MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

1) The spectra of most galaxies show redshifts. This means that their spectral lines 1) _____
   A) have wavelengths that are longer than normal.
   B) have normal wavelengths, but absorption of light makes them appear red.
   C) have wavelengths that are shorter than normal.
   D) always are in the red part of the visible spectrum.
   E) have a higher intensity in the red part of the spectrum.

2) From laboratory measurements, we know that a particular spectral line formed by hydrogen appears at a wavelength of 486.1 nanometers (nm). The spectrum of a particular star shows the same hydrogen line appearing at a wavelength of 485.9 nm. What can we conclude? 2) _____
   A) The star is moving toward us.
   B) The "star" actually is a planet.
   C) The star is getting hotter.
   D) The star is getting colder.
   E) The star is moving away from us.

3) From laboratory measurements, we know that a particular spectral line formed by hydrogen appears at a wavelength of 121.6 nanometers (nm). The spectrum of a particular star shows the same hydrogen line appearing at a wavelength of 121.8 nm. What can we conclude? 3) _____
   A) The star is moving away from us.
   B) The "star" actually is a planet.
   C) The star is moving toward us.
   D) The star is getting colder.
   E) The star is getting hotter.

4) You observe a distant galaxy. You find that a spectral line normally found in the visible part of the spectrum is shifted toward the infrared. What do you conclude? 4) _____
   A) The composition of the galaxy is changing.
   B) The galaxy has very weak gravity.
   C) The galaxy is made purely of hydrogen.
   D) The galaxy is moving away from you.
   E) The galaxy is moving toward you.

5) If one object has a large redshift and another object has a small redshift, what can we conclude about these two objects? 5) _____
   A) The one with the large redshift is moving toward us faster than the one with the small redshift.
   B) The one with the large redshift is hotter and therefore is putting out more radiation.
   C) The one with the large redshift is moving away from us, and the one with the small redshift is moving toward us.
   D) The one with the large redshift is redder than the other one.
   E) The one with the large redshift is moving away from us faster than the one with the small redshift.

6) Suppose you want to know the chemical composition of a distant star. Which piece of information is most useful to you? 6) _____
   A) The Doppler shift of the star's spectrum.
   B) Whether the star's spectrum has more emission lines or more absorption lines.
   C) The wavelengths of spectral lines in the star's spectrum.
   D) The peak energy of the star's thermal radiation.

7) Which of the following terms is given to a pair of stars that appear to change positions in the sky, indicating that they are orbiting one another? 7) _____
   A) eclipsing binary
   B) double star
   C) visual binary
   D) spectroscopic binary
   E) none of the above

8) Which of the following terms is given to a pair of stars that we can determine are orbiting each other only by measuring their periodic Doppler shifts? 8) _____
   A) visual binary
   B) spectroscopic binary
   C) double star
   D) eclipsing binary
   E) none of the above

9) You observe a star in the disk of the Milky Way, and you want to plot the star on an H–R diagram. You will need to determine all of the following, *except* the 9) _____
   A) distance to the star.
   B) rotation rate of the star.
   C) apparent brightness of the star in our sky.
   D) spectral type of the star.

10) A star of spectral type G lives approximately how long on the main sequence? 10) _____
   A) 1,000 years
   B) 10 billion years
   C) 1 million years
   D) 10,000 years
   E) 100 million years

11) A star of spectral type O lives approximately how long on the main sequence? 11) _____
   A) 10,000 years
   B) 10 million years
   C) 1,000 years
   D) 1 billion years
   E) 100 million years

12) Which of the following is true about low-mass stars compared to high-mass stars? 12) _____
   A) Low-mass stars are hotter and more luminous than high-mass stars.
   B) Low-mass stars have the same temperature and luminosity as high-mass stars.
   C) Low-mass stars are cooler but more luminous than high-mass stars.
   D) Low-mass stars are cooler and less luminous than high-mass stars.
   E) Low-mass stars are hotter but less luminous than high-mass stars.

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

13) a) A star is moving away from an observer with a speed of v=10 km/s, along a path that makes a θ =30 degrees angle with the line-of-sight. At what wavelength will the Hα line be observed? The Hα line has a rest wavelength λ_0=6562.8Å. b) If the observer is also moving directly away from the star at a speed of 20 km/s, at what wavelength will the Hα line be observed? 13) _____

14) A spectroscopic binary system is observed to have a period of 10 yr. The radial velocity of these two stars are v1r=10km/s and v2r=20 km/s. Find the masses of these two stars if the inclination of the orbit is a) 90 degrees b) 45 degrees. How do the mass ratio and the total mass change compared to your answers in item a? 14) _____