

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) $\text{Al}^{2+}(\text{g}) + \text{e}^- \rightarrow \text{Al}^+(\text{g})$
B) $\text{Al}(\text{g}) \rightarrow \text{Al}^+(\text{g}) + \text{e}^-$
C) $\text{Al}^{2-}(\text{g}) + \text{e}^- \rightarrow \text{Al}^{3-}(\text{g})$
D) $\text{Al}^{2+}(\text{s}) \rightarrow \text{Al}^{3+}(\text{s}) + \text{e}^-$
E) $\text{Al}^{2+}(\text{g}) \rightarrow \text{Al}^{3+}(\text{g}) + \text{e}^-$
- 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)

Chapter 7 Homework

- C. 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) $Na > K > Rb$
- D. 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) $B > Be > O > N > Ne$
- A. 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
- C. 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
- A. 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
- E. 14. _____ was the first _____ gas to be incorporated into a compound.
A) Xenon, chalcogen
B) Xenon, halogen
C) Chlorine, noble
D) Neon, noble
E) Xenon, noble
- B. 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) $[Xe]4f^{12} 5d^{10}$

Chapter 7 Homework

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

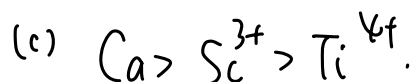
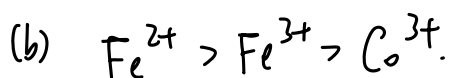
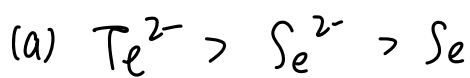
6-10 AAECD

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.



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 further from the nucleus

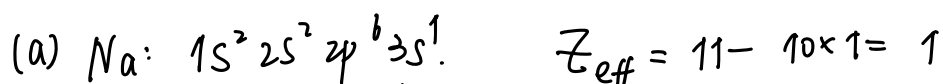
^② shielded by more core electrons.

⇒ easier to be removed.

(b) C: $[\text{He}] 2s^2 2p^2$. — $2p^1$ configuration: readily accepts an electron to achieve more stability: $2p^3$.

N: $[\text{He}] 2s^2 2p^3$. — $2p^1$ configuration: half-filled.
 \downarrow
 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.



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

(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} .