Chapter 7 Focus Questions

Section 1

1. What is the relationship between wavelength and frequency?
2. What is the equation that relates wavelength and frequency?
3. What is the speed of light?

Section 2

3. What is the value of Planck's constant?
4. Since energy is transferred in "packets" or "quanta," it demonstrates that energy also behaves like a particle (matter). Einstein took this step further and said that Electromagnetic radiation (although it is a wave) is also a stream of particles called "photons." What is the equation for the energy of a photon?
5. What does the energy of a photon depend on? (Look at the variables in the equation).
6. What is the equation that states that energy has mass?
7. Calculate the mass of a photon of an x-ray ($\lambda = 1x10^{-10}$m).
8. What is the "dual nature of light?"
12. Calculate your wavelength traveling at 1m/s. You must convert your weight from pounds to kilograms.
13. Compare that value to an electron traveling at $1x10^{7}$m/s. See Ex. 7.3.
14. Do photons primarily exhibit wave or particle like behavior?
15. Do electrons primarily exhibit wave or particle like behavior?
16. Do large objects primarily exhibit wave or particle like behavior?

Section 3

2. What is the difference between a continuous spectrum and a line spectrum?
4. What is equation to calculate the energy of a photon emitted when an electron jumps between energy levels?

Section 4

1. What was the idea that led to Bohr's model?
2. Do electrons eventually collapse into the nucleus?
3. Draw a picture of Bohr's model.
4. What is the equation that gives the energy levels available to an electron in a hydrogen atom? What does Z represent? What does n represent? What does the negative sign represent?
5. Are electrons more tightly bound to the nucleus closer or farther from the nucleus?
6. Does a very negative number mean tightly or loosely bound to the nucleus?
7. If an atom lost energy to make a transition, is the transition more or less stable?
8. What is the equation for the wavelength of the photon emitted when a electron jumps to a ground state (or absorbed when an electron jumps to an excited state)?

Section 5

1. Heisenberg, deBroglie, and Schrödinger developed what approach to the atomic model?
4. What is the Heisenberg Uncertainty Principle (in words and mathematically)?
6. Where is the probability of finding the electron in the hydrogen atom the greatest?

Section 6

1. What are quantum numbers?
2. What is the quantum number, n?
3. As n increases, what does E do?
4. As n increases, what does the size of the orbital do?
5. Is the energy less or more negative as n increases? Is the electron, therefore, more or less tightly bound to the nucleus?
6. What is the quantum number, l?
7. What is the quantum number, m_l?
8. For the d sublevel (1=2), m_l can be -2,-1,0,1,2. How many orbitals does the d sublevel contain?
9. For the f sublevel (1=3), what are the possible values of m_l? How many orbitals does the f sublevel contain?
10. n=2 contains how many sublevels? What are they (letters)?
11. How many orbitals does s have?
12. How many orbitals does p have?
13. How many orbitals does d have?
14. How many orbitals does f have?
15. What quantum number signifies the principle energy level?
16. What quantum number signifies the type of sublevel (s,p,d,f)?
17. What quantum number signifies the orientation of each orbital?

Section 7

1. What happens to the shape of s an n increases in number? In other words, as the energy level increases, what happens to each s orbital?
2. As the energy level increases, what happens to each p orbital?
3. What is the basic shape of a p orbital?
4. Name the p orbitals with x, y, and z
5. Are f orbitals formed in bonding?
6. What does it mean to degenerate?
7. How does the energy of the 4s, 4p, 4d, and 4f orbitals compare for the hydrogen atom?

**Note: for multielectron atoms, 4s, 4p, 4d, and 4f orbitals are not degenerate. However, the three p orbitals are, as are the 5 d orbitals, as are the 7 f
Orbitals

8. What is the ground state for the hydrogen atom?

Section 8

1. How does a charge produce a magnetic moment?
2. How many spin states are there?
3. What values can the magnetic spin quantum number, m_s have?
4. What is that Pauli Exclusion Principle?
5. According to the Pauli Exclusion Principle, what quantum numbers may be the same for two electrons? Which quantum number must be different?
6. In an atom, suppose there is an electron that occupies the $3d_{xz}$ orbital. Give all four quantum numbers for this electron (assume the electron is spinning “up”).
7. In an atom, there is another electron that occupies the $3d_{xz}$ orbital. Give all four quantum numbers for that electron.

Section 9
1. What is a polyelectronic atom?
2. Describe electron shielding.
4. What has greater energy, a 2s orbital or a 2d orbital?
5. As the electron gets farther away from the nucleus, does the energy of the electron increase or decrease?

Section 10
1. Why was the periodic table originally developed?
2. Who is generally given credit to the present form of the periodic table and why?
3. When did Mendeleev predict Ge? What year was it actually discovered? Were all of the properties pretty accurately predicted by Mendeleev?
4. In row 8/Group 3 of Mendeleev's table (Fig. 7.23), what is Di known as today? (Look at the modern periodic table).
5. In row 6/Group 7, what element did Mendeleev predict that has atomic mass of about 100? (Look at the modern periodic table).
6. What is the row # and group # where Mendeleev predicted Ge?
7. Since the undiscovered element with atomic number 113 is similar in properties to thallium, what group must this undiscovered element belong to? How about number 114?

Section 11
1. In your own words, what is the Aufbau Principle?
2. In your own words, what is Hund's rule?
3. Draw the orbital diagram for chlorine and state how many unpaired electrons there are.
4. Write the electron configuration for chlorine (long form and the short form using the noble gas).
5. What are valence electrons?
6. Why are valence electrons so important?
7. What electron orbitals are considered valence electrons?
8. Why do elements in the same group have similar properties?
9. What is the electron configuration for Br?
10. What is the expected electron configuration for Cr? What is the actual configuration?
11. Since half filled sublevels tend to be favored, write the electron configuration for Mo.
12. Why do the s sublevels fill before the d sublevels?
13. Why would an electron occupy a 5d orbital before a 4 orbital at times?
14. How many valence electrons does group 1 have? Group 2? Group 3? Group 4? Group 5? Group 6? Group 7? Group 8?
15. Why is it often difficult to predict the electron configuration of the transition metals, lanthanides, and actinides?

Section 12
1. What is ionization energy?
2. What is the first ionization energy? The second? The third?
3. Why is there such a large jump in the third and fourth ionization energies for aluminum?

4. For a group 2 element, where would the large jump occur?
5. Going across the period, I.E. (increases, decreases). Why?
6. Going down a group, I.E. (increases, decreases). Why?
7. What is electron affinity?
8. What is the trend as you go from left to right? Why?
9. What is the trend for E.A. as you go down a group? Why?
10. When atoms form bonds, what happens to their electron clouds?
11. What is the trend in atomic radius as you go left to right across a period? Why?
12. What is the trend in atomic radius as you go down a group? Why?

Section 13

1. What determines an atom's chemistry?
2. What are the special names of groups 1, 2, 7, and 8?
3. Where are the metals found? What charges do they form? Why do they have lower I.E. than nonmetals?
4. Why would atoms with low ionization energies be very reactive?
5. Where are the nonmetals found? What charges do they form? Why do they have higher I.E. than metals?
6. Why are the upper right hand elements more reactive (except for the noble gases)?
7. Why are the noble gases unreactive?
8. Where are semimetals located?
9. Why is H a nonmetal?
10. Why does density generally increase down a group?
11. Is there a general trend among all groups in melting and boiling points?