

1. Determine the number of valence electrons and draw the Lewis electron dot structure for:  
 a. sulfur (6)                      b. calcium (2)      c. chlorine (7)                      d. arsenic (5)

2. List, by number, both the period and group of each of these elements.

<u>Element</u>	<u>Period</u>	<u>Group</u>
a. beryllium Be	2	2
b. iron Fe	4	8
c. lead Pb	6	14

3. Would you expect strontium to be, chemically, more similar to calcium or rubidium and WHY? **More similar to calcium; same number of valence electrons**
4. Where, generally, are the metals located on the periodic table? **Left of staircase**
5. Where, generally, are the nonmetals located on the periodic table? **Right of staircase**
6. What are the Group 1 elements called? **Alkali metals**
7. What are the Group 2 elements called? **Alkaline earth metals**
8. What are the Group 17 elements called? **halogens**
9. What are the Group 18 elements called? **Noble gases**
10. What do we mean by the “atomic radius?” **The size of a neutral atom**
11. Within a group, what happens to the atomic radius as you go down the column? Why does this occur? **Atomic radius increases because you are adding an extra energy level (electron shell).**
12. Within a period, what happens to the atomic radius as the atomic number increases? Why does this occur? **The elements are in the same period so the number of energy levels (shells) stays the same, but you are gaining a proton in the nucleus. The effective nuclear charge increases – the protons in the nucleus have more pull and pulls the electrons closer to the nucleus, decreasing the radius**
13. What is meant by the phrase “increasing nuclear charge”? How is this related to atomic radius? **Adding more protons to the nucleus allows the nucleus to have more pull and attracts the electrons in the outer most shell, which are pulled closer to the nucleus.**

14. Metals usually form what type of ions? **Cations (positively charged ions)**      Nonmetals usually form what type of ions? **anions (negatively charged ions)**
15. What is ionization energy? **energy required to remove an electron**
16. What do we mean by the first, second, and third ionization energies for a particular atom?  
**1st ionization energy = energy required to remove 1st electron; 2nd ionization energy = energy required to remove 2nd electron; and 3rd ionization energy = energy required to remove 3rd electron**
17. Why does each successive ionization require more energy than the previous one? **The nuclear charge remains the same, but you are losing an electron; therefore, the nucleus has a stronger hold on the fewer remaining electrons in the outer shell.**
18. What is the general trend of ionization energy as you go from left to right across the periodic table? Why does this occur? **increases; effective nuclear charge increases going across a period, so the nucleus has a stronger hold on the valence electrons and more energy is required to take them away (elements on the right are closer to obtaining a full valence shell and don't want to lose electrons)**
19. What is the general trend of ionization energy as you go down a group on the periodic table? Why does this occur? **decreases; elements further down a group are larger; the valence electron is located further away from the nucleus, making it easier to remove.**
20. Which of these elements has the highest first ionization energy: Sn, As, or S?
21. What is electronegativity? **The tendency for an atom to attract electrons to itself**
22. What is the general trend of electronegativity within a group? Why does this occur?  
**Decreases; elements further down a group are larger; nucleus is located further away from the valence shell; harder to attract an electron to itself.**
23. What is the general trend of electronegativity within a period? Why does this occur?  
**Increases; effective nuclear charge increases going across a period, so the nucleus is more able to attract an electron (elements on the right are closer to obtaining a full valence shell so have a higher desire to gain an electron to fill their valence shell)**
24. List the following atoms in order of increasing electronegativity: O, Al, Ca;      **Ca, Al, O**
25. List the following atoms in order of decreasing electronegativity: Cl, K, Cu;      **Cl, Cu, K**
26. What is the shielding effect? How is it related to ionization energy and electronegativity?  
**The core electrons shield the valence electrons from the attractive forces of the nucleus.**

27. When an atom becomes an anion, what happens to its radius? Why? **Increases; the number of protons remain the same but you are gaining an electron, so the nucleus has a weaker hold on the increased number of electrons.**

When an atom becomes a cation, what happens to its radius? Why? **decreases; the number of protons remain the same but you are losing an electron, so the nucleus has a stronger hold on the decreased number of electrons.**

