Name:
CH7 Review Problems Solutions

51. Calculate the longest and shortest wavelengths of light emitted by electrons in the hydrogen atom that begin in the $n = 6$ state and then fall to states with smaller values of n.

Longest (smallest energy change)

$n = 6 \rightarrow n = 5$

$$\Delta E = -2.178 \times 10^{-18} J \left(\frac{1}{6^2} - \frac{1}{5^2}\right)$$

$$\Delta E = +2.662 \times 10^{-20} J$$

$$\lambda = \frac{hc}{\Delta E} = \frac{(6.626 \times 10^{-34} J \cdot s)(3 \times 10^8 m/s)}{2.662 \times 10^{-20} J}$$

$$\lambda = 7.47 \times 10^{-6} m = \boxed{7467 nm}$$

Shortest (largest energy change)

$n = 6 \rightarrow n = 1$

$$\Delta E = -2.178 \times 10^{-18} J \left(\frac{1}{6^2} - \frac{1}{1^2}\right)$$

$$\Delta E = +2.1175 \times 10^{-18} J$$

$$\lambda = \frac{hc}{\Delta E} = \frac{(6.626 \times 10^{-34} J \cdot s)(3 \times 10^8 m/s)}{2.1175 \times 10^{-18} J}$$

$$\lambda = 9.39 \times 10^{-8} m = \boxed{93.9 nm}$$

58. Which of the following orbital designations are incorrect: 1s, 1p, 7d, 9s, 3f, 4f, 2d?

Correct: 1s, 7d, 9s, 4f
Incorrect: 1p, 3f, 2d ℓ can't = n

68. The elements Cu, O, La, Y, Ba, Tl, and Bi are all found in high-temperature ceramic superconductors. Write the expected electron configuration for these atoms.

Cu: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d^{10}$ (*) exception
O: $1s^2 2s^2 2p^4$
La: $[Xe] 6s^2 5d^1$ (*) exception
Y: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^1$
Ba: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2$
Tl: $[Xe] 6s^2 4f^{14} 5d^{10} 6p^1$
Bi: $[Xe] 6s^2 4f^{14} 5d^{10} 6p^3$

74. Identify the following elements.
   a. An excited state of this element has the electron configuration $1s^2 2s^2 2p^5 3s^1$. Neon
   b. The ground-state electron configuration is $[Ne] 3s^2 3p^4$. Sulfur
   c. An excited state of this element has the electron configuration $[Kr] 5s^2 4d^6 5p^2 6s^1$. Silver
   d. The ground-state electron configuration contains three unpaired 6p electrons. Bismuth

78. Which of the following electron configurations correspond to an excited state? Identify the atoms and write the ground-state electron configuration where appropriate.
   a. $1s^2 2s^2 3p^1$ - excited - Boron - 1 unpaired
   b. $1s^2 2s^2 2p^6$ - ground - Neon - Ø unpaired
   c. $1s^2 2s^2 2p^4 3s^1$ - excited - Fluorine - 3 unpaired
   d. $[Ar] 4s^2 3d^5 4p^1$ - excited - Iron - 6 unpaired

   How many unpaired electrons are present in each of these species?

81. Arrange the following groups of atoms in order of increasing size.
   a. Be, Mg, Ca
   b. Te, I, Xe
   c. Ga, Ge, In

a) Be < Mg < Ca
b) Xe < I < Te
c) Ge < Ga < In

83. Arrange the atoms in Exercise 81 in order of increasing first ionization energy. (the trends are opposite of #81)

a) Ca < Mg < Be b) Te < I < Xe c) In < Ga < Ge

87. In each of the following sets, which atoms or ion has the smallest radius?

a. Li, Na, K Li
b. P, As P
c. O^+, O, O^- O^+
d. S, Cl, Kr Cl
e. Pd, Ni, Cu Cu

89. In 1994 at an American Chemical Society meeting, it was proposed that element 106 be named seaborgium, Sg, in honor of Glenn Seaborg, discoverer of the first transuranium element.

a. Write the expected electron configuration for element 106.
b. What other element would be most like element 106 in its properties?

a) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{14} 5d^{10} 6p^6 7s^1 5f^{14} 6d^5$ (4) exception

b) Tungsten

93. For each of the following pairs of elements

(C and N) (Ar and Br)

pick the atom with

a. more favorable (exothermic) electron affinity.
b. higher ionization energy.
c. larger size.

a) C Br
b) N Ar
c) C Br

115. Which of the following are possible sets of quantum numbers for an electron in an atom? For the sets of quantum numbers that are not possible, state what is wrong with each set.

a. $n = 1, \ell = 0, m_\ell = 1, m_s = +\frac{1}{2}$ if $\ell = 0$, $m_\ell \neq 1$
✓ b. $n = 9, \ell = 7, m_\ell = -6, m_s = -\frac{1}{2}$
c. $n = 2, \ell = 1, m_\ell = 0, m_s = 0$ $m_s \neq 0$
d. $n = 1, \ell = 1, m_\ell = 1, m_s = +\frac{1}{2}$ if $\ell = 1$, $n \neq 0$
e. $n = 3, \ell = 2, m_\ell = -3, m_s = +\frac{1}{2}$ if $\ell = 2$, $m_\ell \neq -3$
✓ f. $n = 4, \ell = 0, m_\ell = 0, m_s = -\frac{1}{2}$

121. An ion having a 4+ charge and a mass of 49.9 amu has 2 electrons with principal quantum number $n = 1$, 8 electrons with $n = 2$, and 10 electrons with $n = 3$. Supply as many of the properties for the ion as possible from the information given. *Hint:* In forming ions, the 4*s* electrons are lost before the 3*d* electrons.

a. The atomic number 24
b. Total number of *s* electrons 6
c. Total number of *p* electrons 12
d. Total number of *d* electrons $2e^-$
e. The number of neutrons in the nucleus 26 n
f. The ground-state electron configuration of the neutral atom

Ion = +4 charge $\# e = p - 4$
MM = 49.9 $p + n = 49.9$

$n=1$, $2e^-$
$n=2$, $8e^-$ } $20e^-$
$n=3$, $10e^-$

a) At # = # of protons $\#p = \#e + 4 = 20 + 4 = 24$

b) 2 s e^- in each energy level, $2 \times 3 = 6$ s electrons

c) 6 p e^- w/ $n=2$, 6 p e^- w/ $n=3$ } 12 electrons for p

d) $s + p + d = 20e^-$ $6 + 12 + d = 20e^-$ $d = 2$ electrons

e) $p + n = 49.9$ $n = 49.9 - p = 49.9 - 24 = 25.9 \approx 26n$

$24e^-$

f) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^4$ (4)
$1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d^5$ exception