

Electron Dot (Lewis) Diagrams

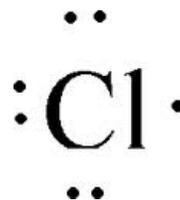
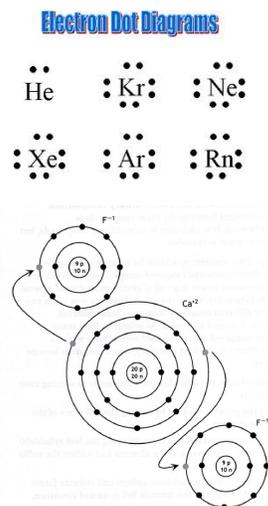
What are electron dot (Lewis) diagrams and how can they help us to understand how compounds form?

Bohr Diagrams

So far we have used Bohr diagrams to show how many electrons an element has and how elements bond in ionic compounds. For example here is CaF_2 .

Electron Dot Diagrams

There is another model called the **electron dot** or **Lewis** diagram. This system represents an atom and its valence electrons. The electron dot diagram uses the symbol of the element to replace the nucleus and inner shell electrons. The electrons in the valence shell are shown as dots placed around the symbol. For example, we learned that chlorine has 7 valence electrons. The electron dot symbol for chlorine is shown at the right.

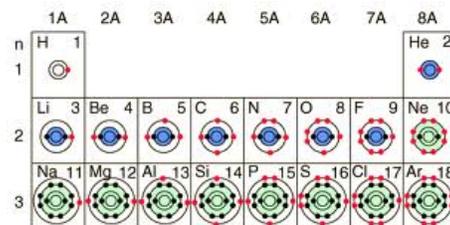


Electron Dot Diagrams Noble Gases

We learned that the noble gases have 8 valence electrons in their outermost shells, except for helium that has 2 valence electrons.

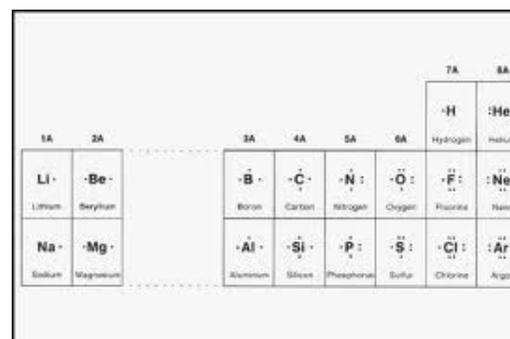
Bohr Models for First 18

Remember that we drew Bohr model diagrams for the first 18 elements. The red dots show the valence electrons.



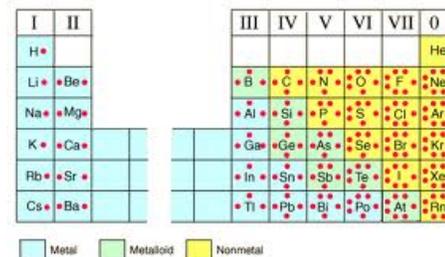
Electron Dot for First 18

Here are the electron dot diagrams for the first 18 elements.



Electron Dot for Families

Families of elements have the same number of valence electrons. These are electron dot diagrams for families of elements.



Lithium Hydride

Electron dot diagrams can be used to show the formation of ionic compounds.

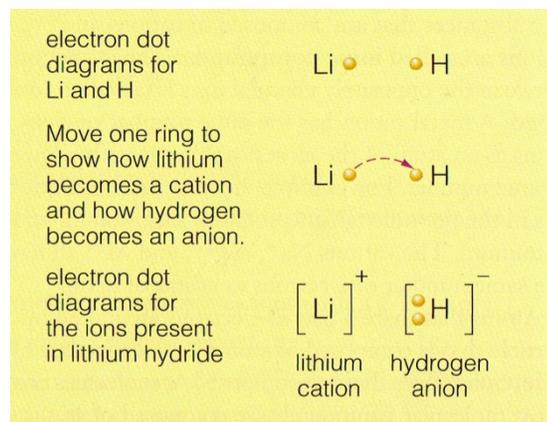
Li has 1 valence electron. H also has 1 valence electron.

The Li atom gives away its valence electron to the H atom.

Li becomes the cation Li^+ .

H becomes the anion H^- .

The new ionic compound, LiH is shown with square brackets around the Li with a + sign, and the H now has 2 dots in square brackets with a "-" sign.



