Dr. Taylor **Chapter 3.7- 4 Homework #2** **Chem 111 Spring 2012**

Quantum numbers and Electron Configurations

1. How many orbitals are there in the shell with n = 3?

2. An electron in a hydrogen atom has the quantum numbers n = 4, l = 1, m_E = 0. In what type of orbital is the electron located?

3. An electron in a hydrogen atom has the quantum numbers n = 4, l = 3, m_E = 0. In what type of orbital is the electron located?

4. How many orbitals are there with l = 2?

5. An electron in an atom has a magnetic quantum number of –2. What is the lowest possible value for the principal quantum number of this electron?

6. Which of the following is a possible set of quantum numbers for a 4d-electron?
   A. n = 4, l = 1, m_l = 0, m_s = ½
   B. n = 4, l = 3, m_l = 2, m_s = ½
   C. n = 4, l = 1, m_l = –1, m_s = – ½
   D. n = 4, l = 2, m_l = 0, m_s = – ½
   E. n = 4, l = 4, m_l = –2, m_s = ½

7. Which of the following is a possible set of quantum numbers for a 4p-electron?
   A) n = 4, l = 2, m_l = –1, ms = – ½
   B) n = 4, l = 2, m_l = 0, ms = ½
   C) n = 4, l = 3, m_l = 2, ms = ½
   D) n = 4, l = 4, m_l = –2, ms = ½
   E) n = 4, l = 1, m_l = 0, ms = – ½

8. Which of the following represents a possible set of quantum numbers for an electron in an atom?
   A) n = 3, l = 0, m_l = 1, m_s = ½
   B) n = 3, l = 0, m_l = 1, m_s = – ½
   C) n = 3, l = 2, m_l = –2, m_s = – ½
   D) n = 3, l = 2, m_l = 0, m_s = 0
   E) n = 3, l = 3, m_l = –1, m_s = – ½

9. Which subshell can hold the greatest number of electrons?
   A. 6p B. 3d C. 4d D. 4f E. 5d

10. For a 6p subshell, what is the most positive value of m_E?
   A. 0 B. +1 C. +6 D. –1 E. +5

11. If the azimuthal quantum number is 3, the type and number of orbitals is

12. What is the orbital diagram for a ground-state nitrogen atom?

13. How many unpaired electrons does a ground-state atom of sulfur have?

14. Which element has $1s^22s^22p^63s^2$ as its ground-state electron configuration?

15. What is the electron configuration of a ground-state copper atom?

16. How many *valence electrons* does a tin (Sn) atom have?

17. How many electrons are in the 4*p* orbitals of selenium?

18. How many electrons are in the 4*d* orbitals of Tc?

19. What is the charge on the monatomic ion that calcium forms in its compounds?

20. Which two electron configurations represent elements that would have similar chemical properties?
   (1) $1s^22s^22p^4$ (2) $1s^22s^22p^5$ (3) $[Ar]4s^23d^{10}4p^3$ (4) $[Ar]4s^23d^{10}4p^4$
   A. (1) and (2) B. (1) and (3) C. (1) and (4) D. (2) and (4) E. (2) and (3)

21. Which of the following make an *isoelectronic pair*: Cl^-, O^{2-}, F, Ca^{2+}, Fe^{3+}?

22. Which one of the following is *not* isoelectronic with Kr?
A. As^{3+} B. Se^{2-} C. Rb^{+} D. Sr^{2+} E. Br^{-}

23. Which of the following is the electron configuration of a sulfide ion?
A. $[Ne]3s^2 3p^4$ B. [Ne] C. $[Ne]3s^2 3p^1$ D. [Ar] E. $[Ne]3s^2 3p^2$

24. Which of the following is the electron configuration of the iron(III) ion?
A. $[Ar]3d^5$ B. $[Ar]4s^1 3d^5$ C. $[Ar]4s^2 3d^3$ D. $[Ar]3d^6$ E. $[Ar]4s^2 3d^9$

25. The electron configuration of a cobalt(III) ion is
A. $[Ar]3d^5$ B. $[Ar]4s^1 3d^5$ C. $[Ar]4s^2 3d^4$ D. $[Ar]3d^6$ E. $[Ar]4s^2 3d^9$

26. Write ground-state electron configurations for the following ions:
a. S^{2-} _____
b. Ca^{2+} _____
c. Cr^{3+} _____
d. Ni^{2+} _____
e. Br^{-} _____

Periodic Trends

1. Which of the atoms listed below has the smallest radius?
A. Al B. P C. Mg D. Na

2. For which of the following reactions is the enthalpy change equal to the second ionization energy of nitrogen?
A. $N^{2+}(g) \rightarrow N^{3+}(g) + e^-$
B. $N^{2+}(g) + e^- \rightarrow N^{+}(g)$
C. $N(g) \rightarrow N^{2+}(g) + 2e^-$
D. $N^{-}(g) + e^- \rightarrow N^{2-}(g)$
E. $N^{+}(g) \rightarrow N^{2+}(g) + e^-$

3. For which of the following reactions is the enthalpy change equal to the third ionization energy of vanadium?
A. $V^{2+}(g) \rightarrow V^{3+}(g) + e^-$
B. $V^{3+}(g) + e^- \rightarrow V^{2+}(g)$
C. $V(g) \rightarrow V^{3+}(g) + 3e^-$
D. $V^{2-}(g) + e^- \rightarrow V^{3-}(g)$
E. $V^{3+}(g) \rightarrow V^{4+}(g) + e^-$

4. Which element will display an unusually large jump in ionization energy values between I_3 and I_4, its third and fourth ionization energies?
A. Na B. Mg C. Al D. Si E. P

5. For silicon atoms, which ionization energy will show an exceptionally large increase over the preceding ionization energy?
A. 2nd B. 3d C. 4th D. 5th E. 6th

6. The successive ionization energies of a certain element are I_1 = 589.5 kJ/mol, I_2 =1145 kJ/mol, I_3= 4900 kJ/mol, I_4 = 6500 kJ/mol, and I_5 = 8100 kJ/mol. This pattern of ionization energies suggests that the unknown element is
A. K B. Si C. As D. Ca E. S

7. The successive ionization energies of a certain element are I_1 = 577.9 kJ/mol, I_2 = 1820 kJ/mol, I_3= 2750 kJ/mol, I_4 = 11,600 kJ/mol, and I_5 = 14,800 kJ/mol. This pattern of ionization energies suggests that the unknown element is
A. K B. Al C. Cl D. Se E. Kr

Answers:
Quantum Numbers and Electron Configurations

1. 9 (1 S, 3p and 5 d)	2. 4p	3. 4f	4. 5
5 3	6. D	7. E	8. C
9. D	10. B	11. 4f, 7	12. ↑↓ ↑↓ (1s, 2s) ↑ ↑ ↑ (2p)
13. 2	14. Mg	15. $[Ar]4s^1 3d^{10}$	16. 4
17. 4	18. 5	19. +2	20. C
21. Cl^- and Ca^{2+}	22. A	23. D	24. A
25. D	26. a. [Ar] b. [Ar]	c. $[Ar]3d^3$ d. $[Ar]3d^8$	e. [Kr]

Periodic Trends 1. B 2. E 3. A 4. C 5. D 6. D 7. B