Homework Ch. 3 RQ 2-20 (even), Ch. 4 RQ 2-12 (all)

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.

6. Color is usually related to wavelength; red is the longest wavelength and violet the shortest wavelength. Since wavelength and frequency are inversely proportional, red has 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 smeared out in an electron cloud or probability shell. The exact location of the electron can not be determined.

8. The hydrogen atom has one proton in its nucleus and one electron moving around it. The electron is found in one of many possible energy levels or orbitals.

9. When a physical quantity is quantized it means that it takes on only specific values rather than a continuous range of values.

10. The normal condition for atoms is one in which the number of electrons equals the number of protons in the nucleus. The electrons are in their lowest energy level. When an atom is excited, an electron is found in a higher energy orbital. The precisely-defined energy states or energy levels are referred to as orbitals. They are the regions occupied by electrons that surround the nucleus.

11. In order for a photon to be absorbed, it must have an energy that is precisely equal to the energy difference between two energy levels, the lower level 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 by 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.

14. When the spectrum of the light source is observed, an absorption spectrum is seen because the cloud has absorbed specific wavelengths. But if the cloud is observed, it is seen to emit specific wavelengths, as its atoms that absorbed the light now re-emit the energy.

15. 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 the Sun the H-alpha line is weak.

16. Molecules can rotate and they can vibrate. These two motions have quantized energy levels just like the electrons in an atom. Changes in the rotational or vibrational state of a molecule will produce specific spectral lines unique to each molecule.