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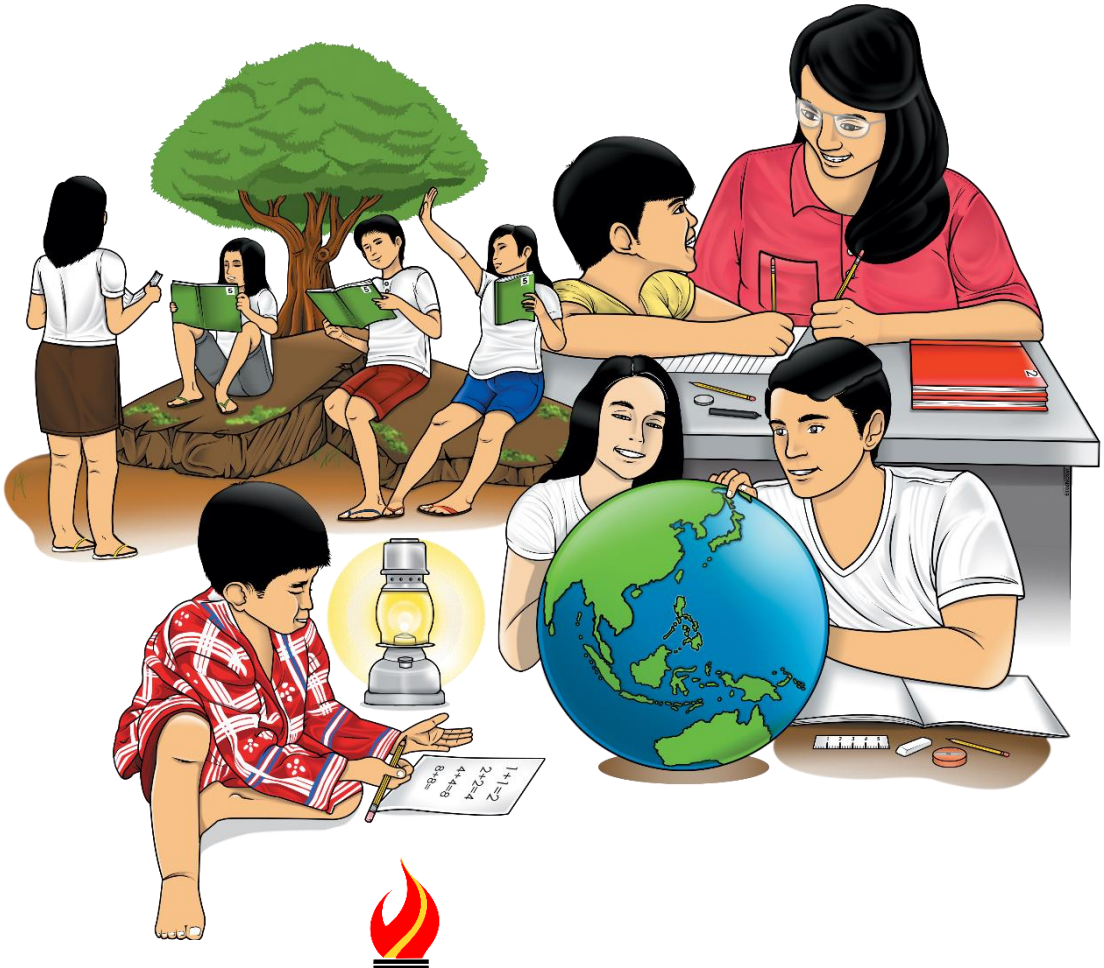
Science

Quarter 2 – Module 2
Formation of an Ionic Bond And Covalent Bond



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Science

Quarter 2 – Module 2
Formation of an Ionic Bond And Covalent Bond

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Introductory Message

This Self-Learning Module (SLM) is prepared so that you, our dear learners, can continue your studies and learn while at home. Activities, questions, directions, exercises, and discussions are carefully stated for you to understand each lesson.

Each SLM is composed of different parts. Each part shall guide you step-by-step as you discover and understand the lesson prepared for you.