Magnesium Chloride

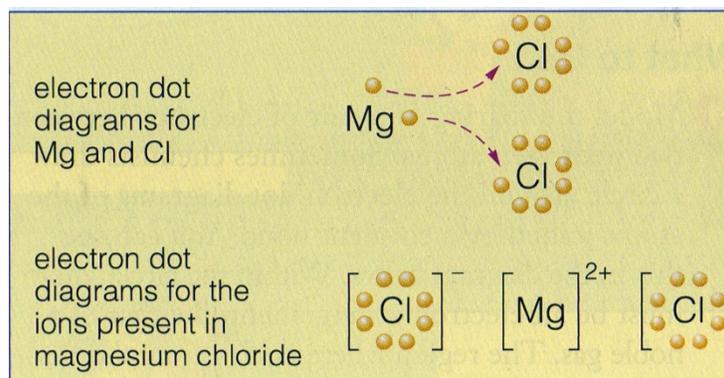
The diagram at the right shows the formation of MgCl_2 .

Mg gives away its 2 valence electrons to become Mg^{2+} .

This time 2 Cl are necessary.

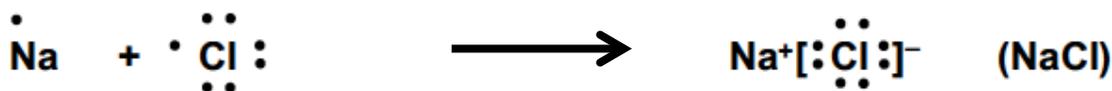
Each Cl receives 1 electron to become Cl^- .

Notice that the electron dot diagram for the compound MgCl_2 shows square brackets around each ion with their charges and electrons in the outer levels. Mg gave away its 2 valence electrons so does not show any, but each Cl has 8.



Formation of NaCl

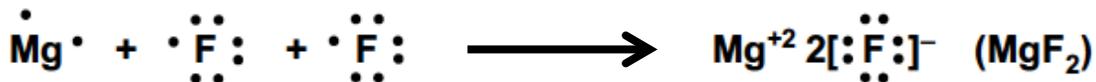
The following electron dot diagram shows the formation of NaCl.



Formation of MgF_2

The following electron dot diagram shows the formation of MgF_2 .

Notice that instead of drawing electron dot diagrams for 2 F^- , the number "2" has been placed in front of one of the F^- .



Checklist

1. Draw an "electron dot" diagram showing the first 18 elements in the periodic table.
2. Explain how the electron dot diagram is similar for families in the periodic table.
3. Draw an electron dot diagram showing the formation of ions and ionic compounds.
4. Explain how hydrogen can be considered as behaving like a metal or a nonmetal.

Practice:

1. The diagram at the right shows an electron dot diagram for Argon.

The diagram below it shows a Bohr model for Argon.

What does the Bohr model show that the electron dot does not?



2a) How many valence electrons do all the noble gases have (except for helium)?

2b) For an electron dot diagram, how many dots would be shown around the noble gas elements (except for helium)?

2c) Neon has 10 electrons in all and argon has 18, yet the electron dot diagrams for both neon and argon are the same. Explain why.

3. In the diagram below, some electrons are coloured red and some black. What name is given to the electrons that are coloured red?

	1A	2A	3A	4A	5A	6A	7A	8A
n	H 1							He 2
1								
2	Li 3	Be 4	B 5	C 6	N 7	O 8	F 9	Ne 10
3	Na 11	Mg 12	Al 13	Si 14	P 15	S 16	Cl 17	Ar 18

5. The diagram to the right shows the electron dot structure for the first 18 elements.

The structure for aluminum and sulfur has been blocked out. Show the electron dot structure for these two elements.

You do not need to look at another periodic table. Look at the electron dot structure of other elements in the same family and use that information to draw the electron dot structure for these two elements.

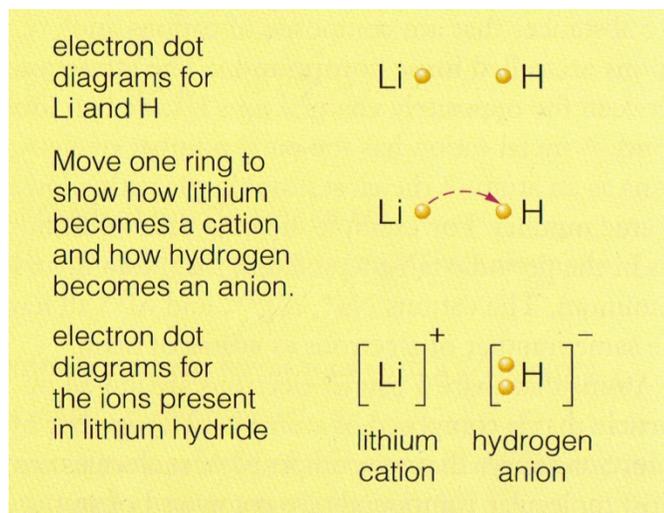
1A	2A	3A	4A	5A	6A	7A	8A
						H Hydrogen	He Helium
Li Lithium	Be Beryllium	B Boron	C Carbon	N Nitrogen	O Oxygen	F Fluorine	Ne Neon
Na Sodium	Mg Magnesium	Al Aluminum	Si Silicon	P Phosphorus	S Sulfur	Cl Chlorine	Ar Argon

