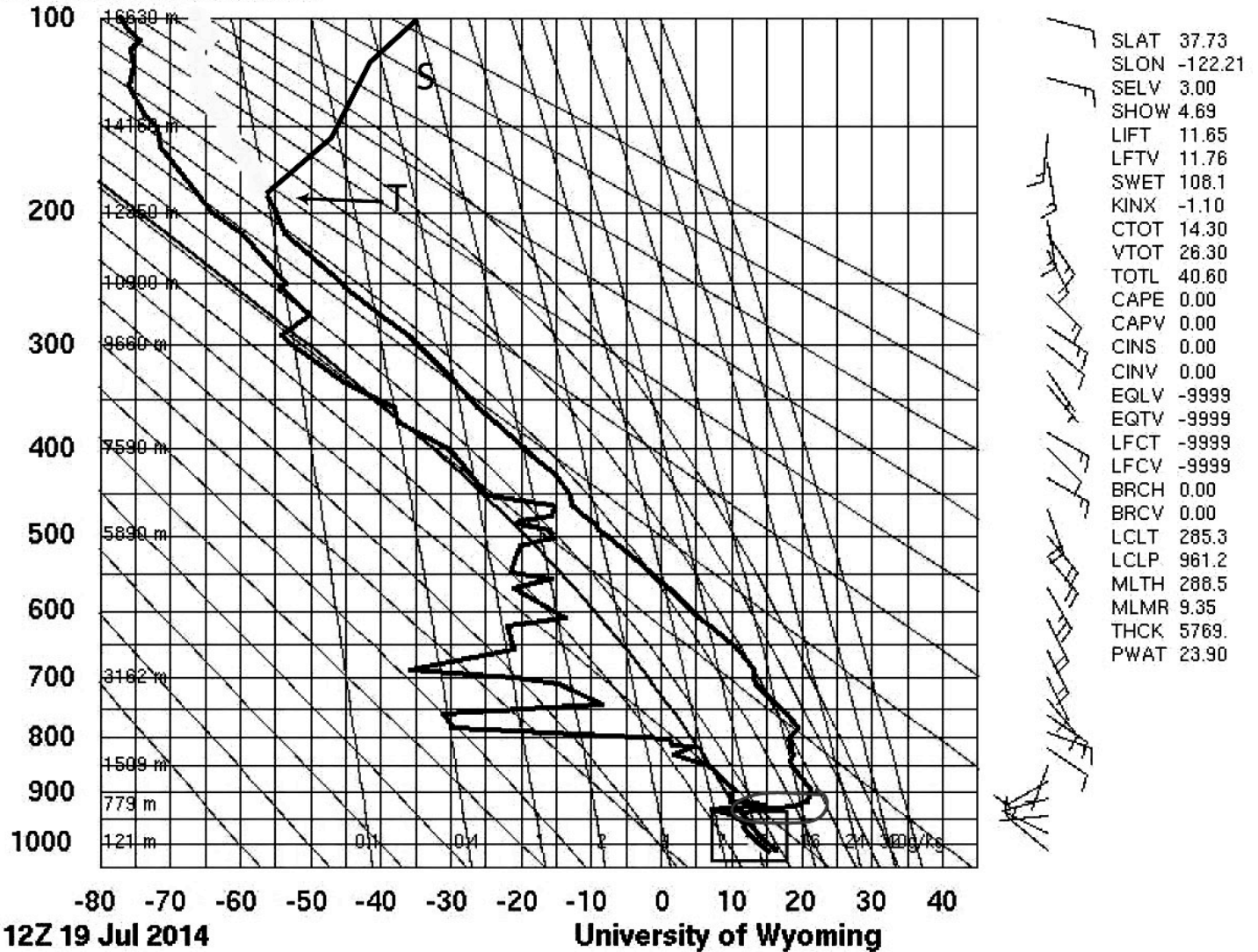
II. Sounding

72493 OAK Oakland Int

Figure 2: Oakland Sounding on Stuve Diagram for 12 UTC 19 July 2015

Label/locate the following in the temperature sounding (environmental lapse rate): (5 pts each for a total of 20 points)

1. Tropopause with a T
2. Circle the Inversion in the Troposphere.
3. Stratosphere with an S
4. Draw a square or a box aroundThe layer most likely to have clouds .