HW 6

Looking at the periodic table, we can tell several things about each element:

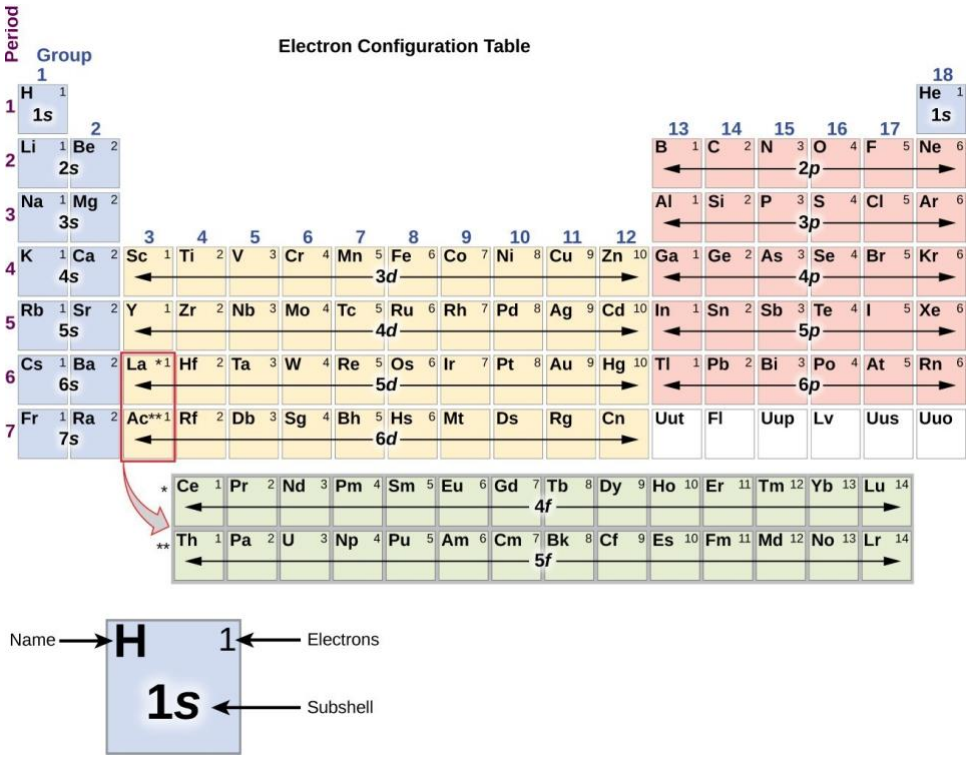
1. **Atomic Number and Atomic Weight**
   Each element's atomic number (number of protons) and atomic weight are given.
2. **Highest Energy Level**
   The period (horizontal row) corresponds to the highest occupied energy level (principal quantum number) of an element's electrons.
3. **Valence Electrons and Reactivity**
   - The group (vertical column) often helps determine the number of electrons in the outer shell, known as *valence electrons*. These electrons participate in chemical reactions.
   - Elements in Group 1 have 1 valence electron, and those in Group 2 have 2.
   - For Groups 13-18, the valence electrons equal the group number minus 10.
   - Most elements in the d-block (transition metals) have a valency of 2.
4. **Physical Characteristics**
   The element's placement (also indicates whether it's a metal, nonmetal, or metalloid.
5. For majority of atoms the electrons will occupy levels and orbitals as following:

1s,2s,2p,3s,3p,4s,3d,4p,5s,4d,5p,6s,4f,5d,6p,7s,5f,6d… Examples of electron configurations: K - $[Ar]4s^1$; Sc – $[Ar]4s^23d^1$;
Ga - $[Ar]4s^23d^{10}4p^1$; Cs – $[Xe]\ 6s^1$; La - $[Xe]\ 6s^24f^1$; Pb - $[Xe]\ 6s^24f^{14}5d^{10}6p^2$; Rf – $[Rn]\ 7s^25f^{14}6d^2$

