

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Per#: \_\_\_\_\_

## Periodicity Topic#6

### WS#1: Groups of Elements (Internet Research)

#### Reactive Metals: The s-block Elements

- Which of the following metals is not an alkali metal? (a) sodium (b) potassium (c) iron (d) francium
- Alkali metals must be stored under oil because of their extreme  
(a) radioactivity (b) reactivity (c) softness (d) brilliance
- The only alkali metal to be produced commercially in large amounts is  
(a) cesium (b) potassium (c) lithium (d) sodium
- The alkaline earth metals are not as reactive as the alkali metals because (a) they have higher mp (b) they are not soft (c) they have higher ionization energies (d) they oxidize too easily
- Which of the following alkaline earth metals is radioactive? (a) radium (b) beryllium (c) magnesium (d) strontium
- Magnesium is produced commercially by (a) recovering it from sea water and mineral deposits. (b) decomposing limestone. (c) mining the metal in its elemental state. (d) burning magnesium compounds and recovering the metal from the ashes.
- Calcium carbonate ( $\text{CaCO}_3$ ) forms the \_\_\_\_\_ of marine animals, such as oysters.
- Magnesium reacts with \_\_\_\_\_, which makes magnesium fires very hard to fight.
- The alkali metals are malleable, ductile, and good conductors of \_\_\_\_\_ and \_\_\_\_\_.
- The most reactive metals are found in the \_\_\_\_\_-block of the periodic table.
- Alkali metals cannot be used as structural metals because they are \_\_\_\_\_ elements.
- The name alkali comes from an Arabic word that means \_\_\_\_\_.
- Crystals containing the alkaline earth metal, \_\_\_\_\_, give emeralds their green color.
- Because the alkali metals are very reactive, they are \_\_\_\_\_ found as pure metals in nature.
- Why is beryllium a better choice than iron to use in an alloy for making airplanes?
- How did the alkaline earth metals get their name?

#### Transition Metals: The d-block Elements

T or F. Substitute a word or words to make it true.

- Transition elements play an important role in living organisms.
- Most transition metals have high densities and low melting points.
- Copper is a hard, silvery metal whose ions exhibit a variety of different colors.
- Because it is so strong, iron has been used by people for thousands of years.
- Hemoglobin contains the element cobalt.
- Copper, platinum, and gold are called the coinage metals.
- The alloy brass is made of copper and tin.
- The major use of copper is in making coins.
- Sterling silver is an alloy of silver and copper.
- A piece of 18-karat jewelry contains 100 percent gold.

For questions 11-20, write the letter of the element that matches each description. Some may be used only once, more than once, or not at all.

a. gold      b. mercury      c. zirconium      d. cobalt      e. iron      f. chromium

- soft metal used in jewelry
- coinage metal
- found in vitamin B<sub>12</sub>
- a compound of hemoglobin
- used to plate automobile grills
- used for coloring in paint pigments
- fourth most abundant element in the Earth's crust
- least expensive of all metals
- best known alloy is stainless steel
- alloyed with small amounts of C to form steel
- What properties of chromium make it ideal as a protective coating over other metals?
- Define the term alloy. Name several important alloys and the metals from which they are made.
- Why are gold alloys more commonly used for jewelry than pure gold?
- Why is iron such a significant metal? What is one of the disadvantages of iron?

#### The Inner Transition Metals: The f-block Elements

Multiple Choice

- All isotopes of the actinides series are (a) radioactive (b) nonmetals (c) unreactive in air (d) commonly used in jewelry.
- The elements of the \_\_\_\_\_-series are called lanthanides after the element lanthanum. (a) 5f (b) 6f (c) 4f (d) 3f

43. The lanthanides are very similar to one another because (a) they are hard, dull metals (b) they all lose  $3e^-$  to form +3 ions (c) they are very reactive with water (d) they are all used as structural metals.
44. The lanthanides are difficult to separate from one another because (a) they occur together in nature (b) they have differing number of electrons in their outer orbital (c) their electron configurations are not regular across the series (d) they are widely distributed in nature.
45. The only actinides that occur to any extent in nature are (a) fermium & plutonium (b) uranium & neptunium (c) actinium & thorium (d) thorium & uranium
46. All the elements after \_\_\_\_\_ are artificial elements. (a) thorium (b) lawrencium (c) uranium (d) plutonium

Short Answer

47. What are the primary commercial uses of the lanthanides? Why are they rather unfamiliar?
48. Why is there a conflict over the placement of the *f*-block elements in the periodic table?
49. How do the properties of the lanthanide metals compare to those of the alkaline earth metals?