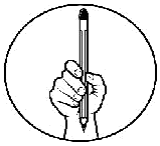
Pre-tests are provided to measure your prior knowledge on lessons in each SLM. This will tell you if you need to proceed on completing this module or if you need to ask your facilitator or your teacher's assistance for better understanding of the lesson. At the end of each module, you need to answer the post-test to self-check your learning. Answer keys are provided for each activity and test. We trust that you will be honest in using these.

In addition to the material in the main text, Notes to the Teacher are also provided to our facilitators and parents for strategies and reminders on how they can best help you on your home-based learning.

Please use this module with care. Do not put unnecessary marks on any part of this SLM. Use a separate sheet of paper in answering the exercises and tests. And read the instructions carefully before performing each task.

If you have any questions in using this SLM or any difficulty in answering the tasks in this module, do not hesitate to consult your teacher or facilitator.

Thank you.



What I Know (Pre - Test)

I. Multiple Choice: Choose the letter that corresponds to the correct answer. Write the letter of your answer on a separate sheet of paper.

1) Which of the following pair of elements would form an ionic bond?
   a) N and F
   b) Ca and Li
   c) Mg and Cl
   d) O and O

2) Which of the following orbital notation illustrates sodium atom ($_{11}$Na)?
   a) ↓↑ ↓↑ ↓↑ ↓↑ ↓↑ (1s 2s 2p)
   b) ↓↑ ↓↑ ↓↑ ↓↑ ↓ ↑↓ (1s 2s 2p 3s)
   c) ↓↑ ↓↑ ↓↑ ↓↑ ↓↑ ↓ (1s 2s 2p 3s)
   d) ↓↑ ↓↑ ↓↑ ↓↑ ↓↑ ↓↑ ↓↑ ↓↑ ↓↑ (1s 2s 2p 3s 3p)

3) Ionic bonds are formed between:
   a) Two metals
   b) Two nonmetals
   c) Two nonreactive elements
   d) Metals and nonmetals

4) In forming ionic bonds:
   a) Electrons are shared by two metals
   b) Electrons are transferred from non-metals to metals
   c) Electrons are accepted by metals from non-metals
   d) Electrons are released by metals and accepted by non-metals

5) Reactive metals are mostly found at the:
   a) The right part of the periodic table
   b) Left part of the periodic table
   c) Middle part of the periodic table
   d) Lower part of the periodic table

6) Reactive non-metals are mostly found at the:
   a) The right part of the periodic table
   b) The left side of the periodic table
   c) Middle part of the periodic table
   d) Lower part of the periodic table

7) In order to have a complete transfer of electron/s, the electronegativity difference of the two combining elements must be:
   a) Less than 1.9
   b) Greater than 1.9
   c) Equal to 4
   d) Equal to zero

8) Elements in Family 2 or IIA are capable of:
   a) Accepting 5 electrons
   b) Donating 3 electrons
   c) Donating 2 electrons
   d) Receiving 1 electron

9) To gain stability, sodium atom must lose 1 electron to attain the electronic configuration of which noble gas?
   a) Ne
   b) Kr
   c) F
   d) He

10) To gain stability, Cl atom must gain an electron to attain the electronic configuration of which noble gas?
   a) Ne
   b) Kr
   c) Ar
   d) He

11) Which of the properties of atoms is the most suitable reference for the kind of bond that will take place among them?

a) ionization energy
b) atomic size
c) electronegativity
d) electron affinity

12) A chemical bonding between the two atoms which shares a single pair of an electron is:

a) single bond
b) double bond
c) triple bond
d) all of these

13) What kind of particle is produced after covalent bonding?

a) atom
b) molecule
c) ion
d) electron

14) What kind of chemical bond will form between two hydrogen atoms?

a) metallic bond
b) B. ionic bond
c) polar covalent bond
d) non polar covalent bond

15) When does covalent bonding take place?

a) It takes place when atoms attain stability.
b) It takes place when atoms collide with one another
c) It takes when the attraction is weak.
d) It takes place when atoms share electron.

