Chapter 7 Questions

Sections 7.1 & 7.2

1a) What is the relationship between the wavelength and the frequency of radiant energy?
b) Ozone in the upper atmosphere absorbs energy in the 210 -230 nm range of the spectrum. Is this radiation of a higher or lower frequency than visible light?

2) Label each of these statements as true or false. For those that are false, correct the statement.
a) Visible light is a form of electromagnetic radiation.
b) Electromagnetic radiation and sound waves travel at the same speed.
c) Electromagnetic radiation is incapable of passing through water.
d) Infrared light has a lower frequency than visible light.
e) Electromagnetic radiation travels through a vacuum at constant speed, regardless of wavelength.
f) Red light has a higher frequency than blue light.
g) The longer the wavelength, the less energy a wave has.

3a) What is the frequency of radiation that has a wavelength of 0.589 pm?
b) What is the wavelength of radiation that has a frequency of 5.11×10^{11} s^{-1}?
c) What distance does electromagnetic radiation travel in 6.54 s?
d) Light with a wavelength of 150 μm has what frequency?

4a) What does it mean when we say that energy is quantized?
b) Why don't we notice the quantization of energy in everyday activities?

5a) Calculate the energy that can be emitted or absorbed at a wavelength of 812 nm.
b) Calculate the energy of a photon of frequency 5.72×10^{13} s^{-1}.
c) What wavelength of radiation has photons of energy 5.44×10^{-18} J? What portion of the electromagnetic spectrum would this radiation be found?
d) How much energy is emitted by radiation with a wavelength of 19.0 pm?

Sections 7.3 & 7.4

6) Explain how the existence of line spectra is consistent with Bohr's theory of quantized energies for the electron in the hydrogen atom.

7a) In terms of the Bohr theory, what process is occurring when excited hydrogen atoms emit radiant energy of certain wavelengths and only those wavelengths.
b) What kind of process corresponds to the absorption of light of certain wavelengths by hydrogen atoms?

8) Is energy emitted or absorbed when the following electron transitions occur in hydrogen?
a) from n = 4 to n = 2?
b) From an orbit of radius 2.12 angstroms to one of radius 8.48 angstroms?
c) from n = 2 to n = 6?
d) from n = 5 to the ground state?

9) What evidence do we have that light and matter can interact?

10) One wavelength of light that is emitted by hydrogen when exposed to electricity is 465 nm. What is the energy level difference between the two levels?

11a) de Broglie proposed that under the right conditions, a piece of matter can experience wavelike properties. What proof was later shown?
b) Why is the wavelength of ordinary sized objects small?
c) Why is the wavelength of electrons larger?
d) What would be the wavelength of an electron with a speed of 4.05×10^{6} m/s. Mass of an electron is 9.1094×10^{-28} g.

Section 7.7, 7.8 & 7.11

12) In the Bohr model of the hydrogen atom, the ground state electron orbits the nucleus at a radius of 0.53 angstroms. In the quantum mechanical description of the hydrogen atom, the most probable distance of the ground state electron from the nucleus is 0.53 angstroms. Why are these two statements different?

13) Determine the element from the electron configurations:
a) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{14} 5d^{10} 6p^6 7s^2 5f^{14} 6d^{10}$
b) [Rn] $7s^2 5f^{14}$
c) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^3$
d) [Kr] $5s^2 4d^{10} 5p^5$
e) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^6$
f) [Rn] $7s^1 5f^{14} 6d^5$
g) [Ar] $4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{14} 5d^5$
h) $1s^2 2s^2 2p^6 3s^1$
i) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d^{10}$
j) [Xe] $6s^1 4f^{14}$

14) Write the electron configuration for the following atoms:
a) hafnium
b) chromium
c) francium
d) lead
e) terbium
f) antimony
g) xenon
h) carbon

15) Write the configurations for the following atoms using the shortcut notation for electron configurations.
a) iodine
b) silicon
c) calcium
d) tantalum
e) bohrium
f) krypton

Sections 7.10 & 7.12

16a) Why did Mendeleev leave blanks in his early version of the periodic table? How did he predict the properties of the elements that belonged in these blanks?

17) Arrange the following atoms in order of increasing distance of the n=3 electron shell from the nucleus: K, Mg, P, Rh, Ti.

18) How do the sizes of atoms change as we move
a) from left to right in a row in the periodic table?
b) from top to bottom in a group in the periodic table?
c) Arrange the following atoms in order of increasing atomic radius: F, P, S, As

19) Notice that among the nonmetallic elements, the change in atomic radius in moving one place left or right in a row is smaller than the change in moving up or down within a group. Explain these observations.

20a) Why does the He atom have a smaller radius than the H atom?
b) Why is the He atom smaller than the Ne atom?

21a) Why is the second ionization energy of lithium much greater than that of beryllium?
b) The difference between the third and fourth ionization energy of scandium is much larger than the difference between the second and third ionization energies for scandium. Why?

22a) What is the trend in first ionization energies as one proceeds down the group 18 elements? Explain how this trend relates to variations in atomic radii.
b) What is the trend in first ionization energies as one moves across the fourth period from K to Kr? How does this trend compare with the trend in atomic sizes?

23) Base on their positions in the periodic table, predict which atom of the following will have the largest first ionization energy:
a) O, Ne
b) Mg, Sr
c) K, Cr
d) Br, Sb
e) K, Ca, Sr
f) As, S, F
g) Ba, Po, Se
h) Xe, Li, Ne, Rb

Review

1) 5.00 g of aluminum is dropped into 500,0 mL of 0.500 M copper (II) chloride solution. Write a net ionic equation for the reaction and determine the mass of copper created.

2) Determine the pH of a 0.800 M solution of hypochlorous acid.

3) Determine the standard enthalpy and entropy of the synthesis of solid iron (III) chloride. Then, use these values to determine if the reaction is spontaneous or not.

4) A 4.00 m^3 weather balloon is released at a pressure of 102 kPa and at 30 ^oC. The balloon rises to a higher altitude where the temperature and pressure is now -4 ^oC and 0.894 atm, respectively. What is the volume of the balloon at the higher altitude?