Spectral Classification

In this exercise you will learn how to classify the spectrum of an unknown star using a Series of standard reference spectra. You should be able to classify each unknown star within one half of a spectral class.

The spectra included with this exercise were obtained using a digital camera in place of a photographic plate. One of the things that you will notice is that the spectra show the typical black body curves corresponding to black bodies of different temperatures. Of course the major difference between the black body curves of stars and true black bodies is the presence of the absorption lines. The standard spectra are listed in Figures 1 and 2. Notice that several absorption lines have been identified that are key to classifying the spectra. In O and B type stars you will see that neutral and singly ionized helium are present while the Balmer lines are relatively weak as compared to A and F type stars. In stars of type A to G the Balmer lines are found to decrease in intensity as you go towards cooler stars, while at the same time the calcium lines around 393.3 nm increase in intensity. By carefully comparing the strength of the $H\gamma$ line at 434.0 nm with the calcium lines at 393.3 nm you can classify stars of spectral types A through G. At type A7 the hydrogen and calcium lines have equal strengths. For cooler stars of types K through M the calcium line at 422.6 nm is a good indicator as its strength increases as stars get cooler. In M type stars lines due to TiO (titanium oxide) are present. The TiO bands at 476.1 and 494.4 nm can be compared with the calcium line at 422.6 nm for the M type stars.

Questions:

1. Using only the standards in Figures 1 and 2 and your textbook summarize the elements that characterize of each of the seven spectral classes (O, B, A, F, G, K, and M). Use the space provided on page four.

2. Identify the spectral class of each of the unknown stars in Figure 3. Place the spectral types in the blanks to the right of each unknown spectrum. You need to include the letter types and the numeric sub types. For example, instead of writing A, you would write A2 or whatever is appropriate for each unknown spectrum.

3. From looking at the spectrum in Figure 4 and applying Kirchhoff's Laws of spectroscopy propose a plausible physical model that explains the presence of the hydrogen emission lines along side the TiO bands. First ask yourself what type of star (spectral type) do the absorption lines represent. Then try explaining the emission using Kirchhoff's Laws. Use the space provided on page six to write your answer.

