ChemQuest 14

Lewis Dot Structures

Name: __________________________ Date: __________________________ Hour: ______

Information: Valence Electrons

The electrons in the highest energy level are called valence electrons. Valence electrons are the electrons located farthest from the nucleus. Valence electrons are always in the highest energy level. The valence electrons are the most important electrons in an atom because they are the electrons that are the most involved in chemical reactions and bonding.

The electron configuration for thallium (Tl) is:
1s²2s²2p⁶3s²3p⁶4s²3d¹⁰⁵p⁶⁶s²⁶p⁶⁶p⁶¹⁴⁵d¹⁰⁶p³
The outermost energy level (not sublevel) is the 6th energy level. How many total electrons does thallium have in the sixth level? 3, they are in boldfaced type above. Therefore, thallium has 3 valence electrons.

Critical Thinking Questions

1. Write the electron configurations for
   a) oxygen:
   b) sulfur:
2. How many valence electrons does oxygen have?
3. How many valence electrons does sulfur have?
4. Verify that selenium (atomic number = 34) has six valence electrons by drawing an electron configuration and giving a brief explanation.

Information: Bohr Diagrams

Below are seven “Bohr diagrams” for atoms #3-9.

FIGURE 1:

Critical Thinking Questions

5. In each of the Bohr diagrams in Figure 1, the first energy level only has two electrons drawn in it. Why is this?
6. What is the maximum number of electrons that the second energy level can have? How many electrons can the 3rd energy level have?
7. Draw Bohr diagrams for the following atoms.
   a) magnesium   b) phosphorus   c) argon

Information: Electron Dot Diagrams

Below are electron dot diagrams, also known as “Lewis Structures” for atoms #3-10.

FIGURE 2:

Li: Be: B: C: N: O: F:

The position of the dots is important. For example, another atom that has three dots in its Lewis structure is aluminum. Aluminum’s three dots must be positioned the same way as boron’s. Thus, aluminum’s Lewis structure is:

FIGURE 3:

Critical Thinking Questions

8. What relationship exists between an atom’s valence electrons and the number of dots in the Lewis structure of the atom?
9. Why does nitrogen’s Lewis Structure has five dots around it while nitrogen’s Bohr diagram contains 7 dots around it.
10. Recall from questions 1-4 that oxygen, sulfur and selenium all have the same number of valence electrons (6). They also are in the same column of the periodic table. Predict how many valence electrons tellurium (Te) will have.

11. Comparing Figure 2 and Figure 3 we see that boron and aluminum have the same number of dots in their Lewis structures. Notice they are in the same column of the periodic table. Write the Lewis structure for gallium (Ga).

12. Write the Lewis structure for sulfur and selenium. Compare the structures you write with oxygen’s Lewis structure from Figure 2.
   a) Sulfur  
   b) Selenium

13. In question seven, you drew the Bohr diagram for magnesium. Now write the Lewis Structure for magnesium. What similarities exist between the Lewis Structures for magnesium and beryllium?

14. Complete this statement: If elements are in the same column of the periodic table, they must have Lewis Structures that are ____________.

15. Why does sodium have the same Lewis structure as lithium?

16. Lewis structures are easier to draw than Bohr diagrams, but what information is lost by drawing a Lewis structure instead of a Bohr Diagram?

17. Draw the Lewis structure for the following elements.
   a) germanium  
   b) bromine  
   c) xenon  
   d) potassium  
   e) arsenic

18. You should be able to tell how many valence electrons an atom has by which column of the periodic table the element is in. How many valence electrons are in each of the following atoms?
   a) bromine  
   b) tin  
   c) krypton  
   d) rubidium