Name(s): ______________________________ ______________________________

______________________________ ______________________________

Date: ___________________ Course/Section: ___________________

Grade: ___________________

Astronomical Redshift

Objectives:

Students will learn about the expansion of the universe, how redshift tells us a galaxy's recession velocity, and how, from that, we can infer a galaxy's distance.

Checklist:

- ☐ **Complete the pre-lab quiz with your team (if required).**
- ☐ **Compile a list of resources you expect to use in the lab.**
- ☐ **Work with your team to complete the lab exercises and activities.**
- ☐ **Record your results and mark which resources you used.**
- ☐ **Share and discuss your results with the rest of the class.**
- ☐ **Determine if your team's answers are reasonable.**
- ☐ **Submit an observation request for next week (if required).**

Resources:

Pre-Lab Quiz

Record your group's answers to each question, along with your reasoning. These concepts will be relevant later in this lab exercise.

1.
2.
3.
4.
5.

Part 1: Measuring Rest Wavelengths

1. With the Hydrogen tube in the carousal, record the wavelengths of the emission lines and identify which Balmer line they are.

Relative Strength of Line	Peak Wavelength λ_{rest}	Balmer Line Name

2. Sketch the spectra of Hydrogen and label the axes and the peak lines by both their wavelength and Balmer name.

Part 2: Measuring Redshifted Wavelengths

1. Sketch the spectrum of the quasar and identify the emission lines. Your spectrum may have OIII in it as well as Hydrogen lines.

2. Identify five emission lines in the spectrum of a quasar and record their measured wavelengths in the table below. Use the graph in Part 2 of the lab website to help identify the lines. Then, compute the change in wavelength ($\Delta\lambda$) using λ_{rest} from your table in Part 1. If you identified the two OIII lines, the λ_{rest} are 500.7 nm and 495.5 nm. Then, compute the average Z.

Object Name:				
Emission Line name	Rest Wavelength λ_{rest}	Peak Wavelength λ_{peak}	$\Delta\lambda = \lambda_{peak} - \lambda_{rest}$	$Z = \Delta\lambda / \lambda_{rest}$

3. Find an average redshift and use it to compute the velocity in km/s of the quasar. Show your work.

Average Z=

4. Using Hubble's Law, find the distance of the quasar from Earth, given the assumed value for the Hubble constant. Show your work.

5. What is the real distance to your galaxy, and how does that compare to the calculated distance you found in question 3?

6. Make a plot of velocity in km/s vs distance in Mpc. Using the velocity computed for each galaxy and the real distance, plot each galaxy. You can make this plot in Logger Pro or Excel. Fit a line to your data to find the slope of the line. The slope of this line is the Hubble constant. Compare your value of the Hubble constant to the known one.

7. With your value of the Hubble constant, calculate the age of the universe and compare it to the accepted age.