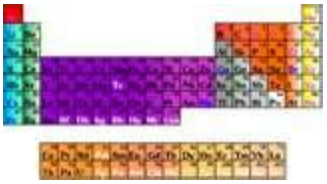

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CHAPTER 5 The Periodic Law

SECTION 1 History of the Periodic Table

OBJECTIVES

1. Explain the roles of Mendeleev and Moseley in the development of the periodic table

2. Describe the modern periodic table.

3. Explain how the periodic law can be used to predict the physical and chemical properties of elements.

4. Describe how the elements belonging to a group of the periodic table are interrelated in terms of atomic elements.

SECTION 2 Electron Configuration and the Periodic Table

OBJECTIVES

1. Describe the relationship between electros in sublevels and the length of each period of the periodic table

2. Locate and name the four blocks of the periodic pable. Explain the reason for these names.

3. Discuss the relationship between group configurations and group numbers.

4. Describe the location in the periodic table and the general properties of the alkali metals, alkaline-earth metals, the halogens, the chalogens,and the noble gases.

SECTION 3 Electron Configuration and Periodic Properties

OBJECTIVES

1. Define atomic and ionic radii, ionization energy, electron affinity, and electronegativity.

2. Compare the periodic trends of atomic radii, ionization energy, and electronegativity, and state the reasons for these variations.

3. Define valence electrons, and state how many are present in atoms of eachmain-group element.

4. Compare the atomic radii, ionization energies, and electronegativities of the d-block elements with those of the main-group elements.

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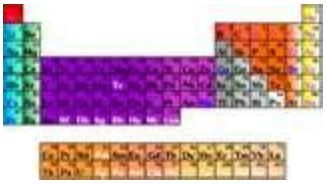

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Vocabulary

The Periodic Law

Sec 5-1 History of the Periodic Table

Periodic law
Periodic table
Lanthanide
actinide

Sec 5-2 Electron Configuration and the Periodic Table

Alkali metals
Alkaline-earth metals
Transition metals
Main-group elements
Chalcogens
Halogens
Noble gases

Sec 5-3 Electron Configurations and Periodic Properties

Atomic radius
Ion
Ionization
Ionization energy
Electron affinity
Cation
Anion
Valence electrons
electronegativity

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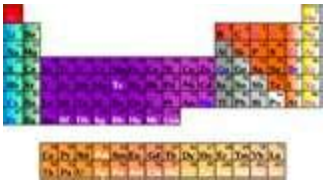

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CHAPTER 5 REVIEW

The Periodic Law

SECTION 1

SHORT ANSWER Answer the following questions in the space provided.

1. _____ In the modern periodic table, elements are ordered
   (a) according to decreasing atomic mass.
   (b) according to Mendeleev's original design.
   (c) according to increasing atomic number.
   (d) based on when they were discovered.

2. _____ Mendeleev noticed that certain similarities in the chemical properties of elements appeared at regular intervals when the elements were arranged in order of increasing
   (a) density.
   (b) reactivity.
   (c) atomic number.
   (d) atomic mass.

3. _____ The modern periodic law states that
   (a) no two electrons with the same spin can be found in the same place in an atom.
   (b) the physical and chemical properties of an element are functions of its atomic number.
   (c) electrons exhibit properties of both particles and waves.
   (d) the chemical properties of elements can be grouped according to periodicity, but physical properties cannot.

4. _____ The discovery of the noble gases changed Mendeleev's periodic table by adding a new
   (a) period.
   (b) series.
   (c) group.
   (d) level.

5. _____ The most distinctive property of the noble gases is that they are
   (a) metallic.
   (b) radioactive.
   (c) metalloid.
   (d) largely unreactive.

6. _____ Lithium, the first element in Group 1, has an atomic number of 3. The second element in this group has an atomic number of
   (a) 4.
   (b) 10.
   (c) 11.
   (d) 18.

7. An isotope of fluorine has a mass number of 19 and an atomic number of 9.
   _____ a. How many protons are in this atom?
   _____ b. How many neutrons are in this atom?
   _____ c. What is the nuclear symbol of this fluorine atom, including its mass number and atomic number?

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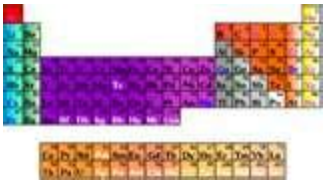

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SECTION 1 continued

8. Samarium, Sm, is a member of the lanthanide series.

   _____ a. Identify the element just below samarium in the periodic table.

   _____ b. By how many units do the atomic numbers of these two elements differ?

9. A certain isotope contains 53 protons, 78 neutrons, and 54 electrons.

   _____ a. What is its atomic number?

   _____ b. What is the mass number of this atom?

   _____ c. What is the name of this element?

   _____ d. Identify two other elements that are in the same group as this element.

10. In a modern periodic table, every element is a member of both a horizontal row and a vertical column. Which one is the group, and which one is the period?