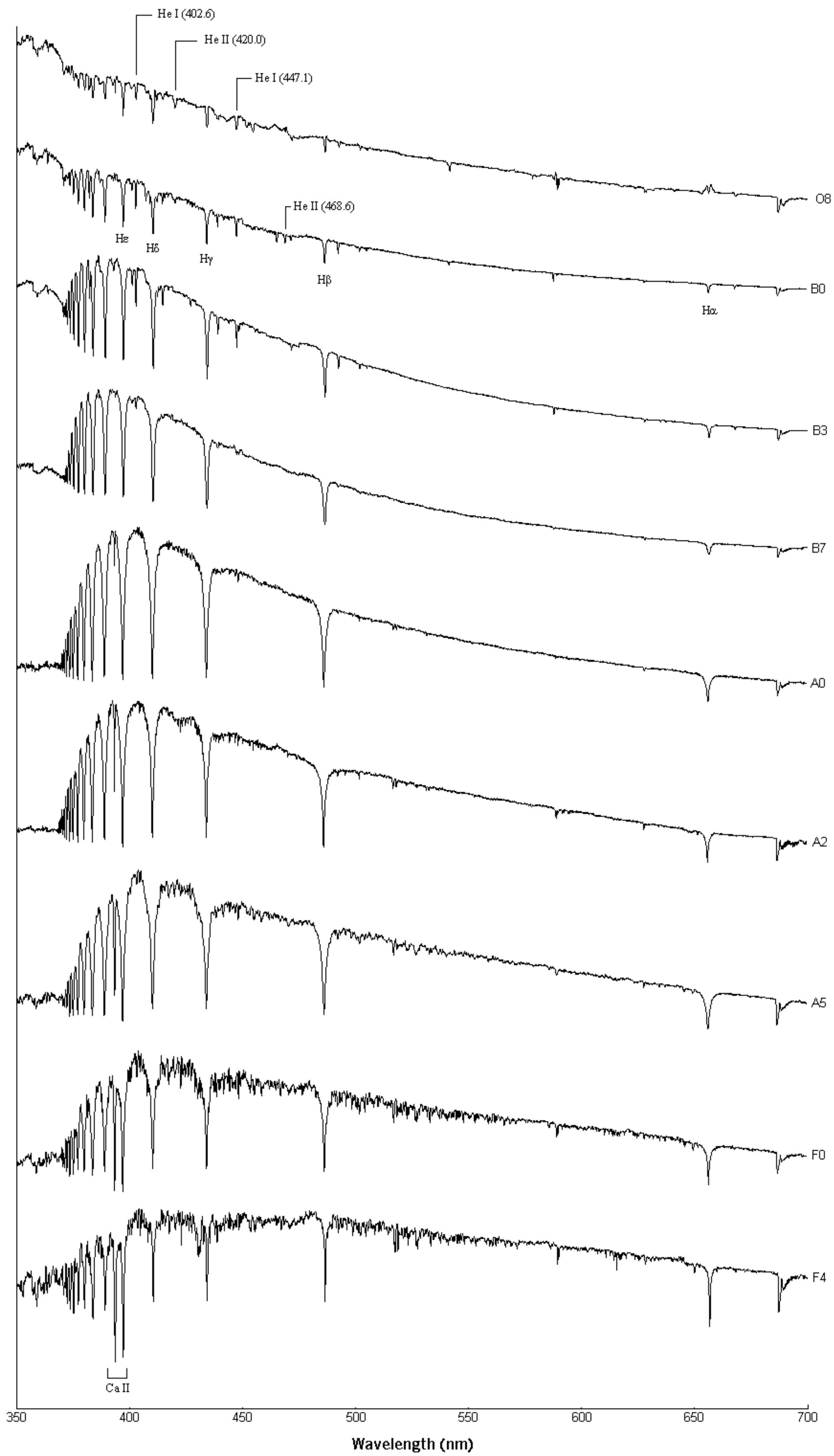

He I (402.6)
He II (420.0)
He I (447.1)
He II (468.6)
Hε
Hδ
Hγ
Hβ
Hα
O8
B0
B3
B7
A0
A2
A5
F0
F4
Ca II
350
400
450
500
550
600
650
700
Wavelength (nm)

