Recitation 03

1. Quantum Numbers:
Consider the element Arsenic (As, Z = 33) in the ground state. Write the full electronic configuration of the ground state.

a. How many electrons have $m_l = 0$?
b. How many electrons have $l = 0$?
c. How many electrons have $m_l = +1$?
d. How many electrons have $m_s=+1/2$ (assume the $4p^3$ spins are all upwards)?

Solution:
As
$Is^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 3p^3$
(a) 15; (b) 8; (c) 7; (d) 18

Chapter 7: Exercise 60

Which of the following sets quantum numbers are not allowed? For the sets of quantum numbers that are incorrect, state what is wrong in each set.

- **a.** $n = 3, l = 3, m_l = 0, m_s = -1/2$
- **b.** $n = 4, l = 3, m_l = 2, m_s = -1/2$
- **c.** $n = 4, l = 1, m_l = 1, m_s = +1/2$
- **d.** $n = 2, l = 1, m_l = -1, m_s = -1$
- **e.** $n = 5, l = -4, m_l = 2, m_s = +1/2$
- **f.** $n = 3, l = 1, m_l = 2, m_s = -1/2$

Solution:

(a) Not allowed. Because when $n = 3$, l can not be 3

(b) Allowed

(c) Allowed

(d) Not allowed. Because m_S value can not be -1

(e) Not allowed. Because l can not be negative

(f) Not allowed. Because when $l = 1$, m_l can not be 2.

Chapter 7: Exercise 65

Give the maximum number of electrons in an atom that can have these quantum numbers.

- **a.** $n = 4$
- **b.** $n = 5, m_l = +1$
- **c.** $n = 5, m_s = +1/2$
- **d.** $n = 3, l= 2$
- **e.** $n = 2, l = 1$

Solution:

(a) 32;

(b) 8;

(c) 25;

(d) 10;

(e) 6

Do yourself sample exercise 75 & 76 from Chapter 7

2. Electron configurations in atoms and ions

Write the closed shell notation for the following elements in the ground state, by merely looking at the location of the element in the periodic table.
Mo, Dy, Os, Ba, Te, Nd

Solution:
Mo: [Kr] $5s^1$ $4d^5$ (d-block transition element)
Dy: [Xe] $6s^2$ $4f^{10}$ $6s^2$ (f-block transition element, Group of Lanthanide)
Os [Xe] $6s^2$ $4f^{14}$ $5d^6$ (d-block transition element)
Ba [Xe] $6s^2$ (II group, alkaline earth metal)
Te [Kr] $4d^{10}$ $5s^2$ $6p^4$ (VI group, semi-metal)
Nd [Kr] $6s^2$ $4f^4$ (f-block transition element, Group of Lanthanide)

Chapter 8: Exercise 35
Which of the following ions have noble gas electron configuration?

a. Fe^{2+}, Fe^{3+}, Sc^{3+}, Co^{3+}

Solution: (a) Sc^{3+}

3. Bond polarity

Chapter 8: Exercise 23
Predict the order of increasing electronegativity in each of the following groups of elements without using Fig 8.3

a. C, N, O
b. S, Se, Cl
c. Si, Ge, Sn
d. Tl, S, Ge

Solution:

The electronegativity in general increases across a period from left to right and decreases down in a group.
Therefore, the answers for exercise 8.23 would be

(a) C < N < O,
(b) Se < S < Cl,
(c) Sn < Ge < Si,
(d) Tl < Ge < S

Chapter 8: Exercise 25

Without using Fig 8.3 predict which bond in each of the following groups will be most polar.

a. C-F, Si-F, Ge-F
b. P-Cl or Si-Cl
c. S-F, S-Cl, S-Br
d. Ti-Cl, Si-Cl, Ge-Cl

Solution:

The most polar bond will be
(a) Ge – F; (b) P – Cl ; (c) S – F ; (d) Ti – Cl