Chapter 7 Homework

Part A Multiple choice (Select the one that is best in each case. 1 point/question)

A. 1. In which set of elements would all members be expected to have very similar chemical properties?
A) O, S, Se
B) N, O, F
C) Na, Mg, K
D) S, Se, Si
E) Ne, Na, Mg

B 2. The effective nuclear charge of an atom is primarily affected by _____.
A) outer electrons
B) inner electrons
C) nuclear charge
D) electron distribution
E) orbital radial probability

B 3. Atomic radius generally decreases as we move _____.
A) down a group and from right to left across a period
B) up a group and from left to right across a period
C) down a group and from left to right across a period
D) up a group and from right to left across a period
E) down a group; the period position has no effect

E 4. Which of the following correctly represents the third ionization of aluminum?
A) $Al^{2+}(g) + e^- \rightarrow Al^+(g)$
B) $Al(g) \rightarrow Al^+(g) + e^-$
C) $Al^{2-}(g) + e^- \rightarrow Al^{3-}(g)$
D) $Al^{2+}(s) \rightarrow Al^{3+}(s) + e^-$
E) $Al^{2+}(g) \rightarrow Al^{3+}(g) + e^-$

B. 5. Of the following metals, _____ exhibits multiple oxidation states.
A) Al B) V C) Sr D) Rb E) Cs

Consider the following electron configurations to answer the questions 6-8:

Na (i) $1s^2\ 2s^2\ 2p^6\ 3s^1$
Mg (ii) $1s^2\ 2s^2\ 2p^6\ 3s^2$
Al (iii) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^1$
S (iv) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^4$
Cl (v) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5$

A. 6. The electron configuration belonging to the atom with the highest second ionization energy is _____.
A) (i) B) (ii) C) (iii) D) (iv) E) (v)

A. 7. The electron configuration belonging to the atom with the lowest first ionization energy is _____.
A) (i) B) (ii) C) (iii) D) (iv) E) (v)

E. 8. The electron configuration of the atom with the most negative electron affinity is _____.
A) (i) B) (ii) C) (iii) D) (iv) E) (v)

9. The list that correctly indicates the order of metallic character is _____.
A) B > N > C
B) F > Cl > S
C) Si > P > S
D) P > S > Se
E) Na > K > Rb

10. Rank the following in terms of decreasing first ionization energies?
A) Ne > O > N > Be > B
B) Ne > N > O > B > Be
C) Ne > O > N > B > Be
D) Ne > N > O > Be > B
E) B > Be > O > N > Ne

11. Nonmetals can be _____ at room temperature.
A) solid, liquid, or gas
B) solid or liquid
C) solid only
D) liquid only
E) liquid or gas

12. Alkaline earth metals _____.
A) have the smallest atomic radius in a given period
B) form monoanions
C) form basic oxides
D) exist as triatomic molecules
E) form halides with the formula MX

13. The reaction of alkali metals with oxygen produce _____.
A) oxides, peroxides, and superoxides
B) peroxides only
C) superoxides only
D) oxides only
E) none of the above

14. _____ was the first _____ gas to be incorporated into a compound.
A) Xeon, chalcogen
B) Xeon, halogen
C) Chlorine, noble
D) Neon, noble
E) Xeon, noble

15. The ground-state electron configuration of a Pt atom is $[Xe]6s^{1}4f^{14}5d^{9}$. What is the electron configuration of a Pt^{2+} ion?
A) $[Xe]4f^{13}5d^{9}$
B) $[Xe]4f^{14}5d^{8}$
C) $[Xe]6s^{1}4f^{12}5d^{9}$
D) $[Xe]6s^{1}4f^{14}5d^{7}$
E) $[Xe]4f^{12}5d^{10}$

Part B Short questions (10 points)

16. (3 points) Arrange each of the following sets of atoms and ions, in order of decreasing size:

(a) Se, Se^{2-}, Te^{2-}; **(b)** Fe^{2+}, Fe^{3+}, Co^{3+}; **(c)** Sc^{3+}, Ti^{4+}, Ca.

17. (4 points) **(a)** Why is calcium generally more reactive than beryllium? **(b)** Why does carbon atom has more negative electron affinity than nitrogen atom?

18. (3 points) **(a)** What value do you estimate for Z_{eff} experienced by the outermost electron in both Na and K by assuming core electrons contribute 1.00 and valence electrons contribute 0.00 to the screening constant? **(b)** Detailed calculations show that the value of Z_{eff} for the outermost electrons in Na and K atoms is 2.51 + and 3.49 +, respectively. Compare the result of the detailed calculations with the value in part (a) and explain which method is more accurate.

Chapter 7 Homework Answer Sheet

Name: **Student ID:** **Instructor:** **Score:**

Part A Multiple choice (15 points)

1-5 ABBEB

6-10 AAECD

11-15 ACAEB

Part B Short questions (10 points)

16. (3 points) Arrange each of the following sets of atoms and ions, in order of decreasing size:
(a) Se, Se^{2-}, Te^{2-}; **(b)** Fe^{2+}, Fe^{3+}, Co^{3+}; **(c)** Sc^{3+}, Ti^{4+}, Ca.

(a) $Te^{2-} > Se^{2-} > Se$.

(b) $Fe^{2+} > Fe^{3+} > Co^{3+}$.

(c) $Ca > Sc^{3+} > Ti^{4+}$.

17. (4 points) **(a)** Why is calcium generally more reactive than beryllium? **(b)** Why does carbon atom has more negative electron affinity than nitrogen atom?

(a) Reactivity for metals is determined by how easily they lose their valence electrons.

Ca's valence electrons are ① farther from the nucleus

② shielded by more core electrons.

⇒ easier to be removed.

(b) C: $[He]2s^2 2p^2$. — $2p^2$ configuration: readily accepts an electron to achieve more stability: $2p^3$.

N: $[He]2s^2 2p^3$. — $2p^3$ configuration: half-filled. → stable.

18. (3 points) **(a)** What value do you estimate for Z_{eff} experienced by the outermost electron in both Na and K by assuming core electrons contribute 1.00 and valence electrons contribute 0.00 to the screening constant? **(b)** Detailed calculations show that the value of Z_{eff} for the outermost electrons in Na and K atoms is 2.51 + and 3.49 +, respectively. Compare the result of the detailed calculations with the value in part (a) and explain which method is more accurate.

(a) Na: $1s^2 2s^2 2p^6 3s^1$. $Z_{eff} = 11 - 10 \times 1 = 1$

K: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1$. $Z_{eff} = 19 - 18 \times 1 = 1$.

(b) detailed calculations are more accurate.

In reality, shielding is imperfect because the outermost s-orbital penetrates into the region of the core electrons.

This incomplete shielding means the valence electron experiences a greater attraction to the nucleus than the simple model predicts, resulting in a higher, more accurate Z_{eff}.