    _____

    _____

11. Explain the distinction between atomic mass and atomic number of an element.

    _____

    _____

    _____

    _____

12. In the periodic table, the atomic number of I is greater than that of Te, but its atomic mass is less. This phenomenon also occurs with other neighboring elements in the periodic table. Name two of these pairs of elements. Refer to the periodic table if necessary.

    _____

    _____

    _____

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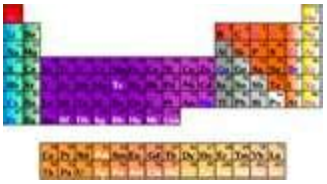

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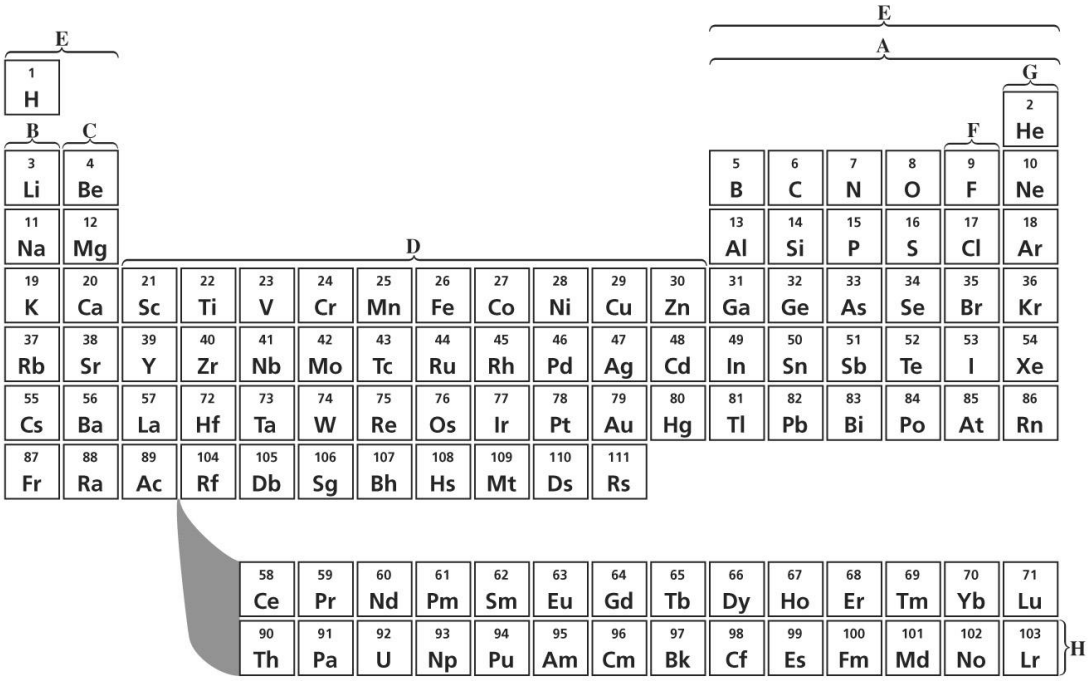
CHAPTER 5 REVIEW

The Periodic Law

SECTION 2

SHORT ANSWER Use this periodic table to answer the following questions in the space provided.



1. Identify the element and write the noble-gas notation for each of the following:

   a. the Group 14 element in Period 4

   _____

   b. the only metal in Group 15

   _____

   c. the transition metal with the smallest atomic mass

   _____

   d. the alkaline-earth metal with the largest atomic number

   _____

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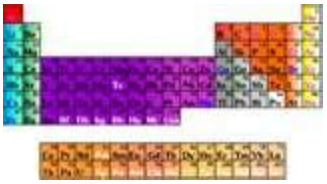

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SECTION 2 continued

2. On the periodic table given, several areas are labeled with letters A–H.

_____ a. Which block does A represent, *s, p, d, or f*?

b. Identify the remaining labeled areas of the table, choosing from the following terms: *main-group elements, transition elements, lanthanides, actinides, alkali metals, alkaline-earth metals, halogens, noble gases*.

_____ B

_____ C

_____ D

_____ E

_____ F

_____ G

_____ H

3. Give the symbol, period, group, and block for the following:

a. sulfur

_____

b. nickel

_____

c. [Kr]$5s^1$

_____

d. [Ar]$3d^5\,4s^1$

_____

4. There are 18 columns in the periodic table; each has a group number. Give the group numbers that make up each of the following blocks:

_____ a. *s* block

_____ b. *p* block

_____ c. *d* block

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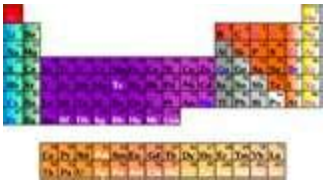

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CHAPTER 5 REVIEW

The Periodic Law

SECTION 3

SHORT ANSWER Answer the following questions in the space provided.

1. _____ When an electron is added to a neutral atom, energy is
   (a) always absorbed. (c) either absorbed or released.
   (b) always released. (d) neither absorbed nor released.

2. _____ The energy required to remove an electron from a neutral atom is the atom's
   (a) electron affinity. (c) electronegativity.
   (b) electron energy. (d) neither absorbed nor released.

