

Lesson 6

Chemistry 0

Fall 2021, L. Tracey Gao

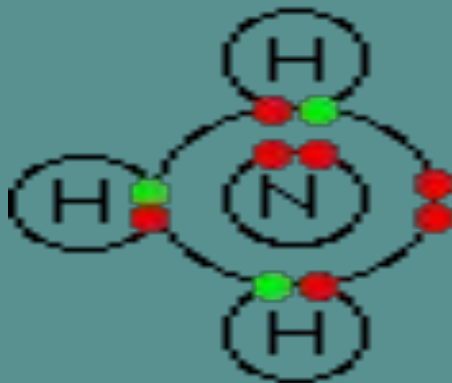


Covalent Bonding-Shared Electron Bonds

- The sharing of electrons between atoms is called a covalent bond, which holds the atoms together as a molecule.
- A covalent bond happens if the attractions are strong enough in both atoms and if each atom has room for an electron in its outer energy level.
- Atoms will covalently bond until their outer energy level is full.
- Atoms covalently bonded as a molecule are more stable than they were as separate atoms.

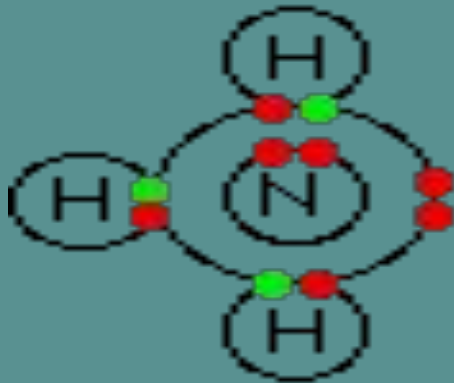
Week 5 Homework

Please draw a picture below and show how the nitrogen and hydrogen atoms share electrons in NH₃ molecules using energy levels model.



Week 5 Homework

Please explain why can't a fourth hydrogen atom join the NH_3 molecule to make NH_4 ?



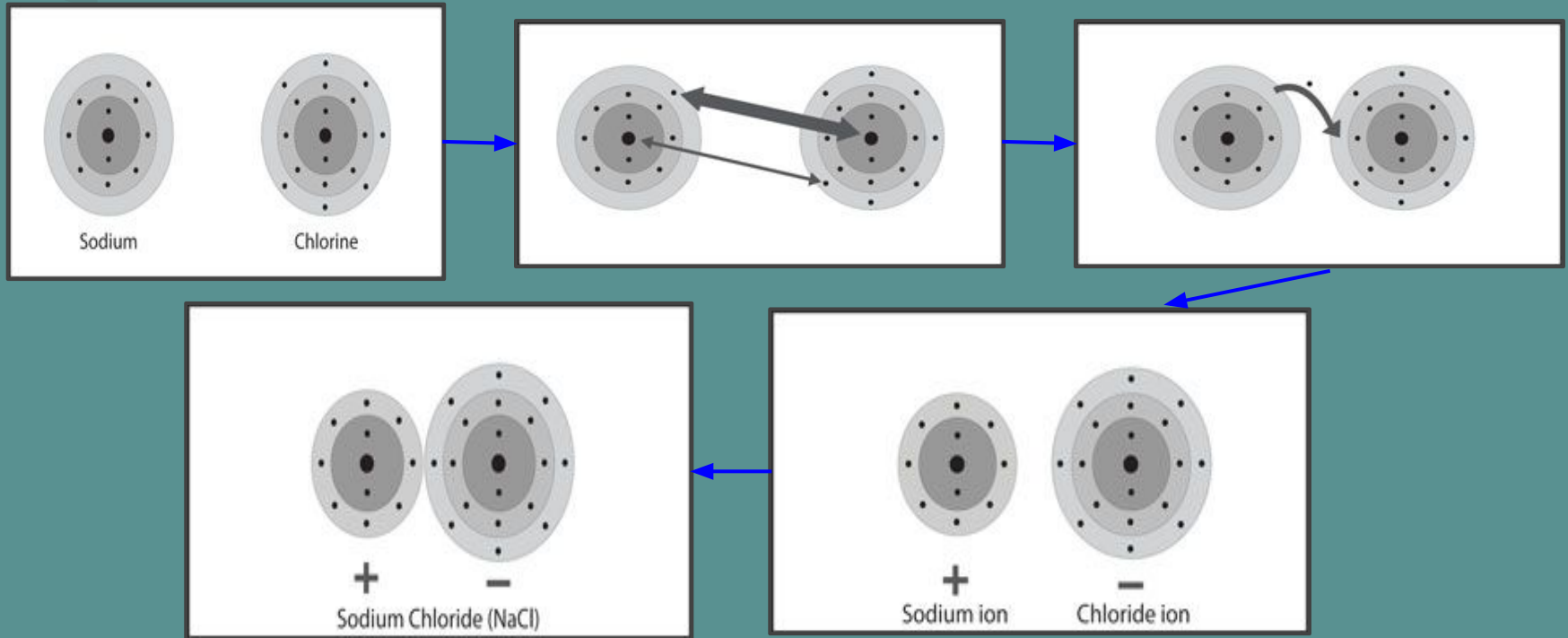
When three hydrogen atoms and a nitrogen atom share their electrons with each other, their outer energy levels are full.