16) Oxygen (O) belongs to group 6A and it is diatomic. How many nonpolar covalent bonds will be there in O_2 molecule?

A. 1 B. 2 C. 3 D. 4

II. Identify the following compounds as polar or non-polar. Indicate your answers in your answer sheet.

17. Cl_2
18. H_2O
19. HCl
20. N_2

Lesson

1

Ionic Bond

What I Need to Know

At the end of the module, you will be able to learn how an ionic bond is formed. Specifically, after going through this module, you will be able to Illustrate how ionic bond is formed using the following approaches:

a) The electronic configuration,
b) The Orbital notation, and
c) The Lewis electron dot structure

You will also learn how to determine whether a transfer of electron will occur by calculating the electronegativity difference of the two combining atoms.

What's New

We usually encounter thousands of compounds in our day - to - day activities. Many of these substances look different while others look the same. But do not be fooled by their physical appearance. Using chemical and other physical characteristics, you will find out they are actually different substances. Consider sugar and salt as our example. If you throw or accidentally dropped few grains of sugar into a flame or hot surfaces, it melts with a distinct odor, turns brown and eventually becomes a black substance.

http://finedininglovers.cdn.crosscast-system.com/ImageAlbum/26161/original_Making-caramel.jpg

On the other hand, if this happened to a few grains of salt, the salt produced somewhat a cracking sound and you could even see it jumping on the hot surface or above the flame and give a distinct odor and color.

https://media.buzzle.com/media/images-en/photos/education/chemistry/chemical-compounds/1200-17034274-sodium-chloride.jpg

https://www.angelo.edu/faculty/kboudrea/molecule_gallery/element078_platinum/flame_sodium_02.jpg

This could be best explained by looking at how the particles of these substances are linked together. The nature of how the component elements are bonded together will give support to the observations mentioned previously. These characteristics will be discussed separately.

What Is It

Let us consider again a very familiar substance, salt. Salt is made up of elements sodium (Na) and chlorine (Cl). Look at the periodic table below.

IUPAC Periodic Table of the Elements

1																	18
1 H hydrogen [1.0078, 1.0082]	2		Key: atomic number Symbol name conventional atomic weight standard atomic weight									13	14	15	16	17	2 He helium 4.0026
3 Li lithium 6.94 [6.938, 6.997]	4 Be beryllium 9.0122											5 B boron 10.81 [10.806, 10.821]	6 C carbon 12.011 [12.009, 12.012]	7 N nitrogen 14.007 [14.006, 14.008]	8 O oxygen 15.999 [15.999, 16.000]	9 F fluorine 18.998	10 Ne neon 20.180
11 Na sodium 22.990	12 Mg magnesium 24.305 [24.304, 24.307]	3	4	5	6	7	8	9	10	11	12	13 Al aluminium 26.982	14 Si silicon 28.085 [28.084, 28.086]	15 P phosphorus 30.974	16 S sulfur 32.06 [32.059, 32.076]	17 Cl chlorine 35.45 [35.446, 35.457]	18 Ar argon 39.948
19 K potassium 39.098	20 Ca calcium 40.078(4)	21 Sc scandium 44.956	22 Ti titanium 47.867	23 V vanadium 50.942	24 Cr chromium 51.996	25 Mn manganese 54.938	26 Fe iron 55.845(2)	27 Co cobalt 58.933	28 Ni nickel 58.693	29 Cu copper 63.546(3)	30 Zn zinc 65.38(2)	31 Ga gallium 69.723	32 Ge germanium 72.630(8)	33 As arsenic 74.922	34 Se selenium 78.971(8)	35 Br bromine 79.904 [79.901, 79.907]	36 Kr krypton 83.798(2)
37 Rb rubidium 85.468	38 Sr strontium 87.62	39 Y yttrium 88.906	40 Zr zirconium 91.224(2)	41 Nb niobium 92.906	42 Mo molybdenum 95.95	43 Tc technetium	44 Ru ruthenium 101.07(2)	45 Rh rhodium 102.91	46 Pd palladium 106.42	47 Ag silver 107.87	48 Cd cadmium 112.41	49 In indium 114.82	50 Sn tin 118.71	51 Sb antimony 121.76	52 Te tellurium 127.60(3)	53 I iodine 126.90	54 Xe xenon 131.29
55 Cs caesium 132.91	56 Ba barium 137.33	57-71 lanthanoids	72 Hf hafnium 178.49(2)	73 Ta tantalum 180.95	74 W tungsten 183.84	75 Re rhenium 186.21	76 Os osmium 190.23(3)	77 Ir iridium 192.22	78 Pt platinum 195.08	79 Au gold 196.97	80 Hg mercury 200.59	81 Tl thallium 204.38 [204.38, 204.39]	82 Pb lead 207.2	83 Bi bismuth 208.98	84 Po polonium	85 At astatine	86 Rn radon
87 Fr francium	88 Ra radium	89-103 actinoids	104 Rf rutherfordium	105 Db dubnium	106 Sg seaborgium	107 Bh bohrium	108 Hs hassium	109 Mt meitnerium	110 Ds darmstadtium	111 Rg roentgenium	112 Cn copernicium	113 Nh nihonium	114 Fl flerovium	115 Mc moscovium	116 Lv livermorium	117 Ts tennessine	118 Og oganesson

