

## Chapter 11 Study Questions

1. How are wavelength and frequency related? How are energy and frequency related?
2. What was the revolutionary new idea in Bohr's model of the hydrogen atom? What was the most significant difference between the quantum mechanical atom and the Bohr hydrogen atom? Briefly explain the relationship between electronic transitions and atomic spectra.
3. Explain, in terms of their electron configurations, why the most reactive metals are in Group 1, the most reactive nonmetals are in Group 17, and the noble gases are chemically inert.
4. What is the electron capacity of
  - a) any Principal energy level?
  - b) each sublevel?
  - c) each orbital?
5. Which of the following sublevels do not exist? List the ones that do exist in order of increasing energy.
  - a)  $1s$
  - b)  $2s$
  - c)  $2d$
  - d)  $3d$
  - e)  $4p$
  - f)  $4f$
6. Which sublevel is in the process of being filled in the following regions of the periodic table?
  - a) Groups 1 and 2
  - b) Transition metals
  - c) Group 15
  - d) Inner transitional metals
7. What is the outer electron configuration of the following groups?
  - a) alkali metals
  - b) halogens
  - c) noble gases
8. Classify each of the following electron configurations as ground state, excited state or impossible:
  - a)  $1s^2 2s^2 2p^1$
  - b)  $1s^2 1p^6 2s^2$
  - c)  $1s^2 2s^2 2p^4 3s^1$
  - d)  $1s^2 2s^2 2p^6 3d^1$
9. Give the complete ground state electron configuration of
  - a) sulfur
  - b) the element with atomic number 29
10. Give the abbreviated ground state electron configuration of
  - a) strontium
  - b) lead ( $Z = 82$ )
11. Give the symbol of the element which (in the ground state)
  - a) has the outer electron configuration  $6s^2$
  - b) is in Group 18 but has no  $p$  electrons
  - c) has three unpaired  $4p$  electrons
  - d) has four valence electrons in the Second Principal Energy level.
  - e) is in Period 3 and has the same outer electron configuration as F.
  - f) has only five  $3d$  electrons.
12. Sketch the shape of  $s$  and  $p$  orbitals. How do orbitals change as  $n$  increases?

13. Draw a complete orbital diagram for  
a) oxygen                                      b) titanium ( $Z = 22$ )
14. Which is a better predictor of chemical properties: Period number or Group number?
15. a) Which element has a greater ionization energy? Cl or Ar? Na or K?  
b) Which element has a larger atomic radius? Mg or Ca? S or Cl?

### **Summary of Chapter 11: Modern Atomic Theory**

wavelength ( $\lambda$ ), frequency ( $\nu$ )

atomic spectra

Bohr model of the hydrogen atom

ground state, excited states

quantum mechanics

electron clouds

orbitals

principle energy levels ( $n$ )

sublevels ( $s, p, d, f$ ): electron capacity and relative energies

ground state electron configuration of atoms

abbreviated electron configurations

outer electron configuration

valence electrons

orbital diagrams

Hund's rule

Pauli exclusion principle

ionization energy

atomic radius

electron configuration & the Periodic Table