Ionic Bonding- Unshared Electron Bonds

- The attractions between the protons and electrons of atoms can cause an electron to move completely from one atom to the other.
- When an atom loses or gains an electron, it is called an ion. The atom that loses an electron becomes a positive ion. The atom that gains an electron becomes a negative ion.
- A positive and negative ion attract each other and form an ionic bond.

Ionic Bond in Sodium Chloride





Ionic Bond in Sodium Chloride

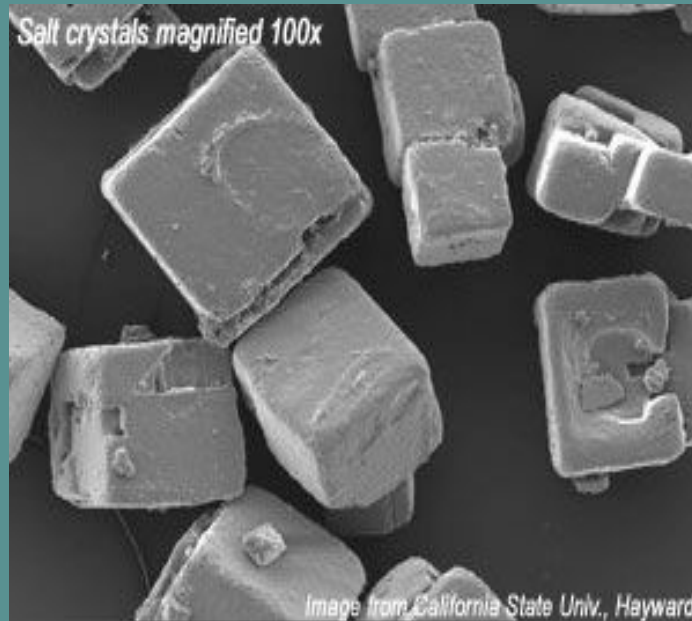
- Sodium and chlorine atoms are near each other.
- The protons of the two atoms attract the electrons of the other atom.
- During the interactions between the atoms, the electron in sodium's outer energy level is transferred to the outer energy level of the chlorine atom.



Ionic Bond in Sodium Chloride

- Sodium lost an electron, it has 11 protons, but only 10 electrons. This makes sodium a positive ion with a charge of +1. Chlorine gained an electron it has 17 protons and 18 electrons. This makes chloride a negative ion with a charge of -1.
- The positive sodium ion and negative chloride ion attract one another. They make an **ionic bond** and form the ionic compound NaCl.