#### From Metals to Nonmetals: The *p*-block Elements

T/F. Substitute word/words to make it true.

50. Aluminum does not corrode in air because a layer of aluminum oxide forms on its surface.
51. More than 40 billion kilograms of hydrogen sulfide is produced annually and used in almost all manufacturing processes.
52. Carbon monoxide is produced when hydrocarbons are burned in plentiful supply of oxygen.
53. Boron is a major component of fossil fuels.
54. Hydrocarbons are the structural materials of most rocks.
55. Germanium is a major component of glass.
56. Nitrogen makes up approximately 80 percent of the Earth's atmosphere.

Multiple Choice

57. Oxygen combines with most elements to form compounds called (a) ozones (b) oxides (c) oxidation (d) carbonates
58. The largest use of sulfur is the production of (a) sulfides (b) sulfates (c) sulfuric acid (d) sulfonates
59. All of the halogens exist in elemental form as \_\_\_\_\_ molecules (a) monatomic (b) diatomic (c) triatomic (d) ionic
60. The most reactive element is (a) bromine (b) iodine (c) fluorine (d) chlorine
61. Natural gas wells are a major source of today's (a) helium (b) hydrogen (c) argon (d) xenon
62. The most industrially useful halogen, which is used to disinfect drinking water, is (a) F (b) Cl (c) Br (d) I
63. There are no known compounds of (a) xenon (b) krypton (c) helium, neon, & argon (d) any of the noble gases
64. The formation of N compounds from  $N_2$  gas are called (a) nitrogen (b) purification (c) oxidation (d) nitrogen fixation.

Short Answer

65. Why is carbon considered "unique" among the elements?
66. Compare the two forms of elemental oxygen (allotropes of oxygen).

#### Hydrogen: One of a Kind

67. Hydrogen is placed at the top of Group \_\_\_\_ column of elements.
68. Hydrogen has \_\_\_\_\_ valence electron(s).
69. Hydrogen exists as a \_\_\_\_\_ under normal conditions.
70. Most of the Earth's hydrogen is combined with oxygen as \_\_\_\_\_.
71. Organic compounds frequently contain hydrogen bonded with \_\_\_\_\_.
72. In terms of mass, hydrogen is the \_\_\_\_\_ most abundant element on Earth.
73. \_\_\_\_\_ is the most abundant element in the universe.
74. Why is hydrogen so rare in the atmosphere?
75. Identify the process where hydrogen is obtained from water?

### **WS#2: History of the Periodic Table**

Write the letter of the contribution that each chemist made to the periodic table. Each letter will be used only once.

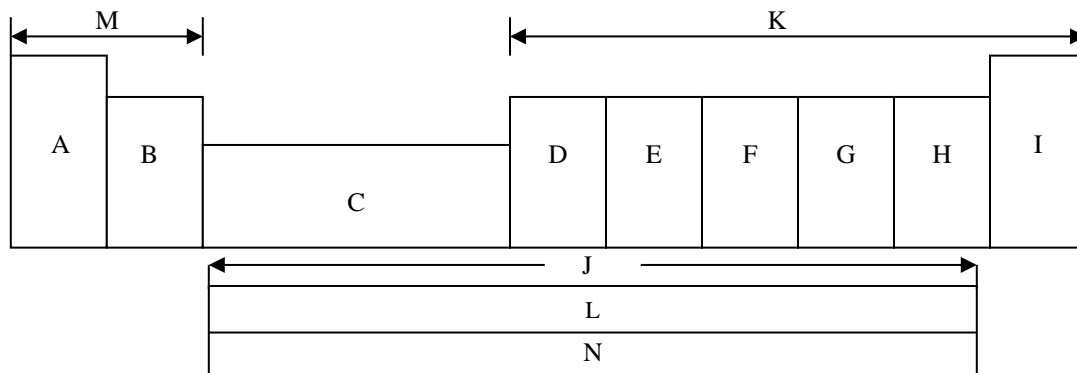
1. In the modern periodic table, elements are ordered
  - a. according to decreasing atomic mass.
  - b. according to Mendeleev's original designs.
  - c. according to increasing atomic number.
  - d. based on when they were discovered.
2. Mendeleev noticed that certain similarities in the chemical properties 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 particle and wave.
  - d. the chemical properties of an element can be grouped according to periodicity, but physical properties cannot.
4. The discovery of the noble gases changed Mendeleev's periodic table by adding s 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?
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 the 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.
13. In Mendeleev's periodic table, he was faced with several empty spaces. These empty spaces led him to predict what?
14. Identify the three elements Mendeleev predicted would fill the empty spaces in his periodic table.
15. What property of an element is used for the basis of the modern periodic table? Who organized the periodic table using this method?

