NAME:_____

Astronomy 106 Observing Spectra with a Diffraction Grating

This exercise is required and will count **30 points** toward your final grade. To receive full credit it must be turned in at the **beginning of class** on **Wednesday, 14 February.**

- Carefully read the lab and complete the experiment as instructed. If something is not clear, do not hesitate to ask the instructor.
- Each student's work must be his/her own.
- Neatness counts, information which is difficult to decipher will not receive credit.

From the instructor, obtain a spectroscope. **Be very careful NOT TO TOUCH THE SURFACE OF THE GRATING! Fingerprints will degrade its performance.** The diffraction gratings are a sheet of clear plastic which has had over ten thousand grooves per inch inscribed on the surface. The grooves create the equivalent of very narrow silts on the surface of the plastic. Because of the nature of light acting as a wave, light passing through a narrow gap is spread out into a rainbow as different colors are spread (dispersed) by an amount related to the color. In the language of physics, the **dispersion is proportional to the wavelength** of the light. The net effect of all the slits acting together breaks the light into a spectrum.

Each rainbow band will contain the colors from red to orange, yellow, green, blue, and violet (ROYGBIV). Other wavelengths of light are produced beyond the red (infrared) and beyond the violet (ultraviolet), but the human eye is only sensitive to wavelengths of light between roughly 400 and 700 nanometers. Each person's eyes differ in sensitivity, it is very possible that you do not observe the same colors as other people. An extreme case of decreased sensitivity to color perception is known as color blindness. Look more carefully, beyond the first spectrum, you should see a second fainter spectrum like the first, and possibly a third beyond the second spectrum. The additional spectra contain no information not also found in the primary spectrum, and need not be considered.

Observing Exercise:

Use the spectroscope to observe many different type of light sources, with the goal of finding one good example of each of the ten types of light source listed on the following page. The sources are grouped by the overall color of their appearance, as either basically white lights, red lights, yellow lights or blue/green lights. Note that a source can appear to be reddish colored when it produces its light (as observed with your spectrograph) in a completely different way from another reddish source.

To distinguish between different types of light sources requires that you **carefully** note the appearance of each spectrum. Include a count of the emission lines, the wavelength of the lines as measured by the spectrograph's scale, and a concise description of the brightness of the emission lines. Be sure to stress the features that make one spectrum different from the others.

The light source you investigate should be the dominant source of brightness in the immediate area. It works best if you are in an otherwise darkened room when observing indoor light sources. Make outdoor observations at night, or in surroundings which are darkened except for the light source in question.

1. Clearly describe the location of each of the following three types of **white light** source, with enough detail that your instructor could find this light himself and duplicate the observation.

i) a continuous spectrum with no discrete emission lines (**spectrum a**)

ii) a fluorescent lamp (**spectrum b**)

iii) a metal halide lamp [some stadium lights] (**spectrum e**)

Explain the distinction between the above three different sources of white light.

2. Clearly describe the location of each of the following two types of **red light** source, with enough detail that your instructor could find this light himself and duplicate the observation.

i) a filtered continuous spectrum (no example shown)

ii) a tubular neon-type lamp (**spectrum h**)

Explain the distinction between the above two different sources of red light.

3. Clearly describe the location of each of the following three types of **yellow light** source, with enough detail that your instructor could find this light himself and duplicate the observation.

i) a filtered continuous spectrum (no example shown)

ii) peach-colored streetlights [low pressure sodium lights] (**spectrum f**)

iii) a tubular neon-type lamp (**spectrum g**)

Explain the distinction between the above three different sources of yellow light.

4. Clearly describe the location of each of the following two types of **blue or green light** source, with enough detail that your instructor could find this light himself and duplicate the observation.

i) bluish-colored streetlights [mercury vapor lights] (**spectrum c or d**)

ii) a tubular neon-type lamp (**spectrum i**)

Explain the distinction between the different sources of blue or green light.

Extra credit: For each of the four color categories, locate and describe a light source which produces a spectrum clearly different than any of the ten listed sources and explain how it differs.