Module 3: Modern Atomic Theory, Electron Structure, and Periodicity

Topic 4 Content: Valence Electrons Presentation Notes

Valence Electrons

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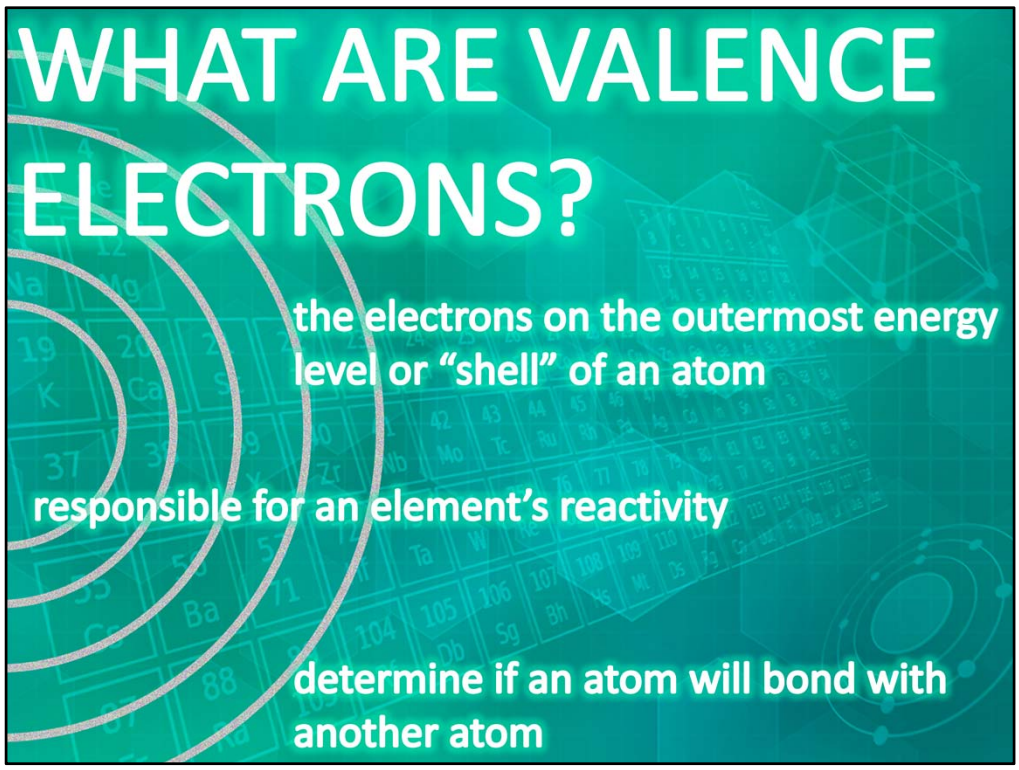

Valence electrons are the electrons on the outermost energy level or "shell" of an atom. These electrons are the ones responsible for an element's reactivity. The valence electrons are important because they will determine if an atom will bond with another atom. Atoms containing valence electrons can bond with other atoms.

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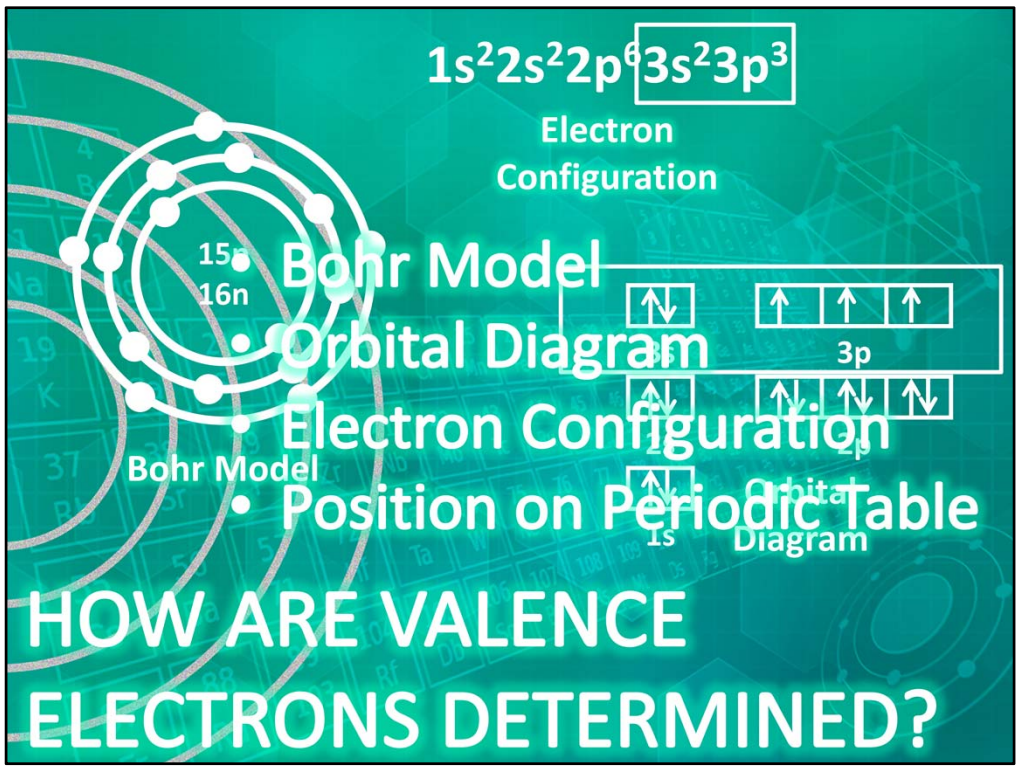