Figure 1

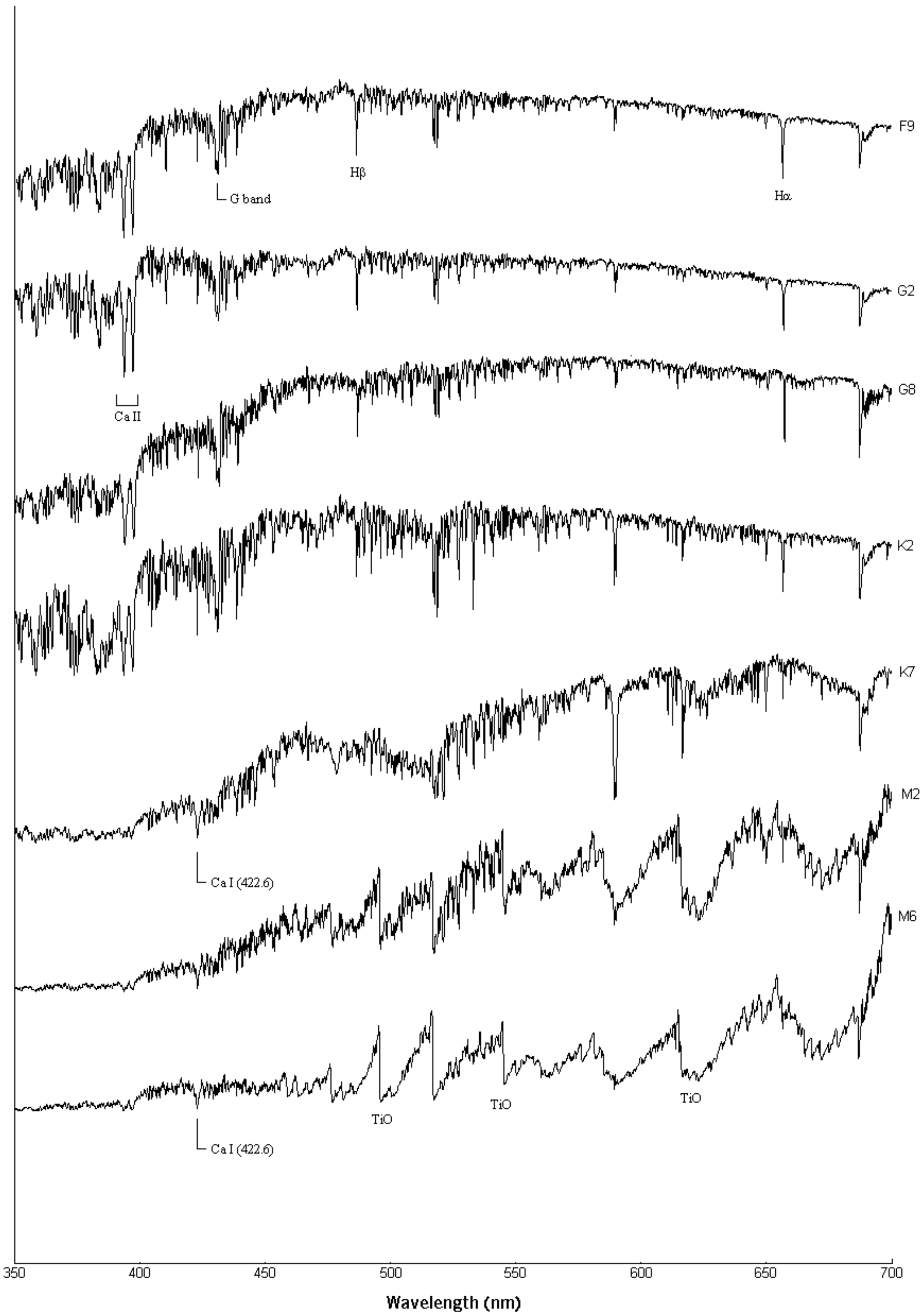
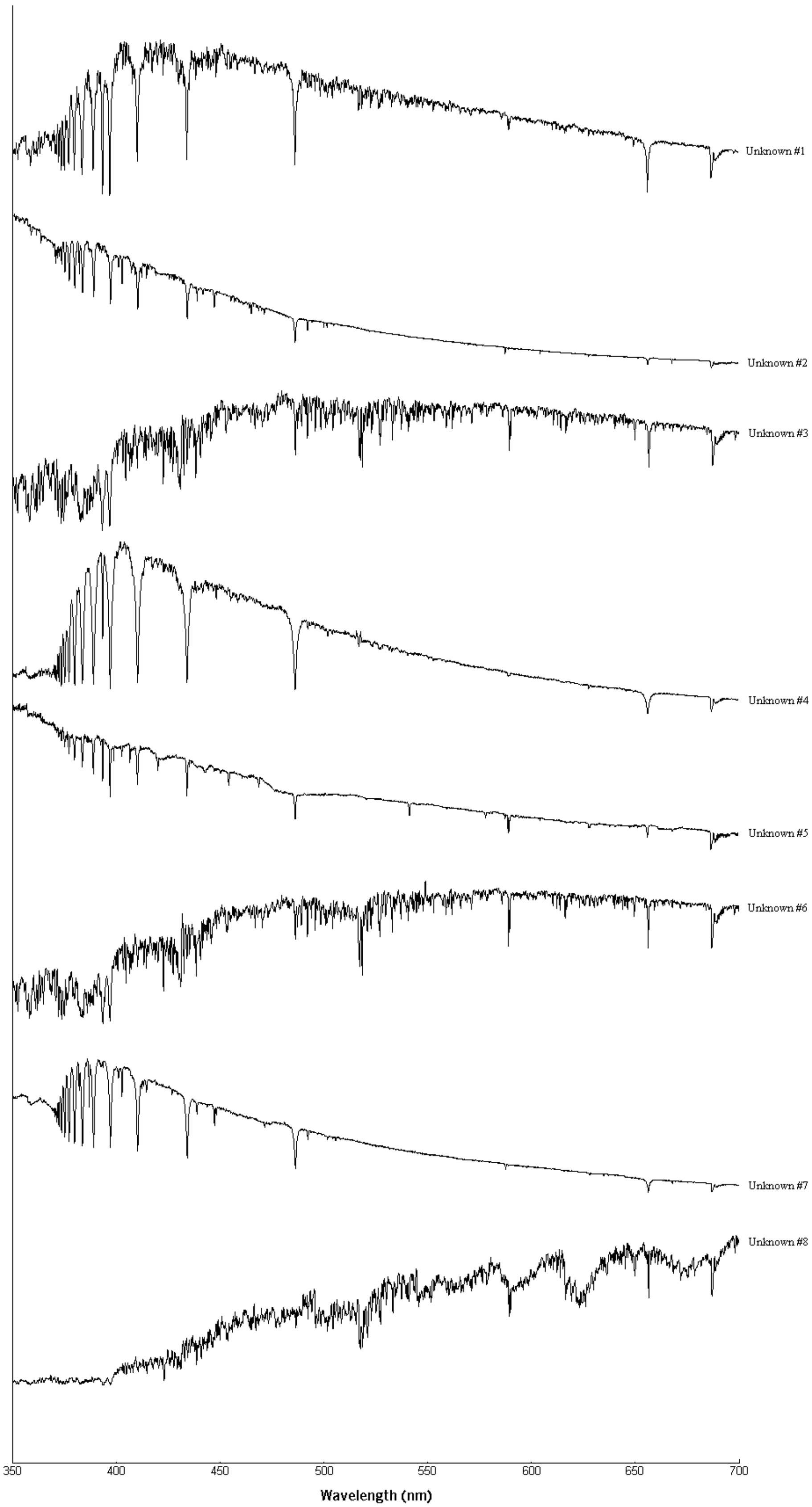