3. From left to right across a period on the periodic table,

   _____ a. electron affinity values tend to become more (negative or positive).

   _____ b. ionization energy values tend to (increase or decrease).

   _____ c. atomic radii tend to become (larger or smaller).

4. _____ a.Name the halogen with the least-negative electron affinity.

   _____ b.Name the alkali metal with the highest ionization energy.

   _____ c.Name the element in Period 3 with the smallest atomic radius.

   _____d.Name the Group 14 element with the largest electronegativity.

5. Write the electron configuration of the following:

   a. Na

   _____

   b. Na^+

   _____

   c. O

   _____

   d. O^{2-}

   _____

   e. Co^{2+}

   _____

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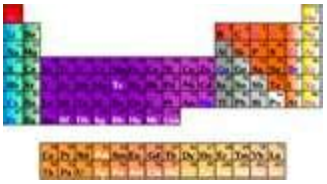

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SECTION 3 continued

6. a. Compare the radius of a positive ion to the radius of its neutral atom.

_____

_____

b. Compare the radius of a negative ion to the radius of its neutral atom.

_____

_____

7. a. Give the approximate positions and blocks where metals and nonmetals are found in the periodic table.

_____

_____

_____

b. Of metals and nonmetals, which tend to form positive ions? Which tend to form negative ions?

_____

_____

8. **Table 3** on page 155 of the text lists successive ionization energies for several elements.

_____ a. Identify the electron that is removed in the first ionization energy of Mg.

_____ b. Identify the electron that is removed in the second ionization energy of Mg.

_____ c. Identify the electron that is removed in the third ionization energy of Mg.

d. Explain why the second ionization energy is higher than the first, the third is higher than the second, and so on.

_____

_____

_____

_____

9. Explain the role of valence electrons in the formation of chemical compounds.

_____

_____

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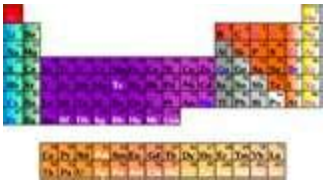

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CHAPTER 5 REVIEW

The Periodic Law

MIXED REVIEW

SHORT ANSWER Answer the following questions in the space provided.

1. Consider the neutral atom with 53 protons and 74 neutrons to answer the following questions.

   _____ a. What is its atomic number?

   _____ b. What is its mass number?

   _____ c. Is the element's position in a modern periodic table determined by its atomic number or by its atomic mass?

2. Consider an element whose outermost electron configuration is $3d^{10}\ 4s^2\ 4p^x$.

   _____ a. To which period does the element belong?

   _____ b. If it is a halogen, what is the value of x?

   _____ c. The group number will equal $(10 + 2 + x)$. True or False?

3. _____ a. In which block are metalloids found, *s, p, d*, or *f*?

   _____ b. In which block are the hardest, densest metals found, *s, p*, or *d*?

4. _____ a. Name the most chemically active halogen.

   _____ b. Write its electron configuration.

   _____ c. Write the configuration of the most stable ion this element makes.

5. Refer only to the periodic table at the top of the review of Section 2 to answer the following questions on periodic trends.

   _____ a. Which has the larger radius, Al or In?

   _____ b. Which has the larger radius, Se or Ca?

   _____ c. Which has a larger radius, Ca or Ca^{2+}?

   _____ d. Which class has greater ionization energies, metals or nonmetals?

   _____ e. Which has the greater ionization energy, As or Cl?

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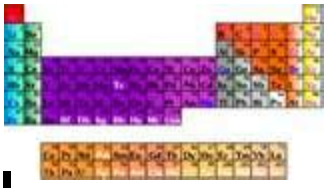

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MIXED REVIEW continued

_____ f. An element with a large negative electron affinity is most likely to form a (positive ion, negative ion, or neutral atom)?

_____ g. In general, which has a stronger electron attraction, a large atom or a small atom?

_____ h. Which has greater electronegativity, O or Se?

_____ i. In the covalent bond between Se and O, to which atom is the electron pair more closely drawn?

_____ j. How many valence electrons are there in a neutral atom of Se?

6. _____ Identify all of the following ions that do not have noble-gas stability. K^+ S^{2-} Ca^+ I^- Al^{3+} Zn^{2+}

7. Use only the periodic table in the review of Section 2 to give the noble-gas notation of the following:

_____ a. Br

_____ b. Br^-

_____ c. the element in Group 13, Period 5

_____ d. the lanthanide with the smallest atomic number

8. Use electron configuration and position in the periodic table to describe the chemical properties of calcium and oxygen.

_____

_____

9. Copper's electron configuration might be predicted to be $3d^9\,4s^2$. But in fact, its configuration is $3d^{10}\,4s^1$. The two elements below copper in Group 11 behave similarly. (Confirm this in the periodic table in **Figure 6** on pages 140–141 of the text.)

_____ a. Which configuration for copper is apparently more stable?

_____ b. Is the *d* sublevel completed in the atoms of these three elements?

_____ c. Every element in Period 4 has four levels of electrons established. True or False?

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