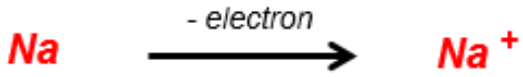
57 La lanthanum 138.91	58 Ce cerium 140.12	59 Pr praseodymium 140.91	60 Nd neodymium 144.24	61 Pm promethium	62 Sm samarium 150.36(2)	63 Eu europium 151.96	64 Gd gadolinium 157.25(3)	65 Tb terbium 158.93	66 Dy dysprosium 162.50	67 Ho holmium 164.93	68 Er erbium 167.26	69 Tm thulium 168.93	70 Yb ytterbium 173.05	71 Lu lutetium 174.97
89 Ac actinium	90 Th thorium 232.04	91 Pa protactinium 231.04	92 U uranium 238.03	93 Np neptunium	94 Pu plutonium	95 Am americium	96 Cm curium	97 Bk berkelium	98 Cf californium	99 Es einsteinium	100 Fm fermium	101 Md mendelevium	102 No nobelium	103 Lr lawrencium

INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY

For notes and updates to this table, see www.iupac.org. This version is dated 28 November 2016.

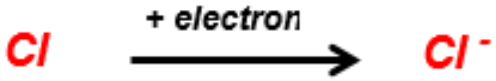
Sodium is a reactive metal found at the left part of the periodic table and chlorine, a reactive non-metal found at the right part of the periodic table. Do you know to what family do the most reactive metals and the most reactive nonmetals belong? Yes, sodium falls under family 1 or IA in the old classification and chlorine in family 17 or VIIA in the old classification. When these two reactive atoms combined, salt will be formed, and it is an example of an ionic compound. But how this ionic substance was formed?

Metals contain loosely held electrons that can be easily dislodged, which means these electrons are easily removed from metals, like sodium atom.



So how do these loosely hold electrons function in the bonding formation? Where will these electrons go after being kicked off from a metal?

Chlorine atom on the other hand is capable of accepting electrons and accommodate it on its shell.



So, what is the purpose of gaining and losing of an electron? How is this process of gaining and losing electron affect the chemical property of an atom?

Some elements are not chemically active under ordinary conditions; these are the noble gases.

Those elements that will lose electrons require a certain amount of energy to do it. This is known as ***ionization energy***.

On the other hand, those elements capable of accepting electrons also require certain amount of energy for them to accommodate the said electrons in their shell, this is known as ***electron affinity***.

Before we will discuss the formation of the ionic bond, let's consider first the information given on the table below. This will give us some precautionary measure in illustrating the formation of an ionic bond.

