Chapter 2: Atomic and Electronic Structure

Lesson 2.1 – Atomic Structure and the Bohr Model

Atomic Structure

- Mass Number = (Protons) + (Neutrons)
- Neutrons = (Mass Number) – (Protons)

Bohr Model of the Atom

- Electrons distance from their nuclei are quantized
- The distance between each energy shell and the next shell above it gets smaller as you get further away from the nucleus.
Lesson 2.2 – Atomic Orbitals

S-orbitals

P-orbitals

D-orbitals

Lesson 2.3 – Quantum Numbers

<table>
<thead>
<tr>
<th>#</th>
<th>NAME</th>
<th>WHAT</th>
<th>RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>principal</td>
<td>Shell (distance from nucleus)</td>
<td>[1...infinity]</td>
</tr>
<tr>
<td>l</td>
<td>azimuthal</td>
<td>subshell (type of orbital)</td>
<td>[0...(n-l)]</td>
</tr>
<tr>
<td>ml</td>
<td>magnetic</td>
<td>specific orbital (orientation in space)</td>
<td>[-l...+l]</td>
</tr>
<tr>
<td>ms</td>
<td>spin</td>
<td>Up or down</td>
<td>+1/2 or -1/2</td>
</tr>
</tbody>
</table>
Lesson 2.4 – Electron Configuration

- What is the electron configuration of oxygen?

- Cool video on stacking of orbitals and how atoms really look: http://www.youtube.com/watch?v=sMt5Dce0kg

Lesson 2.5 – Condensed Electron Configuration, Valence, and Energy Diagrams

Condensed Electron Configuration

- What is the condensed electron configuration of bromine?

Valence Electrons

- What are bromine’s valence electrons?

- How many valence electrons does titanium have?

- When does the d-block count toward an atom’s number of valence electrons?

Continue to next page...
**Lesson 2.5 – Condensed Electron Configuration, Valence, and Energy Diagrams (Continued)**

**Energy Diagrams**

- **Aufbau Principle**: electrons fill the lowest energy orbitals first
- **Hund's Rule**: Don't pair up electrons until you have to.
- **Pauli Exclusion Principle**: no two electrons in the same atom can have the same four quantum numbers. In other words, no two electrons in the same atom can have the exact same address.

**Lesson 2.6 – Electron Configuration Exceptions (Cr and Cu)**

- What are the 5 exceptions you need to know, and what are their electron configurations?
Lesson 2.7 – Excited Electron Configurations
- Electrons can absorb a photon and be promoted to a higher-energy shell or orbital.

Lesson 2.8 – Paramagnetic vs. Diamagnetic

<table>
<thead>
<tr>
<th>When I hear . . .</th>
<th>I think . . .</th>
<th>I then think . . .</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paramagnetic</td>
<td>“Unpaired”-a-magnetic</td>
<td><strong>Attracted</strong> to magnets because it has unpaired electrons.</td>
</tr>
<tr>
<td>Diamagnetic</td>
<td>The other one (all paired)</td>
<td>Slightly <strong>repelled</strong> by magnets because it has all paired electrons.</td>
</tr>
</tbody>
</table>

- If an element has an **ODD** number of electrons, then it’s **paramagnetic**.
- If it has an **EVEN** number of electrons, then it can be either **paramagnetic** or **diamagnetic**; you have to fill out the electron configuration energy diagram to find out.
- **Hint**: Liquid oxygen is paramagnetic, liquid nitrogen is diamagnetic.

Lesson 2.9 – Emission Spectra, Heisenberg Uncertainty, Photoelectric Effect

\[ E_{\text{photon}} = hf = \frac{hc}{\lambda} \]

\( f \) = the photon's **frequency** (this can be different for different photons)
\( c \) = **speed of light**, which is \( 3.0 \times 10^8 \text{ m/s} \)
\( h \) = **Planck’s constant**, which is \( 6.63 \times 10^{-34} \text{ J \cdot s} \)
\( \lambda \) = the photon's **wavelength**

**Heisenberg Uncertainty**
- It is impossible to determine a subatomic particle's **position** and its **momentum** with perfect accuracy.

**Photoelectric Effect**
- **Kinetic Energy**\(_{\text{electron}} = E_{\text{photon}} - \Phi \)
- **\( \Phi \)** = work function (the minimum amount of energy required to ionize the electron)
  - In order to expel an energized electron, the **Kinetic Energy** must be greater than zero.