CHAPTER 24

Spectroscopy

Answers to revision questions

1. An absorption spectrum shows dark (absorption) lines at wavelengths characteristic to the elements, molecules or ions present in the atmosphere of the star. An emission spectrum shows bright (emission) lines at the same wavelengths as absorption lines for the same species present. An absorption spectrum looks similar to a continuous spectrum except that it has dark absorption lines on top.
2. A continuous spectrum can be produced by a hot body or object such as a tungsten filament in an incandescent light globe or by the core of a star.
3. Even though galaxies are homes to hundreds of billions of stars, the majority of which produce absorption spectra, some galaxies have abundant nebulae, which produce emission spectra. Some of the emission lines partially fill the absorption lines as they occur at the same wavelengths. If the light from the galaxy is weak, the weaker absorption lines may not be apparent in the observation.
4. The red shift is the movement of the star's spectral lines into the longer wavelengths or red end of the spectrum, caused by the Doppler effect when the source is moving away from the observer.
5. Chapter 24 should be consulted for the answer to this question. The information includes translational velocity, rotational velocity, chemical composition, surface temperature and density.
6. As for question 4, the shift in the star's spectral lines towards the blue end of the spectrum indicates the star is moving towards us. As its relative position in the sky is not changing, the star must be moving directly towards us.
7. See Figure 24.11. As one side of the star is moving towards the observer, the other is moving away due to the rotation. The centre of the star's surface is moving neither towards nor away from the observer. This results in the spreading of the spectral lines, which at first may be confused with higher density, which cannot be explained.
8. The presence of metallic elements shows up in the spectrum of a star as many fine absorption lines at the wavelengths characteristic for those metals. A 'non-metallic' star would not have such lines in its spectrum.
9. See Figure 24.15. A red star is cooler, and therefore has its peak intensity at a longer wavelength than a white star.
10. The lower the density of the atmosphere of a star (where absorption lines are produced), the finer the absorption lines. A giant star has a lower gravity near the surface. The larger the star, the lower the surface gravity as $g \propto \frac{1}{r^2}$, so the atmosphere is less dense. The largest giant stars produce the finest absorption lines.