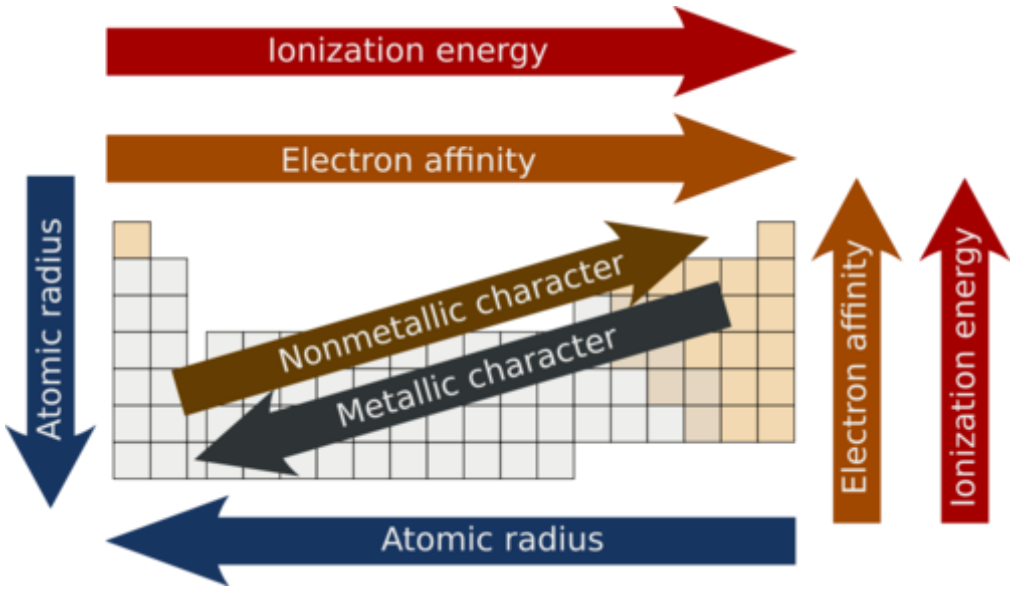
Let's try to clarify the periodic table:

1. **Energy Levels (Shells) and Rows in the Periodic Table**:
   - Each row (or period) in the periodic table corresponds to a new energy level (or shell) for electrons in atoms in their ground (stable) state.
2. **Row 1**:
   - In Row 1, the highest energy level is 1.
   - Energy level 1 has only one sub-level, called 1s.
   - Electrons occupy this 1s sub-level for the elements in Row 1.
3. **Row 2**:
   - In Row 2, the highest energy level is 2.
   - Energy level 2 has two sub-levels: 2s and 2p.
   - Electrons fill up the 1s level first, and then occupy the 2s and 2p sub-levels.
4. **Row 3**:
   - In Row 3, the highest energy level is 3.
   - Energy level 3 can have three sub-levels: 3s, 3p, and 3d.
   - However, the 3d sub-level is not filled immediately after 3p. The 4s sub-level is filled first, which is why the 3d sub-level appears in the 4th row.
5. **Row 4**:
   - In Row 4, the highest energy level is 4.
   - Energy level 4 can have four sub-levels: 4s, 4p, 4d, and 4f.
   - However, the 4f sub-level only begins to fill in the 6th row.

6. **Understanding Principal Quantum Numbers and Orbitals**:
    - The energy levels are assigned numbers, known as principal quantum numbers (1,2,3,4,5,6,7).
    - Each sub-level contains orbitals:
        - The s sub-level has 1 orbital.
        - The p sub-level has 3 orbitals.
        - The d sub-level has 5 orbitals.
        - The f sub-level has 7 orbitals.
7. **Writing Electron Configurations**:
    - When writing the **outer shell configuration** (like for Sulfur, S), we show the highest energy level's s and p orbitals, $3s^2\ 3p^4$.
    - For the **outer sub-shell configuration**, we only show the outermost sub-level, e.g., for Sulfur, it would be $3p^4$.



Properties of elements down a group and across a period.



Answer the following questions

1. Carbon (C) and Lead (Pb) belong to the same group in the periodic table. They have the same outer shell ns^2np^2 (n=2 for carbon, n=6 for Pb). However, Carbon is nonmetal, but Pb is metal. How do you explain this difference?
2. What can you tell about element with symbol N and element with symbol Bi?