2-7. Explain how Bohr’s model of the atom accounts for spectra.

In Bohr’s model the electrons of an atom may only move in certain discrete orbital paths. Each set of possible orbitals has a different energy. When an atom changes from one possible orbital configuration to another it must either acquire or lose that amount of energy. Sometimes this happens in a collision. Other times it happens by either the absorption or emission of a photon of electromagnetic radiation, thus producing an absorption or emission line in a spectrum.

2-8. Why do different elements display different patterns of lines in their spectra?

The possible orbital configurations described in the previous answer differ for each chemical element because of the different number of protons and electrons. When an atom changes from one possible orbital configuration to another it must either acquire a given amount of energy or lose a given amount of energy. When this happens by either the absorption or emission of a photon a spectral absorption emission line is produced. The possible energies of the absorbed or radiated photons differ from element to element because of the different energies associated with each element’s possible orbital configurations. Thus each chemical element has a unique set of associated spectral lines.

2-9. What is the Doppler effect? Why is it important to astronomers?

When there is a changing distance between the source of a wave and a detector of that wave, this relative motion produces a change in the detected frequency and wavelength of the wave. This is true regardless of the nature of the wave. In particular it is true for electromagnetic radiation. Thus an approaching object will have its emitted visible light shifted towards the blue end of the spectrum and a receding object will have its emitted light shifted towards the red end of the spectrum. Because the entire pattern of lines in the spectrum of a star will be shifted without disruption of the pattern, it is possible to measure how much the spectrum is either blueshifted or redshifted which enables the observer of a star to measure that Doppler shift and thereby calculate the star’s rate of approach or recession (radial velocity) using the formula found on p.50 of the text, $v/c = \Delta \lambda / \lambda$.

2-10. If you see a blue star, what does its color tell you about how the star is moving through space? Explain your answer.

The color of the star tells you nothing about its motion through space unless you can measure a Doppler shift, $\Delta \lambda$, for that star. The Doppler shift enables you to compare the color of the star with what it would be if the star were not moving. If the blue star is bluer than it would be if it were stationary, then the star is approaching with a speed given by the formula in the answer to the preceding question. If the blue star is redder than it would be if it were stationary, then the star is receding with a speed given by that same formula.