Honors Chemistry

Chapter 7 Study Questions

1. Calculate the wavelength in nanometers of an X-ray with a frequency of 7.5×10^{11} MHz.

2. Energy is emitted when a hydrogen electron goes from $n = 3$ to $n = 2$.
   a) Calculate the energy emitted. (Use the equation, $E(n) = -R/n^2$, where $R = 2.178 \times 10^{-18}$ J.)
   b) Calculate the wavelength of light emitted.

3. 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 electron energy levels and atomic spectra.

4. 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.

5. What is the electron capacity of
   a) any Principal energy level? b) each sublevel? c) each orbital?

6. Which of the following sublevels do not exist? List the ones that do exist in order of increasing energy.
   a) 1*s* b) 2*s* c) 2*d* d) 3*d* e) 4*p* f) 4*f*

7. What is the maximum number of electrons in an atom that can have these quantum numbers:
   a) $n = 2, l = 1, m_l = 0$ b) $n = 1, l = 0$ c) $n = 3, l = 2, m_l = 1, m_s = +\frac{1}{2}$

8. 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

9. 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) $1s^2 2s^2 2p^6 3d^1$

10. Give the complete ground state electron configuration of
    a) sulfur b) the element with atomic number 27 c) strontium

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 4*p* 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 3*d* electrons.

12. For the element americium, atomic number 95
    a) Give the abbreviated ground state electron configuration
    b) Give a set of four possible quantum numbers for its highest energy ground state electron.

13. Sketch the shape of *s* and *p* orbitals. How do orbitals change as *n* increases?

14. Draw a complete *orbital diagram* for
    a) oxygen b) titanium

15. a) Which element has a greater first 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 7: Atomic Structure & Periodicity

wavelength (λ), frequency (ν)
atomic spectra
Bohr model of the hydrogen atom
ground state, excited states
quantum theory
electron clouds
orbitals
principle energy levels (n)
sublevels (s, p, d, f): electron capacity and relative energies
possible values for 4 quantum numbers (n, l, m_l, m_s)
ground state electron configuration of atoms
abbreviated electron configurations
valence electrons
orbital diagrams
Hund's rule
Pauli exclusion principle
atomic radius
ionization energy
electron configuration & the Periodic Table

how to use the following equations:

$\lambda \nu = c$

$\Delta E = h\nu$

$E(n) = -R/n^2$

where $c = 2.9979 \times 10^8$ m/s, $h = 6.626 \times 10^{-34}$ J ·s, $R = 2.178 \times 10^{-18}$ J