### WS#3: Electron Configuration and the Periodic Table

Identify the parts of the periodic table using the lettered areas. Some letters will be used more than once.

- |                             |  |                              |
|-----------------------------|--|------------------------------|
| 1. carbon family            | 8. <i>f</i> -block elements            | 14. <i>s</i> -block elements |
| 2. halogens                 | 9. nitrogen family                     | 15. all are radioactive      |
| 3. alkali metals            | 10. group of 1 semi-metal and 4 metals | 16. main group elements      |
| 4. <i>p</i> -block elements | 11. inner transition metals            | 17. lanthanides              |
| 5. transition metals        | 12. oxygen group                       | 18. actinides                |
| 6. alkaline earth metals    | 13. noble gases                        |                              |
| 7. <i>d</i> -block elements |  |                              |



Identify the parts of the noble-gas electron configuration.

- $[\text{Ne}] 3s^1$
16. \_\_\_\_\_
  17. \_\_\_\_\_
  18. \_\_\_\_\_
  19. \_\_\_\_\_
  20. Identify the element. \_\_\_\_\_

Identify each of the following elements as a metal (M), nonmetal (NM), or semi-metal (SM).

21. sodium                      22. silicon                      23. neon                      24. calcium                      25. nitrogen

Write the family names that have been given to each of the following groups.

26. Group 1                      27. Group 2                      28. Group 17                      29. Group 18

30. What information is contained in each of the 109 squares on the periodic table?

31. What properties distinguish metals from nonmetals?

32. What is an electron configuration, and what does it tell you about an element?

33. Identify the element and write the noble-gas electron configuration for each of the following:

- a. The Group 14 element in Period 4.                      c. The alkaline-earth metal with the largest atomic number.  
b. The only metal in Group 15.

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

- a. sulfur                      b. nickel                      c.  $[\text{Kr}]5s^1$                       d.  $[\text{Ar}]3d^54s^1$

35. 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

#### WS#4: Periodic Trends

Each of the following questions deals with the trend of atomic radius, ionic radius, or ionization energy. Answer each question accordingly.