Family or Group	IA (1)	IIA (2)	IIIA (3)	IVA (4)	VA (15)	VIA (16)	VIIIA (17)
Covalency number	1	2	3	4	3	2	1
Oxidation number	1+	2+	3+	4+ to 4 -	3 -	2 -	1 -

Covalency number refers to how many bonds an atom can have when it forms a compound, while **oxidation** number refers to the charge of an atom when it loss or gain electrons and become an ion.

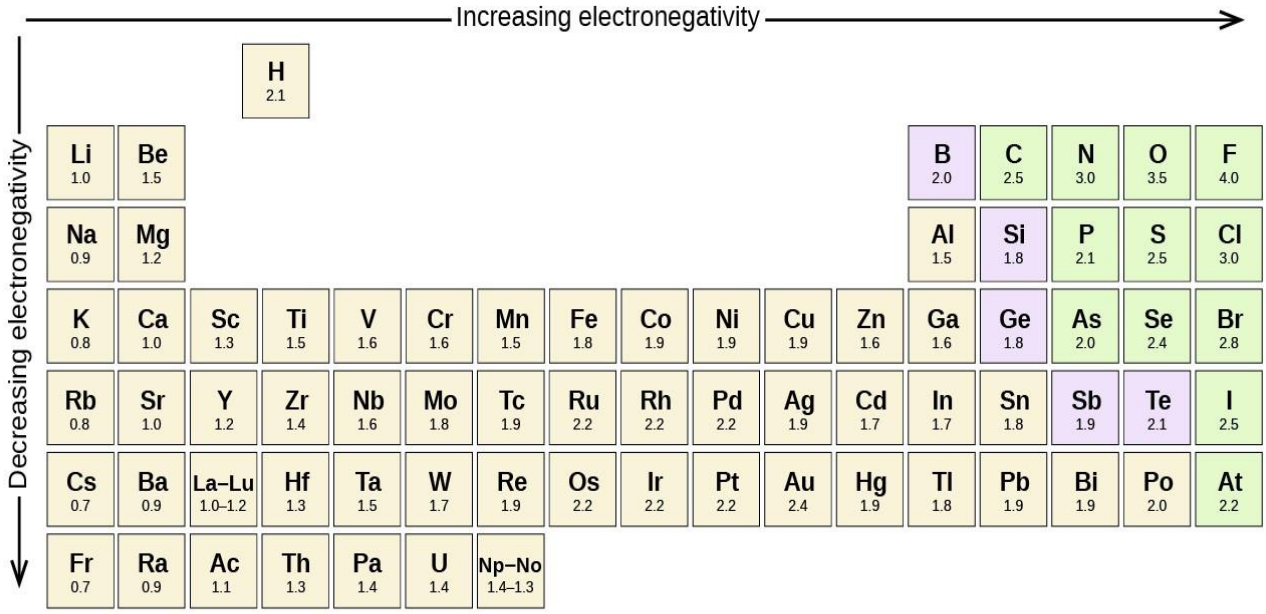
Now, look at your periodic table. What are the elements in family 1 or IA? These are Li, Na, K, Rb, Cs, and Fr. What are their covalency number and charge? From the table given, each element has a covalency number of 1 which means, they can only have 1 bond, and an oxidation number of 1+. How can we account for the charge, 1+? This indicates that each element can give up only one electron, and that explains why sodium has a 1+ charge.

How about the elements in family 4? They have a covalency number of 4, that means, they can form 4 bonds only, a good example is C atom, which will be discussed separately, but, what is that 4- to 4+? What is the meaning of this value range? These values will tell us that C can have a charge of 4 - up to 4+, depending on the type of compounds or ions it will form.

Elements in family 17 or VIIA can carry a charge of 1- . What does it mean? This means that the elements of this family can accept one (1) electron. This explains why chlorine carries a charge of 1 -.

Another important table is the electronegativity table. The values in this table will give us an idea of how to determine the type of bond will be formed by the combining atoms, would it be ionic or covalent. Covalent bonding will be discussed in the next lesson.

