Problems:
9.21, 9.22, 9.23, 924, 9.26

- What is the electronic structure of Ne. Make an educated guess about its chemical reactivity.

Atoms

- Electrons fill up orbitals one by one. There are some things to know when filling up the shells
  - After filling the $3p$ orbital, one starts filling the $4s$ orbital before filling the $4s$ orbital. This is because the $4s$ state is actually lower than the $3d$ state as shown below. They are very close however.
  - **Hunds Rule**. Take filling up the $3p$ orbital for example. When filling up the $2p$ orbital one first fills up the m levels with the same spin, and then one starts the process again for the next spin. See Fig. 9.15 of the book for a good explanation. Thus the structure of Oxygen is the following

$$O : \underbrace{[\uparrow\downarrow]}_{1s^2}\ \underbrace{[\uparrow\downarrow]}_{2s^2}\ \underbrace{[\overbrace{\uparrow\uparrow\uparrow}^{m=-1,0,1}\ \downarrow]}_{2p^4}$$

    where each arrow represents an electron.

- **Moseley's Law** When an electron in an inner shell is knocked out, other electrons decay down to fill their spot, emitting keV X rays. These X rays are known as K_α lines and where used to determine the Z of the nucleus. If a $1s$ electron is knocked out, then the nucleus is only screened by a single remaining $1s$ electron. The $2p$ electrons will decay down to fill the void. The energy of the photon emitted during this transition is

$$E_{2\to 1} \simeq \frac{k_C e^2 (Z-1)^2}{2a_0}\left(\frac{1}{1^2} - \frac{1}{2^2}\right) \tag{1}$$

  You should know where this comes from. For instance suppose a $2p$ electron is knocked out then. Then you should understand why the a $3s$ electron decaying to this $2p$ slot gives a photon of energy

$$E_{3\to 2} \simeq \frac{k_C e^2 (Z-9)^2}{2a_0}\left(\frac{1}{2^2} - \frac{1}{3^2}\right) \tag{2}$$

  This is because there are approximately nine electrons screening the nuclear charge. The problem is essentially the Bohr model with $Z_{\text{effective}} = Z - 9$. (2 electrons from the 1s orbital, 2 electrons from the 2s orbital, 5 electrons from the 2p orbital.)