

Workshop module 12 - Physics 123, Spring 2013

1. How would you expect the ionization energy of Ne to compare to Li? How about the radius? Why?
2. Phosphors that coat the inside of a fluorescent lamp convert ultraviolet radiation (from the mercury vapor discharge inside the tube) into visible light. Make a qualitative schematic diagram of the allowed atomic energy levels that illustrates how this works. Could one also make a phosphor that converts visible light to ultraviolet?
3. How many quantum states are available to electrons in the $n=3$ state of a multi-electron atom, according to Schrodinger's theory of the atom? A hydrogen atom is known to have $l=3$. What are the possible values of n , m_l and m_s for this atom?
4. Would you expect neon to be reactive chemically? Why or why not? What does it mean when something is "reactive chemically"?
5. List all the quantum numbers of all the electrons in a ground-state aluminum atom.
6. How would you expect the wavelength of the $K\alpha$ x-ray line for tungsten to compare to that for gold? Do you understand why $Z-1$ comes into the relevant equation?
7. Consider the nucleus symbolized by Al_{13}^{26} ... what do these numbers/symbol represent? Is it necessary to write "Al" and "13"? Why or why not? Is it necessary to specify the 26? What is an isotope? Do you think different isotopes of the same type of atom will have dissimilar chemical properties?
8. One form of natural radioactive decay happens when a proton inside a nucleus captures an atomic electron and is converted into a neutron and a neutrino. This process is called "electron-capture". Calculate an upper limit to the probability that an Al_{13}^{26} nucleus captures an $n=1$ electron, assuming the wave function of the electron is identical to the $n=1$ hydrogen wavefunction. Assume the nuclear radius of Aluminum is 4×10^{-15} meters. After the electron capture happens, the aluminum nucleus is converted to Mg_{12}^{26} and an x-ray is emitted. What is the lowest frequency x-ray you might expect to be emitted in this process?