1. The frequency of a water wave gives us its height.
2. If a new wave arrives on shore every two seconds, then its frequency is 2 Hz.
3. The greater the disturbance of the medium, the higher the amplitude of the wave.
4. While gravity is always attractive, electromagnetic forces are always repulsive.
5. Changing the electric field will have no effect on the magnetic fields of a body.
6. As they move through space, the vibrating electrical and magnetic fields of a light wave must move perpendicular to each other.
7. Wave energy can only be transmitted through a material medium.
8. As white light passes through a prism, the red (longer) wavelengths bend less than the blue (shorter) wavelengths, so forming the rainbow of colors.
9. Observations in the x-ray portion of the spectrum are routinely done from the surface of the earth.
10. In blackbody radiation, the energy is radiated uniformly in every region of the spectrum, so the radiating body appears black in color.
11. Wein's law relates the peak wavelength of the blackbody to its size. The larger the black body, the shorter its peak wavelength.
12. A blue star is hotter than a red star.
13. According to Wein's law, the hotter the star, the redder its color.
14. Doubling the temperature of a black body will double the total energy it radiates.
15. As a star's temperature increase, the frequency of peak emission also increases.
16. The sun's hot photosphere emits an emission line spectrum
17. The spectral lines of each element are distinctive to that element, whether we are looking at emission or absorption lines.
18. An absorption line spectrum, with dark lines crossing the rainbow of the continuum, is produced by a low-density hot gas.
19. An emission line results from an electron falling from a higher to lower energy orbital around its atomic nucleus.
20. The shorter a wave's wavelength, the greater it's energy.
21. Spectral lines are produced when an electron makes a transition from one energy state to another.
22. In the Bohr model of the atom, an electron can only only exist in specific, well-defined energy levels.
23. When an electron in a hydrogen atom drops from the second to the first excited energy state it emits a bright red emission line called hydrogen alpha.
24. The Zeeman effect reveals the presence of strong magnetic fields by the splitting of spectral lines.
25. The broader the spectral line, the higher the pressure of the gas that is creating it.
26. In the Doppler effect, a red shift of spectral lines shows us the source is receding from us.
27. The larger the red shift, the faster the distant galaxy is rushing toward us.
28. If a fire truck's siren is rising in pitch, it must be approaching us.
29. You would perceive a change in a visible light wave's amplitude as a change in its color.
30. Spectroscopy of a star can reveal its temperature, composition, and line-of-sight motion.
31. The Doppler effect can reveal the rotation speed of a star by the splitting of the spectral lines.
32. Radio waves, visible light, and x-rays are all a type of electromagnetic radiation.
33. Which of these is not a form of electromagnetic radiation?
    A) television signals
    B) light from your camp fire
    C) DC current from your car battery
    D) x-rays in the doctor's office
    E) ultraviolet causing a suntan
34. A wave's velocity is the product of the
    A) frequency times the wavelength of the wave.
    B) period times the energy of the wave.
    C) frequency times the period of the wave.
    D) amplitude times the frequency of the wave.
    E) amplitude times the wavelength of the wave.
35. Consider this diagram. Which statement is true?
    graphic(ch02MC3.tif)
    A) The amplitude is 4 and the wavelength is 12.
    B) The amplitude is 6 and the wavelength is 4.
    C) The amplitude is 4 and the wavelength is 6.
    D) The amplitude is 8 and the wavelength is 12.
    E) The amplitude is 8 and the wavelength is 6.
36. If a wave's frequency doubles, its wavelength
    A) is halved.
    B) is also doubled.
    C) is now 4× longer.
    D) becomes 16× longer.
    E) is unchanged, as c is constant.

37. The speed of light in a vacuum is
    A) 186,000 miles per hour.
    B) 300,000 km/sec.
    C) 768 km/hour.
    D) h = E/c.
    E) not given.

38. Which of these is constant for all forms of E-M radiation in a vacuum?
    A) velocity
    B) wavelength
    C) amplitude
    D) frequency
    E) photon energy

39. The two forms of E-M radiation that experience the least atmospheric opacity are
    A) light and infrared waves.
    B) X and gamma radiation.
    C) microwaves and television waves.
    D) ultraviolet and infrared waves.
    E) light and radio waves.

40. The radiation our eyes are most sensitive to lies in the color
    A) violet at 7,000 Angstroms.
    B) yellow-green at about 550 nm.
    C) black at 227 nm.
    D) red at 6563 Angstroms.
    E) blue at 4,321 nanometers.

41. Medium A blocks more of a certain wavelength of radiation than medium B. Medium A has a higher
    A) opacity.
    B) transparency.
    C) clarity.
    D) albedo.
    E) seeing.

