Homework Ch. 3 RQ 2-7,10-16,18,20 (even), Ch. 4 RQ 1-3,5-7,9,11-13,18

ANSWERS TO CHAPTER 3 REVIEW QUESTIONS

1. A wave is a way in which energy is transferred from place to place without physical movement of material from one location to another.

2. The wave period is a measurement of the amount of time needed for a wave to repeat itself at some point in space. The wavelength is the distance between any two consecutive positions in the wave, such as from peak to peak. The amplitude is the maximum height or depth of the wave above or below the undisturbed state. The wave frequency is the number of waves that pass a point per unit of time, usually waves per second.

3. The longer the wavelength, the lower the frequency; the shorter the wavelength, the higher the frequency. Wavelength and frequency are inversely related.

4. Diffraction is the ability of waves to bend around corners. A sharp-edged gap in a wall produces a fuzzy shadow due to diffraction. Diffraction would not occur if light were strictly made of particles.

5. The speed of light is symbolized by the letter *c*. The speed of light is actually the speed of all electromagnetic radiation in a vacuum and is a constant.

6. White light is made up of the colors violet, blue, green, yellow, orange, and red. The colors are simply waves of different wavelengths. Actually, white light is made up of all wavelengths of light between red and violet, a continuous spectrum. This spectrum is perceived by the eye as being made up of these 6 colors.

7. Positive and negative charges attract each other. They would tend to move towards each other.
8. The electric force is similar to the gravitational force in that it drops off by the inverse square of the distance. It is different in that it can be either attractive or repulsive; dislike charges attract and like charges repel. If the number of positive and negative charges are equal in an object, it appears to be neutral and has no electric force. Gravity is always present and is never neutralized.

9. A star contains many charged particles that are moving. This motion creates waves in the electric fields of the charged particles and these waves propagate or move outward and away from the star. Traveling at the speed of light, a few of these waves will finally reach a person's eye, which also contains charged particles. The waves make the charged particles move, and this motion is sensed by nerves and transmitted to the brain as an image of the star.
10. Light actually consists of vibrating electric and magnetic fields moving through space.

11. Radio waves, infrared radiation, visible light, ultraviolet radiation, x-rays, and gamma rays are all electromagnetic radiation and move at the speed of light in a vacuum. They differ only by their wavelengths (or frequencies), from longest wavelength (radio waves) to shortest wavelength (gamma rays).

12. The parts of the electromagnetic spectrum for which the Earth's atmosphere is transparent are the visible (when it isn't cloudy!) parts of the infrared, and radio waves between about one centimeter to ten meters.

13. A black body is an idealized object that absorbs all radiation falling on it. It also re-emits all this radiation. The radiation emitted occurs at all wavelengths but peaks at a wavelength that depends on the temperature of the black body. The hotter the temperature, the shorter the wavelength of the peak radiation.

14. Wien's Law states that the wavelength at which a body emits the peak amount of radiation in its blackbody curve depends inversely on the temperature of the body; no other factors are involved. By observing the wavelength at which this peak radiation occurs, the temperature of a star can be determined.

15. Stefan's Law relates the amount of radiation emitted by a black body to its temperature. The amount depends upon the fourth power of the temperature.

16. As the coal cools off, its temperature decreases. According to Wien's Law, more and more of its radiation will be emitted at longer and longer wavelengths. According to Stefan's Law, it will emit less and less radiation as it cools. The net result is that it gets fainter and redder with time.

17. The Doppler effect is the observed change in the wavelength (or frequency) of a wave due to the motion of the emitter, observer, or both, towards or away from each other. If the motion is towards each other, the observed wavelength appears shorter than the wave emitted. If the motion is away from each other, the observed wavelength appears longer than the wave emitted.

18. By measuring the amount of shift in the wavelength of some form of radiation, astronomers can determine whether an object is moving towards or away from us. The shift is proportional to the speed. So by measuring the Doppler shift, the velocity can be determined.

19. The Doppler shift occurs when there is a difference in the speed between a source of radiation and an observer. In this case, both are moving together at the same speed, so no shift occurs.

20. Even with clouds, the day-night cycle is quite evident. The lunar cycle would be evident from the light given off by the Moon, although it might not be clear what the object is that causes the lunar cycle. Radio radiation easily penetrates clouds. Little would be known about stars because their radiation is mostly at visible wavelengths.

Ch. 4 Review Questions 1-3,5-7,9,11-13,15,18

1. Spectroscopy is the observation and study of spectra. Since light is about the only information received from astronomical objects, this light is the source of all the information about those objects. Spectroscopy is the detailed study of this light and allows many properties of objects to be determined.
2. A simple spectroscope is made up of a slit, a prism, and an eyepiece or screen. The slit defines a narrow beam of light. The prism (or diffraction grating) spreads the light out into ists various wavelengths or colors. The eyepiece or screen allows the spectrum to be viewed.
3. For a continuous spectrum, the intensity of light varies smoothly and gradually with wavelength. Black bodies have continuous spectra. An absorption spectrum appears like a continuous spectrum but with specific wavelengths missing. Dark vertical lines or bands, which can be quite narrow or very broad, are found throughout the spectrum.
5. A photon is a particle of light. It has no rest mass.
6. Color is usually related to wavelength; red is the longest wavelength of visible light and blue is the shortest. Since wavelength and frequency are inversely proportional, red had the lowest frequency and energy; violet has the highest frequency and energy.
7. Each orbital has a precise energy, like in the Bohr model. But the electron is spread out in an electron cloud or probability shell. The exact location of the electron cannot be determined.
9. When a physical quantity is quantized, it means that it can take on only specific values rather than a continuous range of values.
11. In order for a photon to be absorbed, it has to have an energy that is precisely equal to the energy difference between two energy levels, the lower level of which is occupied by an electron. The electron absorbs the photon and moves to the higher energy level. Very quickly thereafter the electron moves back down to the lower energy level emitting a photon of equal energy to the energy difference between the two levels.
12. A star produces a continuous spectrum. However, this light passes through a cooler layer of gas that surrounds the star. Specific wavelengths are absorbed by this gas and the resulting spectrum appears as an absorption spectrum, a continuous spectrum with specific wavelengths missing. Emission lines are not normally found in a stellar spectrum because they are produced in a hot, low density gas. Most stars have a layer of a cool, low density gas forming an absorption spectrum. However, in some cases, a hot low density layer can form or can be found in clouds of gas between stars and an emission spectrum is seen. Information about the composition and temperature of the cool gas, along with its motions, can be determined from the absorption lines.
13. According to Kirchhoff's first law, a luminous solid liquid or dense gas will emit light of all wavelengths and produce a continuous spectrum.
15. Not only must the element be present, but its electron(s) must be in the proper state (energy levels) for the transition. For example, the H-alpha absorption line of hydrogen results from electrons jumping from the second to the third atomic orbital. Because the Sun's lower atmosphere is rather cool, relatively few atoms have electrons in the second orbital; most are in the ground state. Hence, in sunlight, the H-alpha line is weak.
18. If the spectrograph slit lets in light coming from a swirling gas, or numerous sources with different line-of-sight velocities, the spectral lines can be broadened. If it is swirling gas (a nebula), then some parts of the gas are approaching you, some are receding, and still others have in-between speeds, so you get a mixture of blue shifted and red shifted lines. Even if the source of light is one star, that star may be rotating so that some of the light is moving towards you and some away.
20. Properties of a star that can be determined from spectra include: composition, surface pressure, surface temperature, surface gravity, rotation rate, speed of the entire star, and magnetic field.