Electronegativity Table



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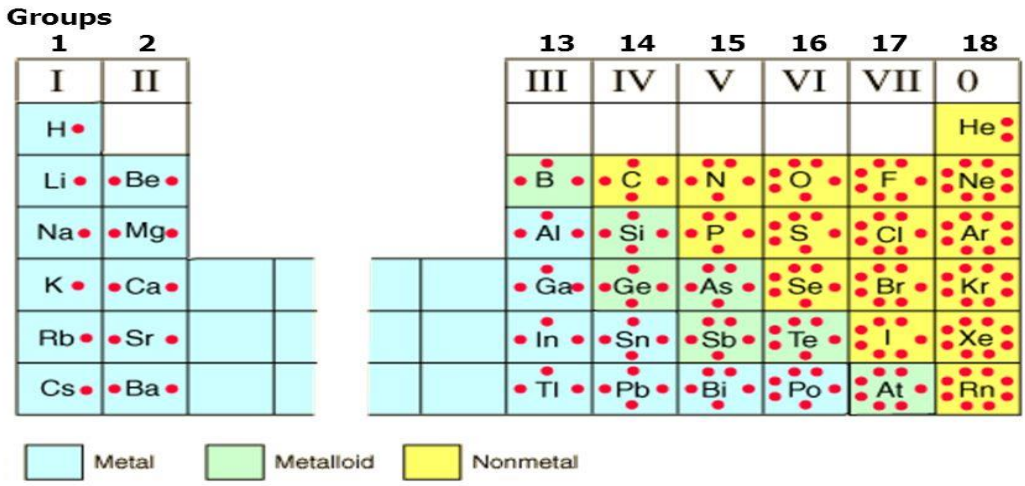
The last table is the **Lewis Electron Dot Structure (LEDS)** of the different elements. The table gives us the elements' symbols surrounded by dots representing the valence electrons or the outermost electrons, which are responsible for the combining capacity of the elements. The dots also tell us to what family each element belong. So, it is expected that the family number is equal to the valence electrons of the element. When the atom gained or lost electron/s, they tend to have the configuration of the elements in the noble gas that has eight (8) electrons, known as ***OCTET*** (except for the element He, which has 2 electrons or ***DUET*****).**

Lewis Electron Dot Structures



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So, ready for the ionic bonding formation? Let's start! Consider again salt. The combination of sodium (Na) atom, from Family 1 and chlorine atom (Cl) from family 17.

The electronic configuration of sodium is $1s^2\ 2s^2\ 2p^6 3s^1$, while that of chlorine atom is $1s^2\ 2s^2\ 2p^6\ 3s^2 3p^5$. Na is a metal, a very reactive metal in family one, and it is capable of losing an electron. How many electrons? 1 electron. It will become an ion with a charge of 1+. Chlorine on the other hand is a very reactive nonmetallic element, a gaseous element, and is capable of accepting or gaining one (1) electron. How many? 1 electron, making an ion with a 1- charge. From the definition of an ionic bond, these two charge particles will be attracting each other (called electrostatic attraction) to form a compound sodium chloride. The best way to understand this is to have an illustration.

First, using the electronic configuration; second, using the orbital notation, and third, using the Lewis Electron Dot Structure (LEDS)

A) <u>Electronic configuration:</u>

$_{11}Na \quad 1s^2\ 2s^2\ 2p^6\ 3s^1 \xrightarrow{-\ electron} {}_{11}Na^+\ 1s^2\ 2s^2\ 2p^6$ (3s is gone)

