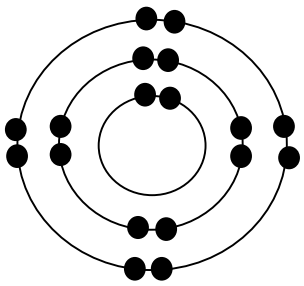
Problems:

1. What is the mass of this atom: ^{39}K ? 39 What is its atomic number ? 19 How many protons does an atom of this element (potassium) have? 19 How many neutrons? 20 How many electrons ? 19

2. The ions, Cl^{-}, K^{+}, and Ca^{++}, all have the same number of electrons a neutral atom of what element ? (Hint: Draw electron shell diagrams for each of these ions)

   A neutral atom of Cl would have 17 electrons; the ion Cl– has one extra electron or a total of 18 (2 in first shell, 8 in second and8 in third). A neutral atom of K would have 19 electrons; the ion K+ has lost an electron and thus also has a total of 18 electrons. A neutral atom of Ca has 20 electrons but Ca ++ has given up **two** electrons, again leaving a total of 18.

   We are looking for a **neutral atom** that also has 18 electrons just like Cl-, K+ and Ca++. In order to be neutral, such an atom would have to have 18 protons (and thus an atomic number of 18). That description applies only to the noble gas, Ar (Argon). All four of these atoms would have the electron configuration shown below.

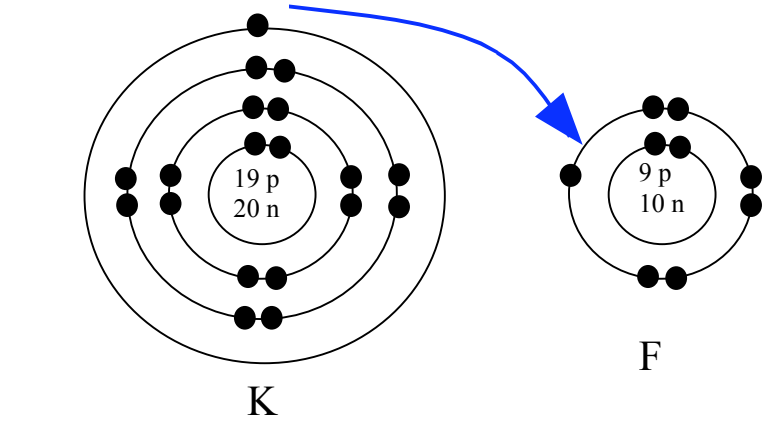


   Given that all four of these atoms have the same electron number and arrangement, why is one an atom of chlorine (Cl), one an atom of potassium (K), one an atom of calcium (Ca) and one an atom of argon (Ar)? [Answer : They may have the same number of electrons but they still differ in their proton numbers, and it is the proton number that defines the **element**].

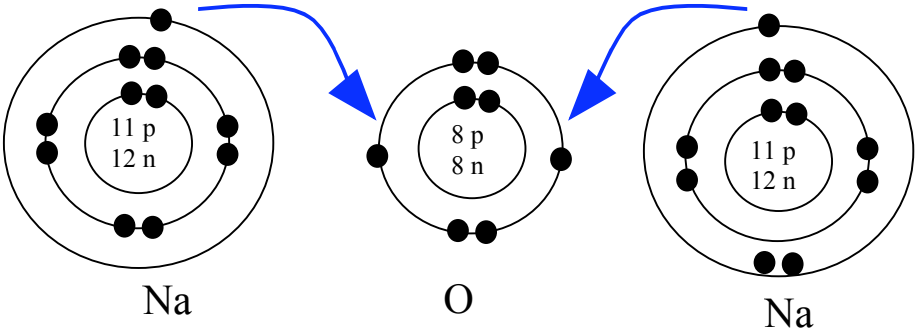
3. Identify the element with atomic number of 20. That can only be calcium (Ca).

4. Identify the element with atomic mass of 23. Elements are not defined by their atomic mass. While atoms of sodium (Na) may *commonly* have a mass of 23, it is possible to find atoms of Na with a mass of 22 or 24. Similarly it would be possible to have an atom of Mg with a mass of 23.

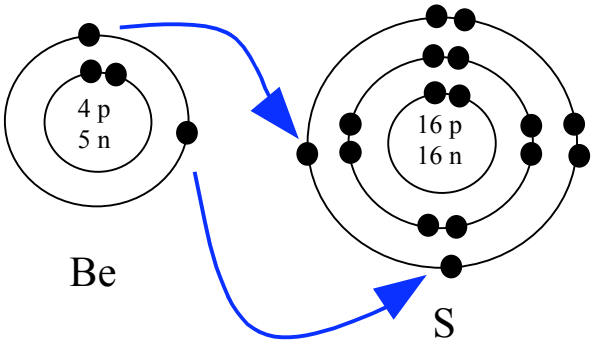
5. Draw ionic bond between K and F, between Na and O, and between Be and S. Write the empirical formula for each compound.