Sodium Chloride Crystal

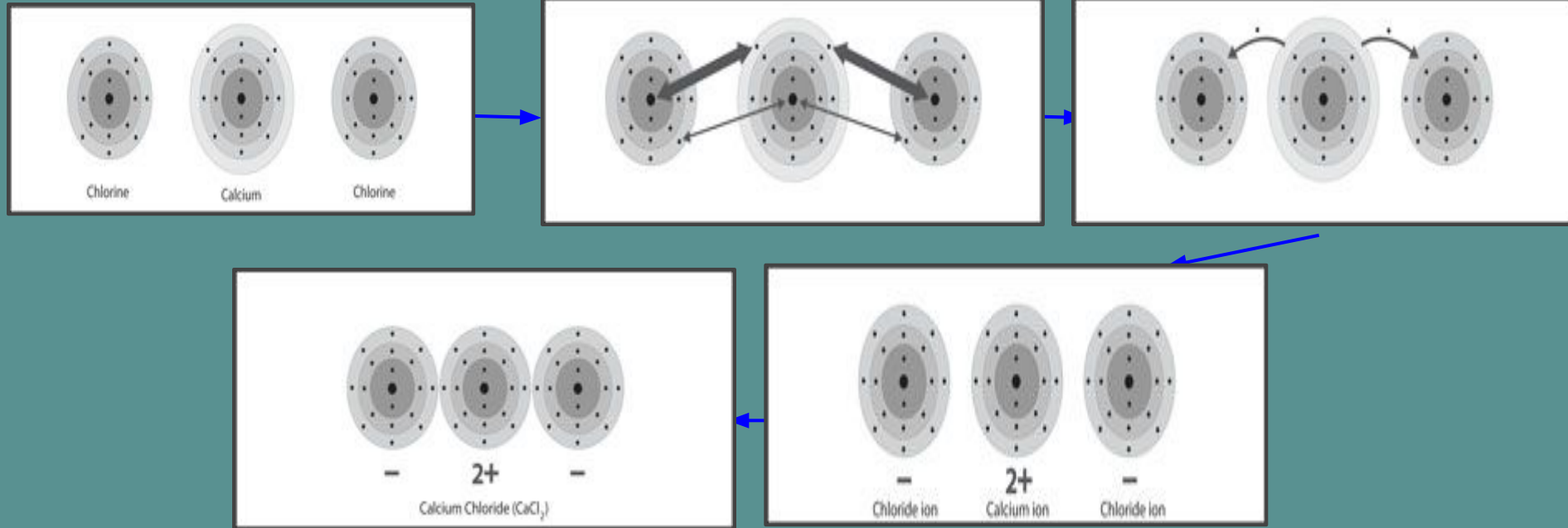




Questions

- What ion is the larger ball with the negative charge?
- What made it negative?
- What is the ion with the positive charge?
- What made it positive?
- What do the image and the model of real salt crystals tell you about the structure of salt?

Ionic Bond in Calcium Chloride (CaCl_2)





Key Concepts about Ionic Bond











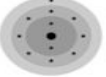
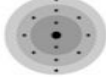
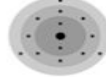
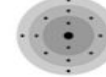
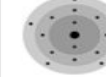





- The attractions between the protons and electrons of atoms can cause an electron to move completely from one atom to the other.
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- A positive and negative ion attract each other and form an **ionic bond**.



Summary

- Atoms bond with one another in two different ways-
 - Covalent bonds
 - Ionic bonds
- When two nonmetals share one or more electrons, they form a covalent bond.
- When a metal transfers one or more electrons to a nonmetal, they form an ionic bond.
- Both types of bonds are based on the same concept: Atoms tend to behave in such a way as to effectively fill their outer energy level.

Energy Levels Model

<h2 style="text-align: center;">ENERGY LEVELS ELEMENTS 1-20</h2>							
HYDROGEN 1  1.01							HELIUM 2  4.00
LITHIUM 3  6.94	BERYLLIUM 4  9.01	BORON 5  10.81	CARBON 6  12.01	NITROGEN 7  14.01	OXYGEN 8  16.00	FLUORINE 9  19.00	NEON 10  20.18
SODIUM 11  22.99	MAGNESIUM 12  24.31	ALUMINUM 13  26.98	SILICON 14  28.09	PHOSPHORUS 15  30.97	SULFUR 16  32.07	CHLORINE 17  35.45	ARGON 18  39.95
POTASSIUM 19  39.10	CALCIUM 20  40.08						



Summary

- There are two main classes of elements:
 - Elements that tend to lose valence electrons- **Metal**
 - Elements that tend to gain electrons- **Nonmetal**
- **Metal** atoms donate all of their valence electrons to **nonmetal** atoms and all the atoms get their outer shells filled. After the electron transfer, the oppositely charged ions attract, and forming an ionic bond.
- **Nonmetals** bond with other **nonmetals** covalently by sharing electrons so that both atoms have a sense of having a filled outer shell.



Exercises

- Determine the total number of electrons in each of the following:
 - He
 - Mg
 - Ca^{2+}
 - O^{2-}



Exercises

- Determine the number of valence electrons in each of the following:
 - He
 - Mg
 - Ca^{2+}
 - O^{2-}



Exercises

- Indicate whether each of the following bonds is covalently or ionic:
 - H_2O
 - F_2
 - MgCl_2
 - Na_2O