

Ionic Compounds and Ionic Bonds

- Very few elements are found naturally in their elemental form.
 - * ○ Atoms of elements combine with atoms of other elements to form a wide variety of chemical **compounds**. *know atom vs. compounds!*

* ○ An **ionic compound** is a neutral molecule that is formed when a metal *ion* and a non-metal *ion* (or a positive *ion* and a negative *ion*) bond together.

- Recall that an **ion** is a particle or group of particles that have an overall net charge (either negative or positive).
- An **ionic bond** is formed when a positive ion and a negative ion attract due to the electrostatic attraction (ie. opposite charges attract)

* ○ To form **ionic bonds**, neutral atoms must first become ions by **completely losing or gaining electrons**

• Recall that an **atom** is *electrically neutral* and is composed of protons (p^+), neutrons (n) and electrons (e^-).

- In order for an atom to be electrically neutral, the number of protons must equal the number of electrons ($\# \text{ of } p^+ = \# \text{ of } e^-$)

• The **octet rule** states that when bonds form between atoms, the atoms will gain, lose or share electrons in such a way that they will create outer energy levels that are completely filled with the maximum number of valence electrons

The 1st energy level can have a maximum of 2 electrons

The 2nd energy level can have a maximum of 8 electrons

The 3rd energy level can have a maximum of 8 electrons

* ○ Metal atoms have a valence energy level that is less than half filled with electrons

- **Metal atoms** will then **lose** all of their **valence electrons** to achieve a full outer energy level
- By losing electrons, **metals will form positive ions called cations**

* ○ Nonmetal atoms have a valence energy level that is more than half filled with electrons

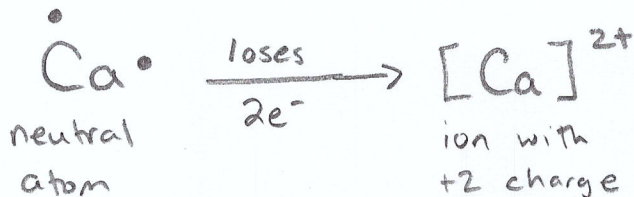
- **Nonmetal atoms** will then **gain** enough **electrons** to achieve a full valence energy level
- By **gaining electrons**, **nonmetals will form negative ions called anions**

• By knowing the number of valence electrons, you can predict the charge the ion will have

EXAMPLE: Use an electron dot diagram to predict the charge on the following ions.

1. calcium ion

↑
group #2
∴ 2 valence e⁻



2. chlorine ion

↑
group #17 ∴ 7 valence e⁻



*remember that e⁻ are negative!

Now try Practice Problem #1

- We can use electron dot diagram to show the ionic bonding (the attraction between two oppositely charged ions) that exists in ionic compounds

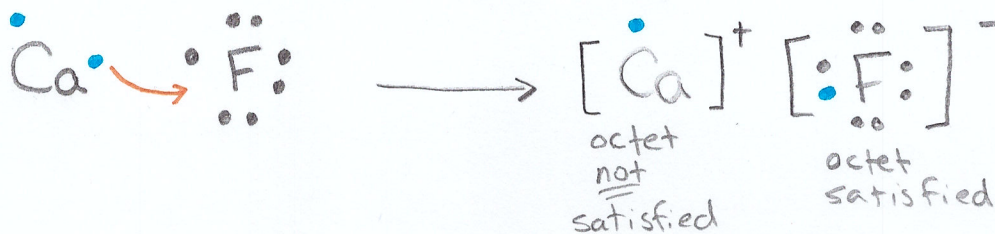
EXAMPLE: Use an electron dot diagram to show how an ionic compound forms between calcium and fluorine.

Step 1: Draw the electron dot diagram for each element.

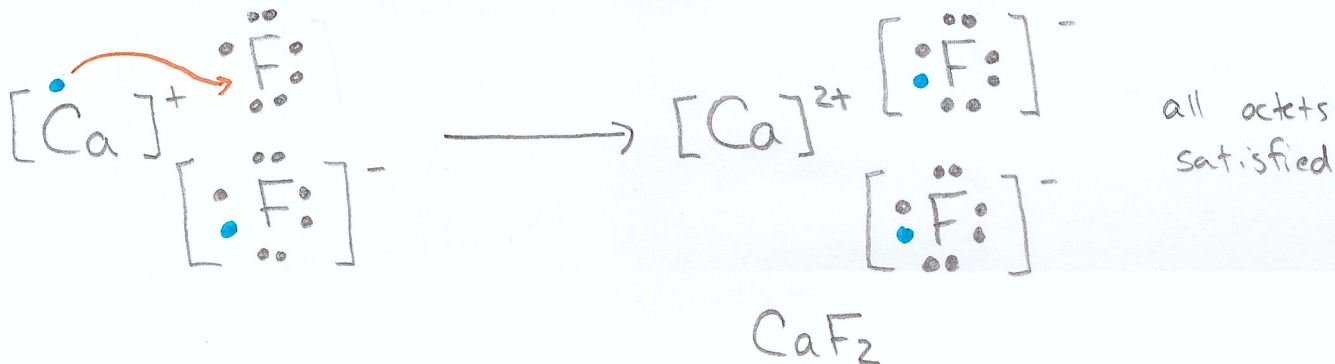


Step 2: Move/transfer electrons from the metal to the nonmetal to satisfy the octet rule for as many elements as possible.