The number of valence electrons can be determined using an atom's Bohr model, orbital diagram, electron configuration, abbreviated electron configuration, or based on an element's position on the periodic table. Look at the Bohr model, orbital diagram, and electron configuration shown here. Each model or diagram indicates the number of valence electrons in a slightly different way. The Bohr model has five dots on the outer ring. The orbital diagram has five arrows on the third energy level. The electron configuration has the exponents two and three on the 3s and 3p sublevel, which add up to five electrons on the third energy level.

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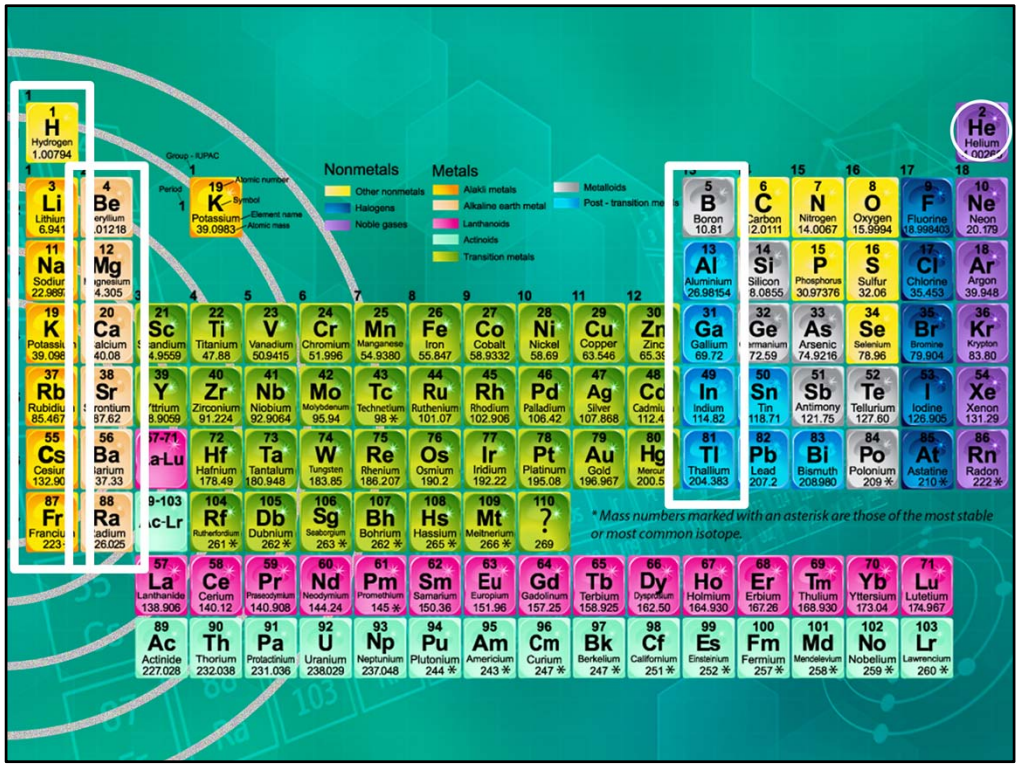
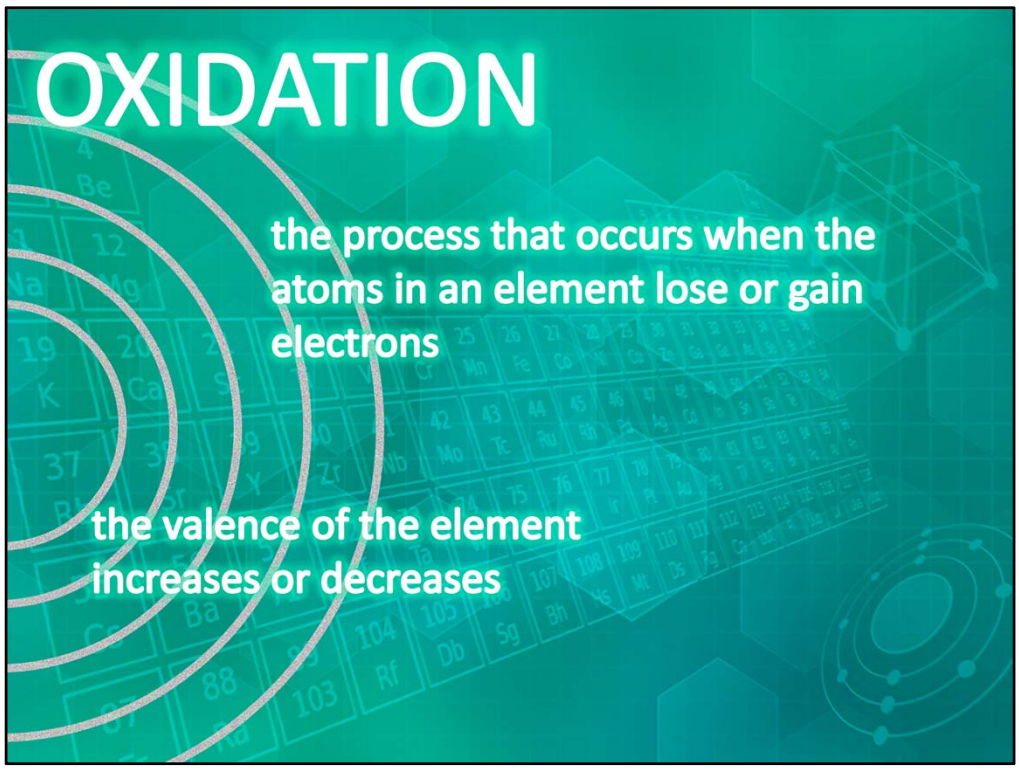
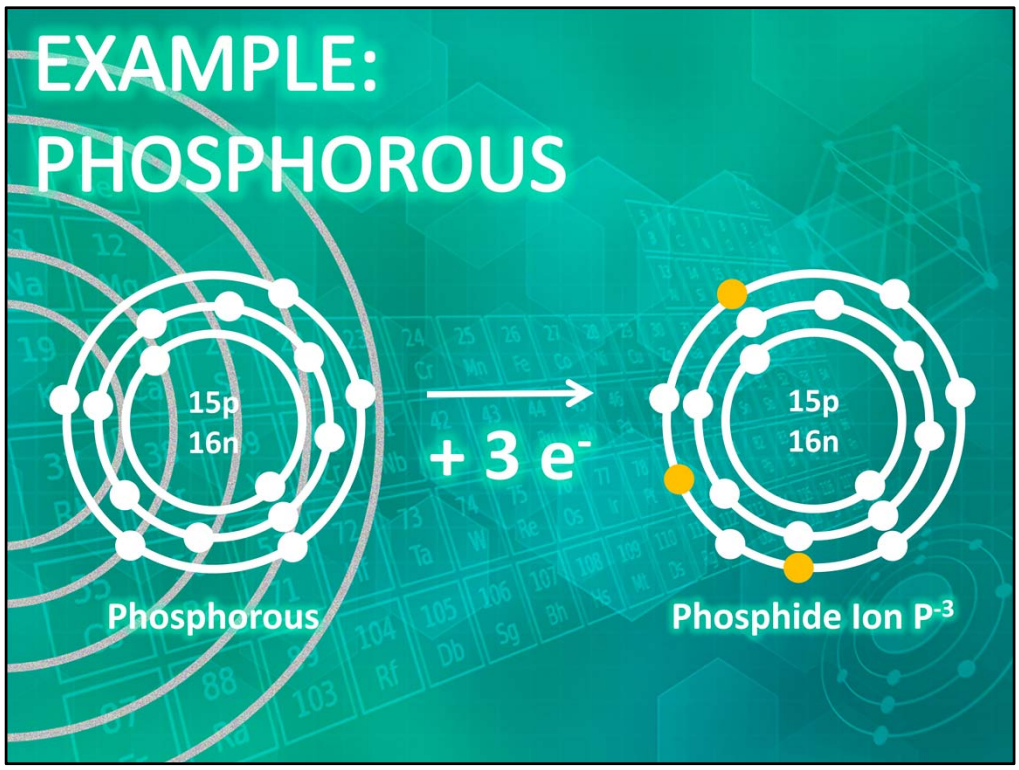


