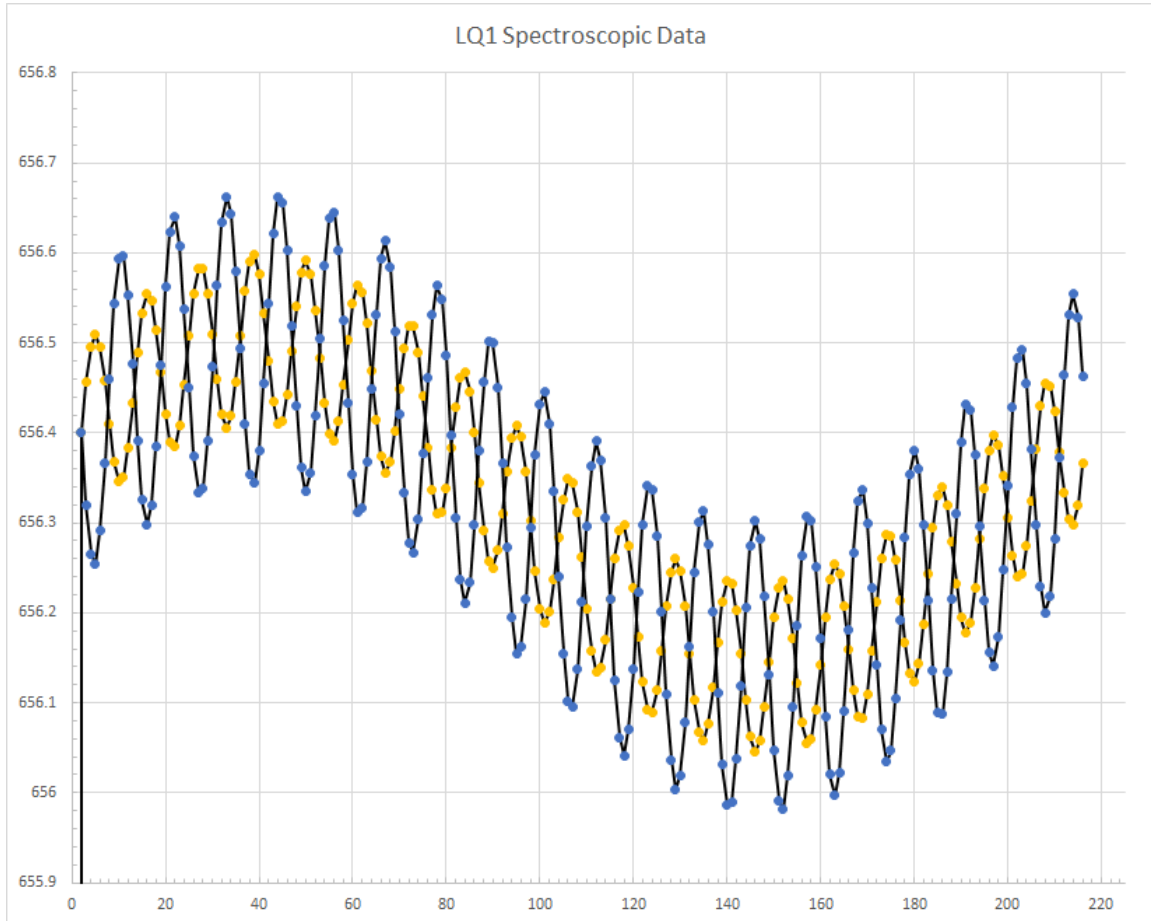


## Section B: Long Question [25 Points]

Astronomers use an 8-meter telescope to observe a star with an apparent flux of  $3.068 \times 10^{-9} \text{ W/m}^2$ . A spectral analysis reveals a blackbody spectrum with two apparent peaks, one at 690.5 nm and the other at 461.8 nm. Sustained spectroscopic observations of the hydrogen alpha line (rest wavelength 656.3 nm) results in the following plot, in which two periodic variations have been identified and marked. Note: the x-axis is in days, and the y-axis is in nanometers.



Precision photometry of the system shows what appears to be an eclipsing binary light curve. The primary transit lasts 4 hours 46 minutes total. Maximum transit depth lasts for 4 hours 7 minutes.

- Calculate the ratio of the radii and the ratio of the luminosities of the two stars in the system. [4]
- Calculate the semimajor axis and mass of each star. [5]
- Calculate the actual luminosity and radius of each star. [3]

- (d) How far away is the system? The Solar flux at Earth is  $1366 \text{ W/m}^2$ . [4]
- (e) What is the angular size of the stars' orbit? Can the telescope distinguish the two stars? What is the minimum separation the telescope can distinguish at the distance of this system? Assume the telescope observes at a wavelength of  $550 \text{ nm}$ . [3]
- (f) Does the available data indicate any other objects in the system? If so, provide mass, semimajor axis, and a likely type. Justify your identification. [6]