28. For each of the following pairs, circle the atom or ion having the larger radius.

a. **S** or O                      c.  $\text{Na}^{1+}$  or  **$\text{K}^{1+}$**                       e.  $\text{S}^{2-}$  or  $\text{O}^{2-}$

b. **Ca** or  $\text{Ca}^{2+}$                       d. Na or **K**                      f. F or  **$\text{F}^{1-}$**

29. For each of the following pairs, identify the smaller ion.

a.  $\text{K}^{1+}$  or  **$\text{Ca}^{2+}$**                       c.  $\text{C}^{4+}$  or  $\text{C}^{4-}$                       e.  $\text{O}^{2-}$  or  **$\text{F}^{1-}$**

b.  **$\text{F}^{1-}$**  or  $\text{Cl}^{1-}$                       d.  $\text{S}^{2-}$  or  **$\text{F}^{1-}$**                       f.  **$\text{Fe}^{2+}$**  or  $\text{Fe}^{3+}$

30. What is the general trend of reactivity for metals within a group and a period? Why? **Reactivity increases as you go down a group, because the outer most electrons are easier to remove. Reactivity decreases as you go across a period because the electrons are closer to the nucleus and are not as easy to remove. (Reactivity is related to the ionization energy of the metal)**

31. What is the general trend of reactivity for non-metals within a group and a period? Why? **Reactivity decreases as you go down a group, because there are more shells making it harder for the nucleus to pull electrons closer to the nucleus. Reactivity increases as you go across a period because electrons are being pulled closer to the nucleus and makes it easier to gain an electron (Reactivity is related to the electronegativity of the nonmetal)**

32. Why are the trends for metals and non-metals opposites? **Atoms want to have a full valence shell, therefore, they must either gain or lose electron(s) to fulfill the octet rule. Metals generally lose electrons because it is easier to achieve an octet, while non-metals generally gain electrons because it is easier to achieve an octet.**

### Multiple Choice Practice

- In the modern Periodic Table, the elements are arranged according to
  - atomic number**
  - mass number
  - oxidation number
  - atomic mass
- On the Periodic Table, an element classified as a semimetal (metalloid) can be found in
  - Period 6, Group 15
  - Period 4, Group 15**
  - Period 3, Group 16
  - Period 2, Group 14

3. An atom of an element contains 20 protons, 20 neutrons, and 20 electrons.  
This element is  
**A. an alkaline earth metal**  
B. a halogen  
C. an alkali metal  
D. a noble gas
4. The properties of silicon are characteristic of  
A. a nonmetal, only  
B. a metal, only  
C. neither a metal nor a nonmetal  
**D. both a metal and a nonmetal**
5. The element in Period 2 with the largest atomic radius is  
A. an alkaline earth metal  
B. a halogen  
C. a noble gas  
**D. an alkali metal**
6. What are two properties of most nonmetals?  
**A. high ionization energy and poor electrical conductivity**  
B. high ionization energy and good electrical conductivity  
C. low ionization energy and poor electrical conductivity  
D. low ionization energy and good electrical conductivity
7. As the Group 1 elements of the Periodic Table are considered from top to bottom, the first ionization energy of each successive element decreases. One reason for this is that the  
A. nuclear charge is decreasing  
B. number of principal energy levels is decreasing  
C. number of neutrons is increasing  
**D. distance between the valence electron and the nucleus is increasing**
8. Compared to atoms of metals, atoms of nonmetals generally have  
A. lower electronegativities and higher ionization energies  
B. higher electronegativities and lower ionization energies  
C. lower electronegativities and lower ionization energies  
**D. higher electronegativities and higher ionization energies**
9. Which halogen has the least attraction for electrons?  
A. Br  
**B. I**  
C. F  
D. Cl
10. Which two elements have chemical properties that are most similar?  
A. C and N  
**B. Li and Na**  
C. Cl and Ar  
D. K and Ca
11. Which element is considered malleable?  
A. sulfur  
B. radon  
C. hydrogen  
**D. gold**
12. In the Periodic Table of the Elements, all the elements within Group 16 have the same number of  
A. protons  
B. neutrons  
C. energy levels  
**D. valence electrons**