- The ionization energies of the alkali metals \_\_\_\_\_ as you go down the family.
- Why does sodium have a higher ionization energy than cesium?
- Why do alkali metals have lower ionization energies than the alkaline earth metals?
- What is the valence electron configuration for hydrogen? For the alkali metals? Why is hydrogen's ionization energy different from the alkali metals ionization energy?
- Chlorine, selenium, and bromine are located near each other on the periodic table. Which of these elements is:
  - the smallest atom?
  - the atom with the highest ionization energy?
- Phosphorus, sulfur, and selenium are near each other on the periodic table. Which of these elements is:
  - the largest atom?
  - the atom with the highest ionization energy?
- Scandium, yttrium, and lanthanum are located near each other in the periodic table. Which of these elements is:
  - the largest atom?
  - the atom with the smallest ionization energy?
- Which of the following atoms is smallest: vanadium, chromium, or tungsten? Which of these atoms has the highest ionization energy?
- Which of the following atoms is smallest: nitrogen, phosphorus, or arsenic? Which of these atoms has the smallest ionization energy?
- Which of the following is the largest: a potassium atom, a potassium ion with a +1 charge, or a magnesium ion with a +2 charge? Smallest?
- Which of the following is the largest: a chlorine atom, a chlorine ion with a -1 charge, or argon atom? Smallest?
- Which of the following is the smallest: a lithium atom, a lithium ion with a +1 charge, or a beryllium atom?
- Which of the following is the largest: a tellurium ion with a -2 charge, an iodine ion with a -1 charge, or a xenon atom?
- Aluminum, silicon, and phosphorus are located near each other on the periodic table. Which of these elements is:
  - the largest atom?
  - the atom with the highest ionization energy?
- Which atom in each pair has the larger atomic radius?
  - Li or K
  - Ca or Ni
  - Ga or B
  - O or C
  - Cl or Br
  - Be or Ba
  - Si or S
  - Fe or Au
- Which ion in each pair has the smaller ionic radius?
  - $\text{K}^+$  or  $\text{O}^{2-}$
  - $\text{Ba}^{2+}$  or  $\text{I}^-$
  - $\text{Al}^{3+}$  or  $\text{P}^{3-}$
  - $\text{K}^+$  or  $\text{Cs}^+$
  - $\text{Fe}^{2+}$  or  $\text{Fe}^{3+}$
  - $\text{F}^-$  or  $\text{S}^{2-}$
- Which atom or ion in each pair has the larger ionization energy?
  - Na or O
  - Be or Ba
  - Ar or F
  - Cu or Ra
  - I or Ne
  - K or V
  - Ca or Fr
  - W or Se
- Write the charge that each of the following atoms will acquire when it has a complete set of valence electrons.
  - O
  - Na
  - F
  - N
  - Ca
  - Ar
- Define *atomic radius*.
- Why do atoms get smaller as you move across a period?
- Explain the relationship between the relative size of an ion to its atom and the charge on the ion.
- Contrast ionization energy and electron affinity. In general, what can you say about these values for metals and nonmetals?
- Why is there such a large jump in ionization energy between the second and third ionization energies for magnesium?
- Explain why noble gases are inert and do not form ions.
- Define the term electronegativity. What is the periodic trend for electronegativity?

## WS#5: Valence Electrons/Electron Dot Diagrams

**Example:** carbon (C),  $ns^xnp^y$  configuration,  $2s^22p^2$ , valence electron number, 4 val  $e^-$ , electron dot diagram,  $:C:$ , forms  $C^{4+}$ , carbon(IV) ion, by losing  $4e^-$  or  $C^{4-}$  (carbide), by gaining  $4e^-$

Determine the number of valence electrons in the atoms below by drawing the valence electron configuration,  $ns^xnp^y$ , and the electron dot diagram. Next, determine the number of electrons the atom will lose or gain to form an ion. Explain why the ion forms by stating whether the atom loses or gains electrons, and how many it loses or gains. Write the chemical symbol for the ion that is formed.

- |                |             |              |               |
|----------------|-------------|--------------|---------------|
| 1. fluorine    | 5. sodium   | 9. iodine    | 13. potassium |
| 2. phosphorous | 6. argon    | 10. aluminum | 14. helium    |
| 3. calcium     | 7. lithium  | 11. oxygen   | 15. magnesium |
| 4. nitrogen    | 8. chlorine | 12. hydrogen | 16. sulfur    |

## WS#6: Review Worksheet

- Explain how Mendeleev developed the periodic table.
- Explain the term periodicity. How does the term apply to chemistry?
- Elements in the same row on the periodic table are said to be in the same \_\_\_\_\_.
- Noble gases are very stable. Therefore, they are usually \_\_\_\_\_.
- As stated by \_\_\_\_\_, elements with similar properties appear at regular intervals when they are arranged in order of increasing atomic number.
- The periodic table is arranged so that \_\_\_\_\_.
- An element's electron configuration can show you \_\_\_\_\_.

Complete the following chart.

Element	Symbol	Atomic #	Atomic Mass	Noble Gas Electron Configuration
8.	Ca			
9.		73		
10.				$[Ar]3d^64s^2$
11.	Na			
12.				$1s^2$
13.	Zn			
14.		50		
15.	Au			

### Matching

- |                      |     |                         |             |     |                    |
|----------------------|-----|-------------------------|-------------|-----|--------------------|
| 16. s-block          | ___ | a. period               | 20. row     | ___ | e. alkali metal    |
| 17. lithium & sodium | ___ | b. hydrogen             | 21. thorium | ___ | f. reactive metals |
| 18. radium & barium  | ___ | c. alkaline-earth metal | 22. cerium  | ___ | g. actinide        |
| 19. $1s^1$           | ___ | d. lanthanide           |             |     |                    |

Give the group, period, and block for the following electron configurations. Do not use the periodic table.