- Remember that metals completely lose electrons to form positive ions and nonmetal completely gain electrons to form negative ions.



Step 3: If all elements do not have their valence energy level satisfied, add more of the needed metal or nonmetal to satisfy the octet rule for every element.



* Step 4: Count to make sure the total charge on the ionic compound is zero (ie. the compound is neutral).

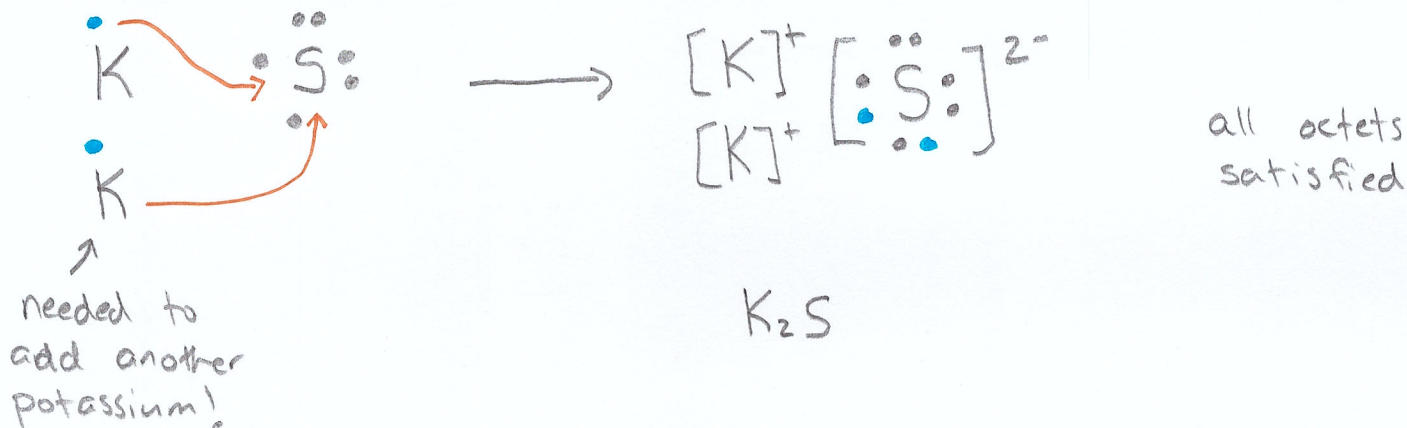
$$+2 + (-1) + (-1) = 0$$

OR

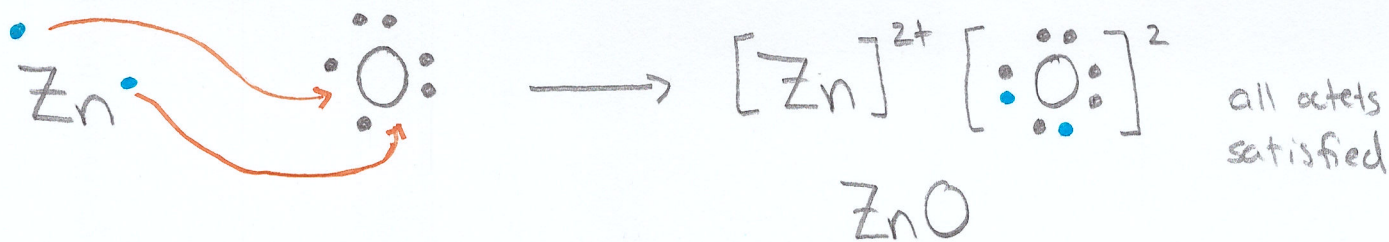
$$1(+2) + 2(-1) = 0$$

EXAMPLE: Use an electron dot diagram to show how an ionic compound forms between the following elements.