42. In the Kelvin scale, absolute zero lies at
    A) zero K.
    B) -373 degrees C.
    C) 273 degrees C
    D) Both A and B are correct.
    E) Both A and C are correct.

43. What is true of a blackbody?
    A) Its energy peaks at the wavelength determined by its temperature.
    B) It appears black to us, regardless of its temperature.
    C) It has a complete absence of thermal energy.
    D) Its energy is not a continuum.
    E) If its temperature doubled, the peak in its curve would be doubled in wavelength.

44. The temperature scale that places zero at the point where all atomic and molecular motion ceases is
    A) fahrenheit.
    B) centigrade.
    C) Ransom.
    D) Celsius.
    E) Kelvin.

45. The total energy radiated by a blackbody depends on
    A) the fourth power of its temperature.
    B) the square of its temperature.
    C) the square root of its temperature.
    D) the cube of its temperature.
    E) the cube root of its temperature.

46. Doubling the temperature of a blackbody will increase its energy by
    A) 4× more
    B) 16× more
    C) 2.5× more
    D) 1.5× more
    E) 5× more

47. If a star was the same size as our Sun, but was 81× more luminous, it must be
    A) three times hotter than the Sun.
    B) nine times hotter than the Sun.
    C) 81 times hotter than the Sun.
    D) four times hotter than the Sun.
    E) twice as hot as our Sun.

48. The Sun's observed spectrum is
    A) a continuum with no lines, as shown by the rainbow.
    B) a continuum with emission lines.
    C) only emission lines on a black background.
    D) only absorption lines on a black background.
    E) a continuum with absorption lines.

49. The element first found in the Sun's spectrum, then on Earth 30 years later, is
    A) hydrogen.
    B) solarium.
    C) technicum.
    D) helium
    E) aluminum.

50. A jar filled with gas is placed directly in front of a second jar filled with gas. Using a spectroscope to look at one jar through the other you observe dark spectral lines. The jar closest to you contains
    A) the hotter gas.
    B) the exact same gas as the other jar.
    C) gas at the same temperature as the other jar.
    D) the cooler gas.
    E) gas at very high pressure.

51. Which of these is emitted when an electron falls from a higher to lower orbital?
    A) another electron
    B) a neutrino
    C) a photon
    D) a positron
    E) a graviton

52. In Bohr's model of the atom, electrons
    A) only make transitions between orbitals of specific energies.
    B) can be halfway between orbits.
    C) move from orbit to orbit in many small steps.
    D) are not confined to specific orbits.
    E) are spread uniformly through a large, positive mass..

53. In general, the spectral lines of molecules are
    A) the same as the atoms they contain.
    B) less complex than those of atoms.
    C) nonexistent.
    D) more complex than those of atoms.
    E) only absorption lines.

54. Electromagnetic radiation
    A) can only travel in a dense medium.
    B) is the same as a sound wave.
    C) has nothing in common with radio waves.
    D) can behave both as a wave and a packet of energy (photon).
    E) has only the properties of waves.

55. In a hydrogen atom, a transition from the 2nd to the 1st excited state will produce
    A) an ultraviolet spectral line.
    B) three different emission lines.
    C) no emission line.
    D) a dark absorption line.
    E) the bright red Balmer alpha emission line..

56. For hydrogen, the transition from the first to third excited state produces
    A) a violet emission line.
    B) an infrared line.
    C) a red emission line.
    D) a blue green absorption line.
    E) an ultraviolet line.

57. The observed spectral lines of a star are all shifted towards the red end of the spectrum.
    A) Which statement is true?
    B) This is an example of the Doppler effect.
    C) The star is not rotating.
    D) The star has a radial velocity towards us.
    E) The second law of Kirchhoff explains this.
    F) This is an example of the photoelectric effect.

58. If a source of light is approaching us at 3,000 km/sec, then all its waves are
    A) red shifted out of the visible into the infrared.
    B) blue shifted by 1%.
    C) red shifted by 1%.
    D) blue shifted out of the visible spectrum into the ultraviolet.
    E) not affected, as c is constant regardless of the direction of motion.

59. If the rest wavelength of a certain line is 600 nm., but we observe it at 594 nm, then
    A) the source is approaching us at 0.1 % of the speed of light.
    B) the source is spinning very rapidly, at 1% of the speed of light.
    C) the source is approaching us at 1 % of the speed of light.
    D) the source is getting 1% hotter as we watch.
    E) the source is receding from us at 10% of the speed of light.

60. According to the Zeeman effect, the splitting of a sunspot's spectral lines is due to
    A) their magnetic fields.
    B) their rapid rotation.
    C) a Doppler shift,
    D) their radial velocity.
    E) temperature variations.