Empirical Formula:
KF

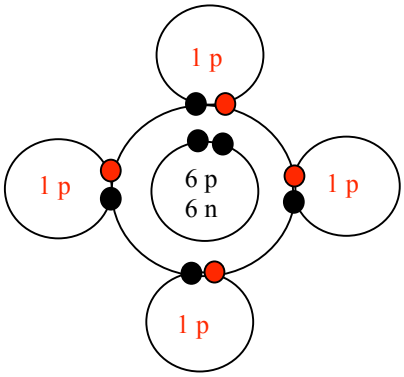


Empirical Formula:
Na_2O



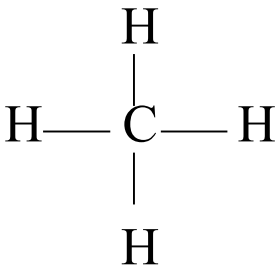
Empirical Formula:
BeS

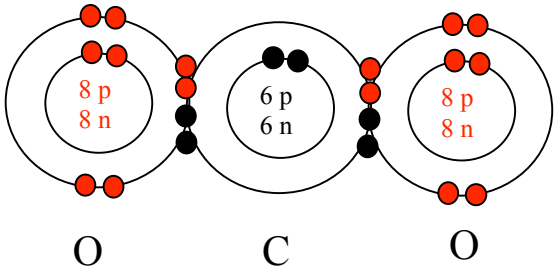
6. Draw the covalent bond between 1-C and 4-H's, between 2-O's and 1-C, and between N and 3-H's. Write the empirical formula of each molecule.



Empirical Formula:
CH_4

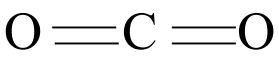
Structural Formula:

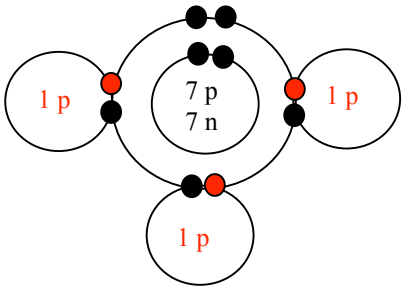




Empirical Formula:
CO_2

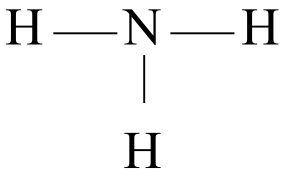
Structural Formula:





Empirical Formula:
NH_3

Structural Formula:

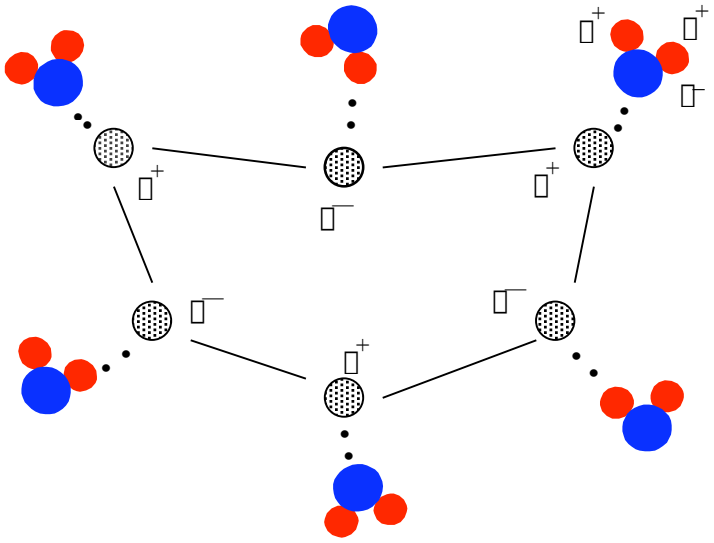


7. You have a beaker of water and the following substances: an ionic compound, a polar molecule and and a nonpolar molecule. If you stirred them into the water, what would happen to each?

The water would mix with the polar molecule and ionic compound forming a solution. The polar molecule would form hydrogen bonds with the water molecules and with the other polar solute molecules. The ionic compound would dissociate into individual ions, and each would be surrounded by hydration shells of water and other polar molecules. These interactions between the variously **charged** components would allow them to stay uniformly and stably mixed.

On the other hand, the nonpolar molecule would separate from this aqueous solution forming a separate layer. The atoms of a nonpolar molecule have **no charge** so they are unable to interact with slight charges associated with the different "poles" of each water molecule.

8. Draw the hydrogen bonds you would expect if the hypothetical molecule drawn below was the solute in an aqueous (water-based) solution.



NOTE: This is just one possible drawing. Any arrangement that shows hydrogen bonds between the slightly positive Hs of water and the slightly negative atoms in this hypothetical molecule (and conversely between the slightly negative Os of water and the slightly positive parts of our imaginary molecule) would be acceptable.

9. The pH of vinegar is 3, the pH of shaving lotion is 5, and the pH of urine is 8. Which is the most acidic? Vinegar most basic? Urine Which has the lowest concentration of H^+? Urine Which has the highest concentration of OH^-? Urine Is concentration of H^+ or OH^- greater in shaving lotion? Shaving lotion has a higher concentration of H+ than OH-.

10. Fill in the first blanks with < *(less than),* > *(greater than),* = *(equal to)* and the second blanks with *acidic, basic or neutral*.

    a. At pH < 7, the $[H^+]$ is > $[OH^-]$. A solution with this pH would be acidic

    b. At pH > 7, the $[H^+]$ is < $[OH^-]$. A solution with this pH would be basic

    c. At pH = 7, the $[H^+]$ is = $[OH^-]$. A solution with this pH would be neutral.

11. Solution A has a pH of 4 and Solution B a pH of 6. How does the $[H^+]$ of A compare to that of B ?
    Solution A has 100 X **GREATER** [H+] than Solution B. A is the stronger acid of the two.