6. How many valence electrons do each of the following families have?

- Alkali metals
- Halogens
- Noble gases
- Chalcogens
- Alkaline earth
- Nitrogen family
- Boron family
- Carbon family

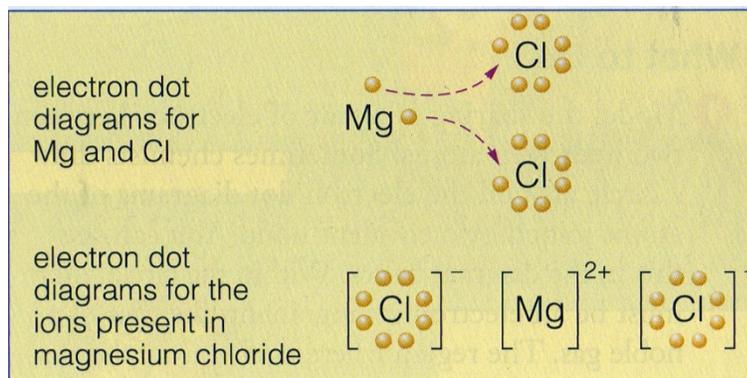
7. The diagram at the right shows the formation of LiH.

- How many valence electrons did the Li have?
- How many valence electrons did the H have?
- Which element donated an electron and which one accepted the electron?
- Which of the elements became a cation?
- What name do we give to one unit of lithium hydride (LiH)?



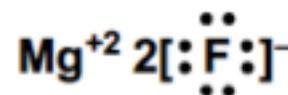
8. The diagram at the right shows the formation of $MgCl_2$.

- In the electron dot diagram showing the Mg^{2+} ion, there are no dots around it. Why is this?
- Why are 2 Cl^- ions necessary to form one formula unit of $MgCl_2$?



9. In the formation of NaCl, how many valence electrons does anion have after the formula unit has been formed?

10. The diagram below shows the electron dot formula of a formula unit. What is the chemical symbol of this formula unit?



11. Draw an electron dot diagram showing the structure of Li_2S .

12. For each of the following families or elements, fill in the table with whether the family donates or receives electrons, how many electrons are involved, and what charge the elements in the family acquire.

Family Element	Donate or Accept Electrons	Number of Electrons	Charge
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**Alkali
Metals**

**Alkaline
Earth**

**Noble
Gases**

Halogens

Chalcogens

Aluminum

Nitrogen

Phosphorus

13. Iron and copper are 2 elements that can form into 2 different ions depending of what element they react with. We will talk more about this later. For each of these two elements fill in the table with whether the element donates or receives electrons, how many electrons are involved, and what charge the elements acquire. There should be two possible answers for each element.

Family Element	Donate or Accept Electrons	Number of Electrons	Charge
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**Iron
(possibility 1)**

**Iron
(possibility 2)**

**Copper
(possibility 1)**

**Copper
(possibility 2)**

14. There are other elements that form charges but it is not possible to predict their charges just by looking at what their families do. For each of these three elements fill in the table with whether the element donates or receives electrons, how many electrons are involved, and what charge the elements acquire. ~~There should be two possible answers for each element.~~

Family Element	Donate or Accept Electrons	Number of Electrons	Charge
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Scandium

Silver

Zinc

Cadmium

15. Hydrogen is an element that can form into 2 different ions depending of what element they react with. For these two possibilities fill in the table with whether the element donates or receives electrons, how many electrons are involved, and what charge the elements acquire.

Family Element	Donate or Accept Electrons	Number of Electrons	Charge
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**Hydrogen
(possibility 1)**

**Hydrogen
(possibility 2)**

16. In each of the examples below, you are given two elements. Draw electron dot diagrams for each one showing how the compound forms and what the final answer is. The example below shows what is necessary in a good answer.

To the left of the black arrow include

- The electron dot diagrams of the elements that react with each other.
- Curving arrows showing how where electrons are transferred.

To the right of the black arrow include

- The electron dot diagram of the final compound.
- The correct chemical formula of the compound.

Here are the questions.

- K and H
- Li and I
- Ca and S
- Be and Cl
- Na and O