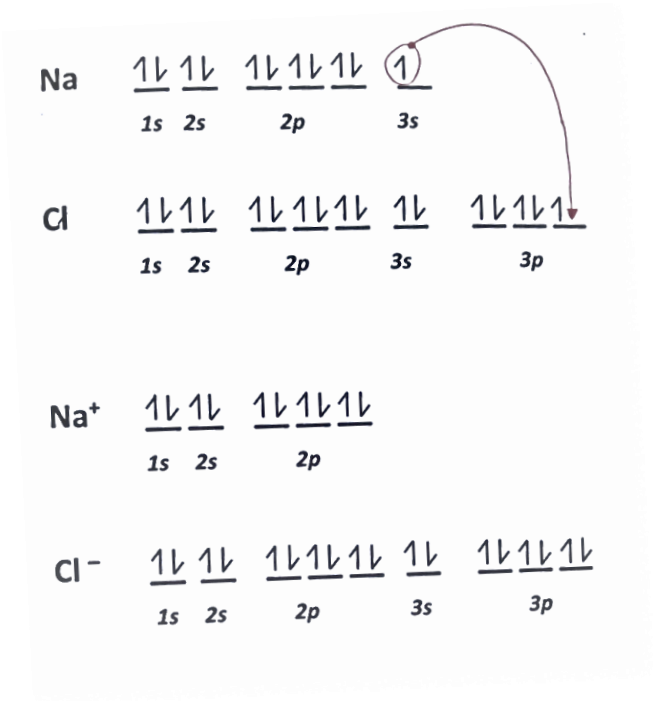
$_{17}Cl \quad 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5 \xrightarrow{+\ electron} {}_{17}Cl^-\ 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$

Combining the two: $Na^+ + Cl^- \longrightarrow NaCl$

or crisscrossing the charges: $Na^+ \quad Cl^-$ Na_1Cl_1 or **NaCl**.

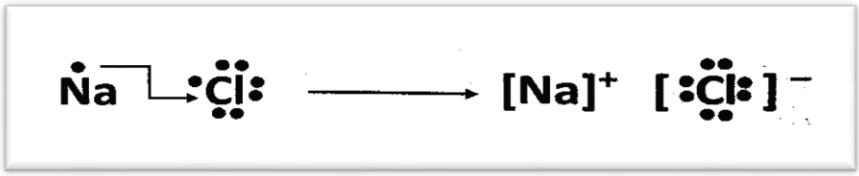
Note that the charges become subscript and eventually removed because these numbers are the same.

B) Orbital Notation



Note that the single 3s electron of Na is transferred to chlorine's 3p configuration, making the 3s of Na to disappear and the 3p of Cl to be filled. Sodium now carries a positive charge, and chlorine, a negative charge

C) Lewis Electron Dot Structure (LEDS)



Notice that the configuration of **Na** $^{+}$ $1s^2 2s^2 2p^6$ is similar to that of Ne. And for **Cl** $^{-}$ $1s^2 2s^2 2p^6 3s^2 3p^6$ is similar to that of Ar.

Both sodium ion and chlorine ion took the noble gas configuration. Sodium ion has the same electronic configuration with Ne (Na^+ is isoelectronic with Ne) and chlorine ion or chloride has the same electronic configuration with Ar (Cl^- is isoelectronic with Ar).

Here is another example, consider the combination: Magnesium ($_{12}Mg$) and Oxygen ($_{16}O$).

a) Electronic configuration:

$_{12}Mg$ $1s^2\ 2s^2\ 2p^6\ 3s^2$ — **- 2 electrons** → $_{12}Mg^{2+}$ $1s^2\ 2s^2\ 2p^6$

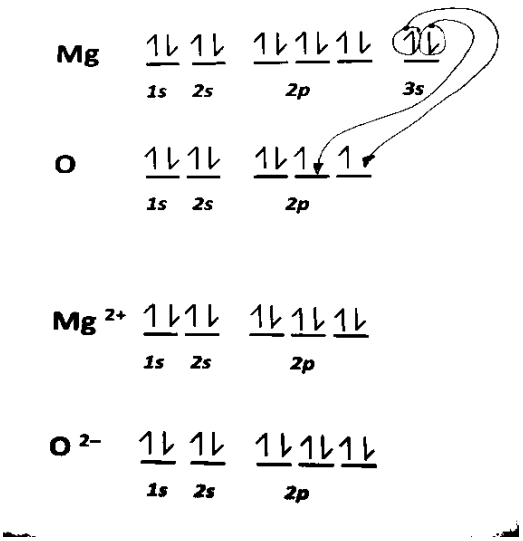
$_{16}O$ $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^4$ — **+ 2 electrons** → $_{16}O^{2-}$ $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$