	Group	Period	Block		Group	Period	Block
23. $[Rn]7s^2$				26. $[Ne]3s^23p^6$			
24. $[Ar]3d^{10}4s^24p^3$				27. $[Xe]6s^1$			
25. $[Kr]4d^{10}5s^25p^5$				28. $[Ar]3d^{10}4s^2$			

Write T/F for each statement. If false, alter the statement to make it true.

- The halogens are less reactive than metalloids. \_\_\_\_\_
- The metalloids are in the  $p$  – block of the periodic table. \_\_\_\_\_
- Mercury, tungsten, and vanadium are alkali metals. \_\_\_\_\_
- Transition metals are generally unable to conduct electricity. \_\_\_\_\_
- Elements in the  $d$  – block do not always have the same outer electron configurations. \_\_\_\_\_
- All of the actinides have been found naturally on Earth. \_\_\_\_\_

Complete the following chart

Noble Gas Configuration	Block	Period	Group/Type	Element
35. $[Xe]4f^{14}5d^{10}6s^26p^6$				
36.		6	1/alkali	
37. $[Ar]3d^54s^1$				
38. $[He]2s^2$				
39.		5	11/transition metal	
40.				fluorine

Complete each sentence.

41. Atomic radius is \_\_\_\_\_.
42. The trend to smaller atoms across a period is caused by \_\_\_\_\_.
43. In general, the atomic radii of the main-group elements \_\_\_\_\_ down a group.
44. The atomic radii of group 3 elements are generally \_\_\_\_\_ than the atomic radii of group 6 elements.
45. The atomic radii of period 2 elements are generally \_\_\_\_\_ than the atomic radii of period 6 elements.
46. For each group of elements, choose the one with the smallest atomic radius
  - a. Na, Li, K, Fr
  - b. Tc, Rh, Zr, Y
  - c. Hf, Cs, Pb, Pt
47. For each group of elements, choose the one with the largest atomic radius.
  - a. He, Rn, Xe, Ar
  - b. As, N, P, Bi
  - c. Ba, Hf, Os, Hg
48. Put each group in order from smallest to largest atomic radius.
  - a. Mg, Sr, Be, Ra
  - b. I, Sr, Y, Cd
  - c. Fe, V, Ca, Ni
49. For each group of elements, choose the element that has the highest first ionization energy.
  - a. Xe, Rn, Kr, Ar
  - b. Co, Fe, Zn, K
  - c. Er, Dy, Sm, Gd
  - d. K, Li, Rb, Cs
50. Arrange each group of elements in order of increasing first ionization energies.
  - a. F, Br, I, Cl
  - b. Ga, Al, Tl, B
  - c. Tc, Nb, Ag, Sb
  - d. Al, Si, Cl, S

Complete each sentence.

51. In general, ionization energies of the main-group elements \_\_\_\_\_ across each period.
52. Among the main-group elements, ionization energies generally \_\_\_\_\_ down each group.
53. The measure of the ability of an atom in a chemical compound to attract electrons is called \_\_\_\_\_.
54. In general, this ability to attract electrons \_\_\_\_\_ across each period.
55. Many noble gases cannot be assigned these values because \_\_\_\_\_.
56. Valence electrons are electrons in an atom that \_\_\_\_\_.

Complete the following chart.

Element	Group #	e <sup>-</sup> configuration	# of valence e <sup>-</sup>
57.		[Ne]3s <sup>1</sup>	
58. Pb			
59. Ar			
60.		[Kr]5s <sup>2</sup>	
61. O			
62.		[Ne]3s <sup>2</sup> 3p <sup>1</sup>	
63. I			7

Graphic organizer

64. These two boxes are representations of the periodic table of elements. Look at the way the arrows are pointing in the two boxes. On a separate sheet of paper, list the trends that are represented by each of the arrows, such as *increasing atomic radius*, *increasing ionic radii*, *increasing ionization energy*, *increasing electronegativity*, *increasing electron affinity*, and *metallic character*.