F9
G band
Hβ
Hα
G2
Ca II
G8
K2
K7
M2
Ca I (422.6)
M6
TiO
TiO
TiO
Ca I (422.6)
350
400
450
500
550
600
650
700
Wavelength (nm)

Figure 2

Spectral Type	**Characteristics**
O	
B	
A	
F	
G	
K	
M	

Figure 3



1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

7. _____

8. _____

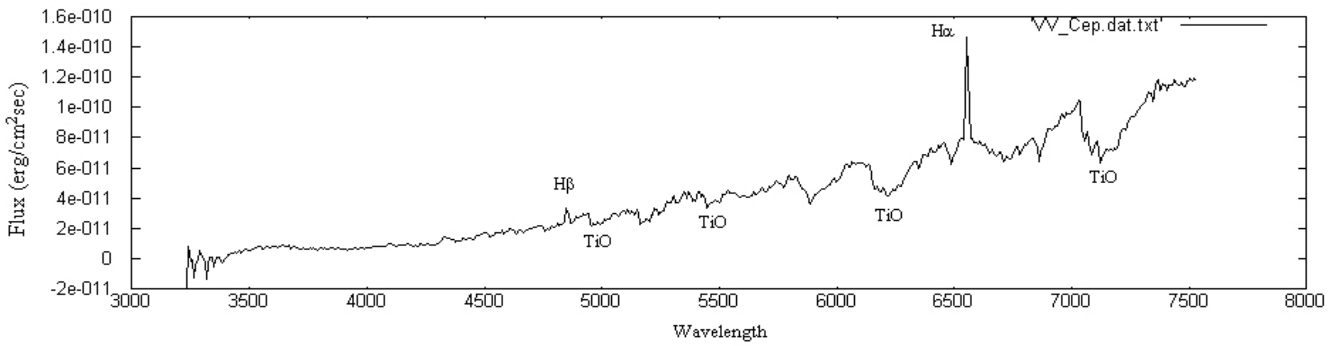


Figure 4

In the following space provide an explanation of the presence of Titanium Oxide bands and hydrogen emission in the same spectrum using what you have learned about Kirchhoff's Laws.

References

Munari, U and Zwitter, T (2002), "A Multi-epoch Spectrophotometric Atlas of Symbiotic Stars", Astronomy & Astrophysics, vol. 383, p. 188,
See http://ulisse.pd.astro.it/symbio_atlas/

"A stellar Library for stellar population synthesis models",
See http://webast.ast.obs-mip.fr/stelib/