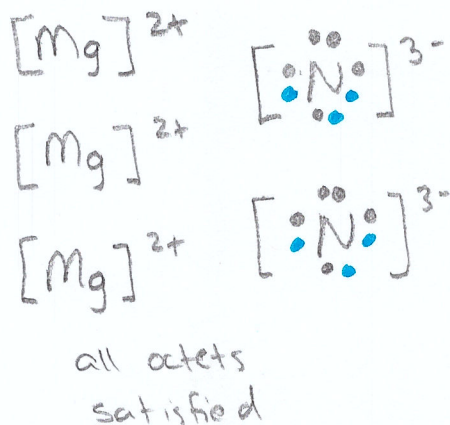
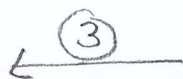
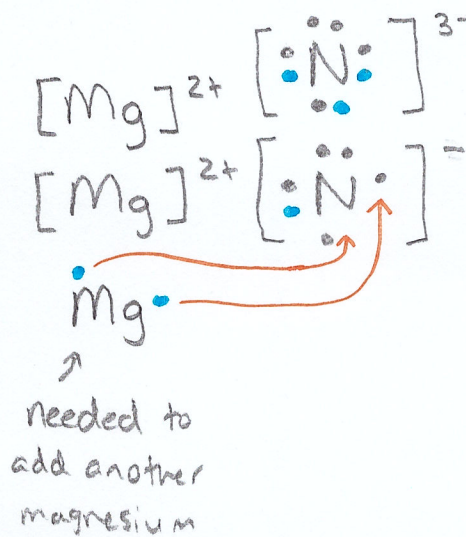
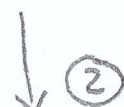
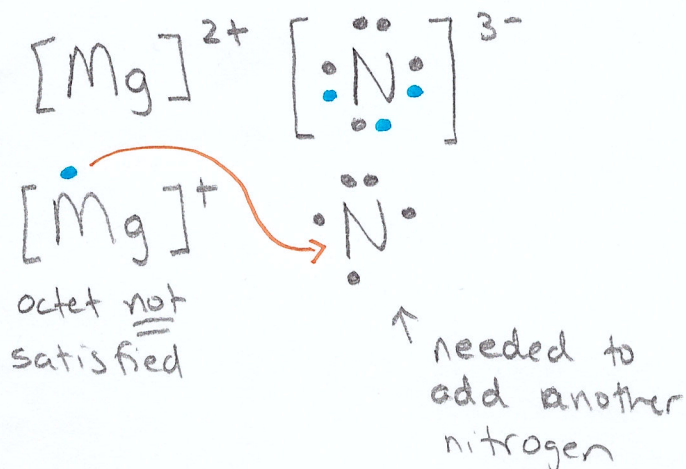
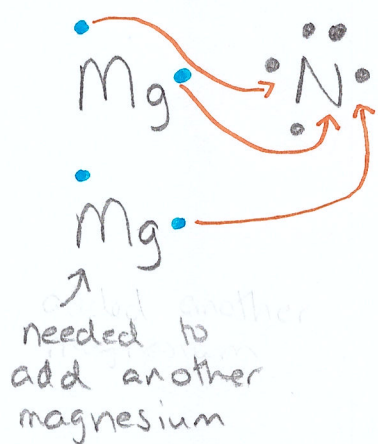
1. potassium and sulphur



2. zinc and oxygen



3. magnesium and nitrogen



$$3(+2) + 2(-3) = 0$$

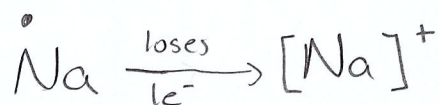
$$+6 + (-6) = 0 \quad \checkmark$$

Now try Practice Problems #6-11

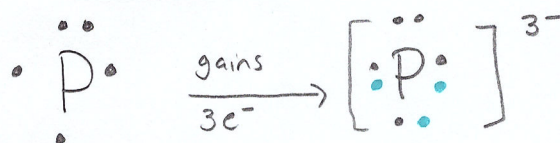
Practice Problems

Use an electron dot diagram to predict the charge on the following ions.

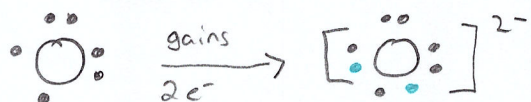
1. sodium ion



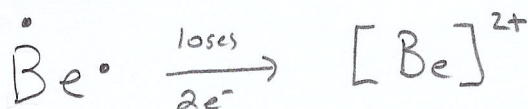
4. phosphorus ion



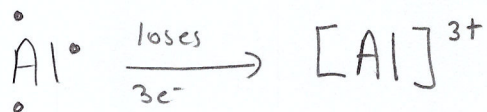
2. oxygen ion



5. beryllium ion

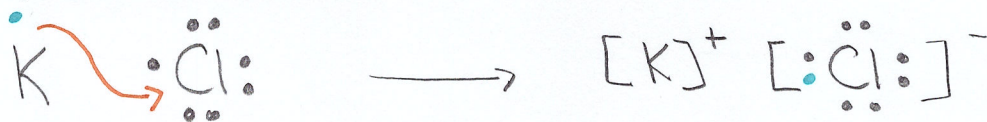


3. aluminum ion



Use an electron dot diagram to show how an ionic compound forms between the following elements.

6. potassium and chlorine



7. barium and oxygen