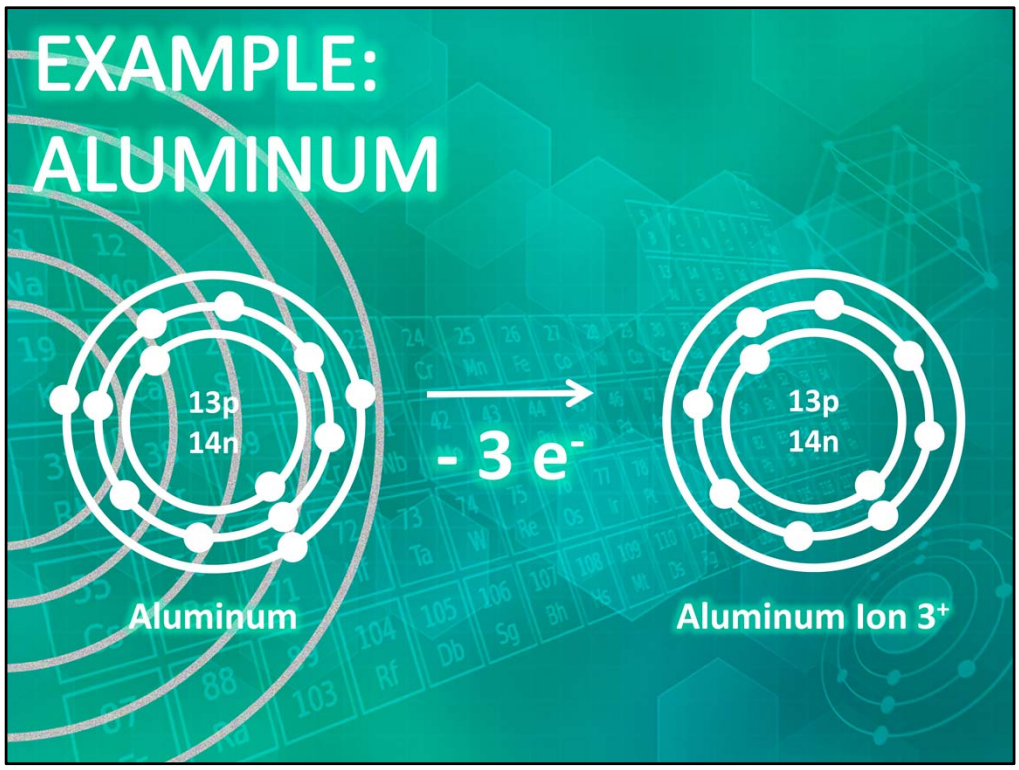
The number of valence electrons is also determined using the periodic table. An element's group on the periodic table corresponds to the number of valence electrons. Elements in group 1A have one valence electron. Elements in group 2A have two valence electrons. Elements in group 3A have three valence electrons. This works for all of the representative elements in groups 1A through 8A except for helium. Helium has only two valence electrons.



Atoms tend to lose or gain electrons to either fill or empty their outermost energy level. Oxidation is the process that occurs when the atoms in an element lose or gain electrons, and the valence of the element is correspondingly increased or decreased.



In the example shown here, phosphorus has five valence electrons. In order to fill its valence shell, it needs to gain three more electrons. The end result is an anion known as phosphide. Phosphide has a charge of negative three.



Aluminum has three valence electrons. In order to empty its valence shell, it would need to lose three more electrons. This creates a cation known as an aluminum ion which has a positive three charge.

