Krane Chapter 8

Problem 4

Use eq 6.42 with $\lambda = v/c$ (v the Greek letter nu stands for frequency)

$E_n = -(Z-1)^2(e^2/4\pi\varepsilon_0\hbar)^2(m/2n^2) = -(Z-1)^2 hcR_\infty/n^2$

and eq 6.40 for R_∞

$v = (E_m - E_n)/h = -(Z-1)^2 cR_\infty(1/m^2 - 1/n^2) \Rightarrow -(Z-1)^2 cR_\infty(1/2^2 - 1/1^2) = (Z-1)^2 cR_\infty(3/4$

Problem 5

Use eq 8,1 with $\lambda = v/c$ (v the Greek letter nu stands for frequency)

$Z - 1 = \sqrt{(4/cR_\infty 3} = \sqrt{1.33/\{(1.0974x10^7)(0.1940x10^{-9})\}} = 25.02$

Therefor Z= 26 (IRON)

Problem 10

Cr: [Ar closed shell]$4s^1 3d^5$

There is nothing that prevents all 6 electrons from having $m_s = +1/2,$ and therefore the total spin would be $S = 3$. The Pauli principle would say that the five 3d electrons must have different m_l values. The 4s electron has $m_l = 0$ only. The total L is therefore $(2+1+0-1-2)_{3d^5} + (0)_{4s^1} = 0.$ Therefore the configuration has $L = 0, S = 3$

Study Problem 12 which is a similar theme.

Problem 19

(a) For a 2p electron, n=2, l=1 thus $m_l = \pm 1, m_s = \pm 1/2$

$|n, l, m_l, m_s\rangle = |2,1,+1,+1/2\rangle, |2,1,+1,-1/2\rangle, |2,1,0,+1/2\rangle, |2,1,0,-1/2\rangle, |2,1,-1,+1/2\rangle, |2,1,-1,-1/$

(b) For each electorn there are 6 possible sets, so without an exclusion principle the total possibilities are $6 \times 6 = 36.$

(c) With the Pauli exclusion principle, there are six sets of the 36 which are identical. That leaves 36-6 allowed combinations.

(d) Since the n values are different in part d, the Pauli principle does not apply, so the answer of part (b) applies.

Problem 22

(a) $E = hc/\lambda = 1240/632.8 = 1.96eV = 3.14 \times 10^{-19} Joules$

$P = 3.5 \times 10^{-3} watts/(3.14 \times 10^{-19}) = 1.12 \times 10^{16} photons.$

(b) From eq 3.10

E= $\sqrt{2\mu_0 cP_{av}/A} = \sqrt{2(4\pi \times 10^{-7})(3 \times 10^{8)}(3.5 \times 10^{-3})/\pi(1.2 \times 10^{-3})^2} = 763\, V/m$

For the incandescent bulb

E= $\sqrt{2\mu_0 cP_{av}/A} = \sqrt{2(4\pi \times 10^{-7})(3 \times 10^{8)}(3.5 \times 10^{-3})/\pi(1)^2} = 77\, V/m$