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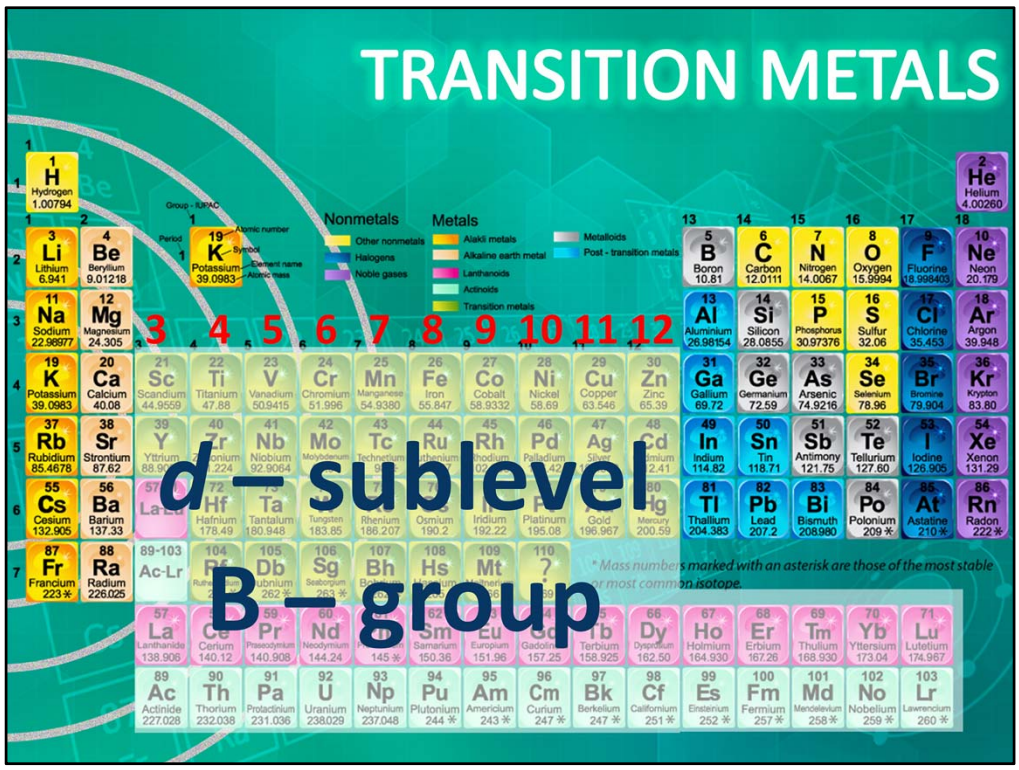

Transition metals file their last electrons into the d-sublevel. This means that they will have two valence electrons. It is possible for the electrons in the d-sublevel to transition, which is why these metals are capable of having various oxidation states. You can view the variable states of the B-group elements labelled in red.

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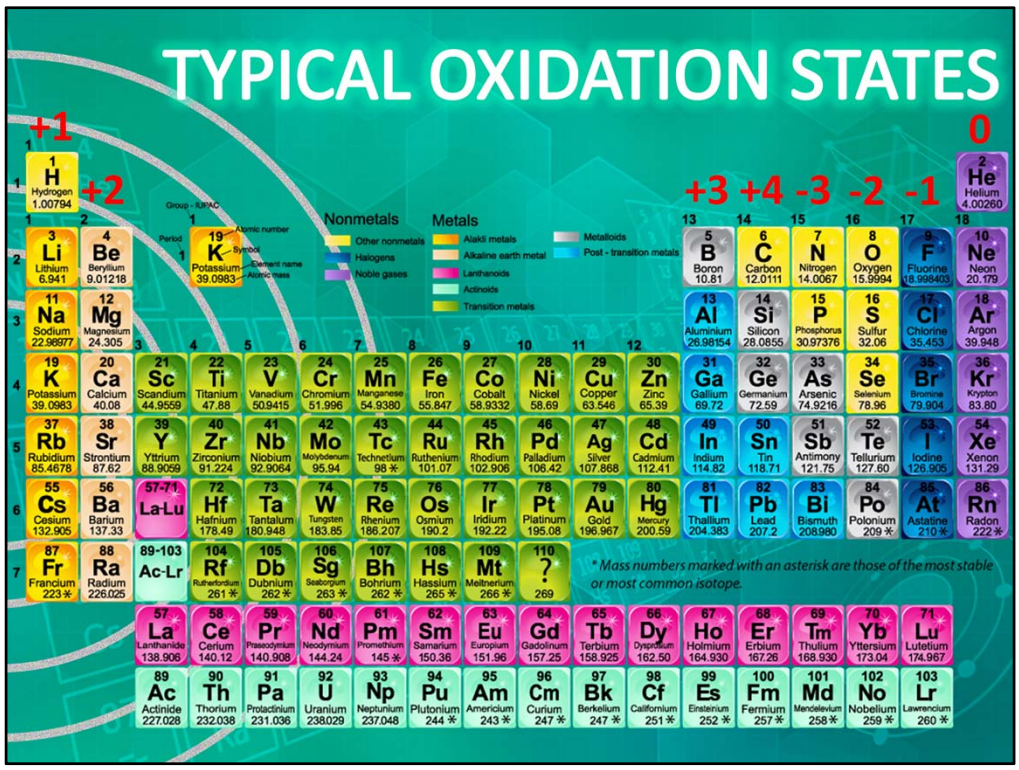

The most typical oxidation states are organized by group on the periodic table. The image show here depicts the most typical oxidation states for each group.