Combining the two: $Mg^{2+} + O^{2-} \longrightarrow MgO$

Or crisscrossing the charges: Mg^{2+} O^{2-} $\longrightarrow$ Mg_2O_2 or MgO

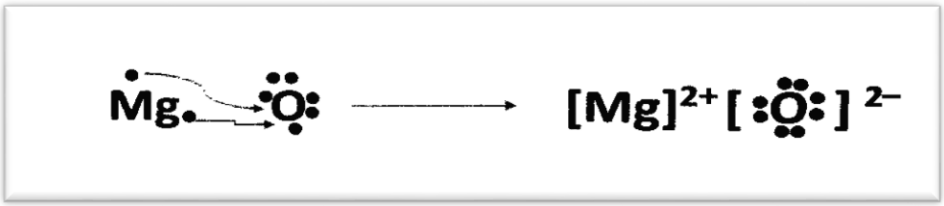
Again, the charges become subscripts and removed because they are the same.

b) Orbital Notation



Note that the two electrons of Magnesium (3s configuration) disappeared and are transferred to the 2p configuration of Oxygen. The 2p configuration of O is now filled, while the 3s configuration of Mg is gone.

c) Lewis Electron Dot Structure (LEDS)



In this example, both Mg ion and Oxygen ion took the configuration of the noble gas Neon. Mg^{2+}, O^{2-}, and the Noble gas Neon are isoelectronic.

Now let us consider the degree of how the electron is transferred by getting the electronegativity difference. We will use the electronegativity table given. If the difference is greater than 1.9, there is a complete transfer of electron (or electrons) and the bond that will be formed is ionic. If the difference is less than 1.9, there will be no transfer of electrons, only shared by the combining elements.

Consider NaCl:

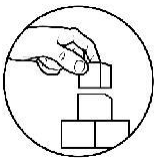
Na	0.9	difference (greater value - lower value)
Cl	3.0	= 3.00 - 0.9 = 2.1

Since the difference is greater than 1.9, therefore there's a complete transfer of electrons; hence there will be a formation of an ionic bond.

Consider the electronegativity difference between Al and O

Al	1.5	difference
Br	2.8	= 2.8 - 1.5 = 1.3

Since the electronegativity difference is less than 1.9, then the bond formed could not be classified as ionic. The value tells us that the energy is not enough to achieve the complete transfer of electrons from Al to Bromine. (This is justifiable the fact that Al is not as reactive as Li or sodium. It is under family 13 or IIIA family). So, the bond formed between them is definitely covalent, and this will be discussed in the next lesson.



What's More

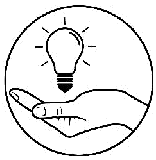
Exercises 1:

A) Using the periodic table of elements, complete the table below by filling in the blanks with the correct answers. The first item is already done to guide you.

Elements	**Group Number**	**Covalency Number**	**Oxidation number**
1) Li	17 or VIIA	1	1-
2) Ca			
3) Br			
4) N			
5) Fr			

B) Tell how many electrons are involved when each given atom forms a bond, then specify whether the electron/s is/are gained or lost. Write your answer on the space provided. The first number is already answered to guide you.

1) K	1 electron	Lost
2) P		
3) F		
4) Al		
5) Ba		



What I Have Learned

Activity1

Illustrate the bonding formation of the following combination of elements, use the three ways of illustrating the ionic bonding formation: ***a) electronic configuration b) Orbital notation, and c) Lewis Electron Dot Structure (LEDS)***. Use a separate paper for your answer.

1) Li and F

a) Electronic configuration:
b) Orbital Notation
c) LEDS

2) Be and O

a) Electronic configuration:
b) Orbital Notation
c) LEDS

Q1: What kind of elements usually form ionic bonds? _____
_____
_____
_____

Q2: How do ionic bonds form between atoms? _____
_____
_____

What I Can Do

Answer as directed.

1) Why it is necessary for an atom to loss or gain an electron?
_____
_____
_____

2) Why do we have to consider the covalency number and the oxidation number of the atom in the construction of the ionic bond?
_____
_____
_____

3) How does a noble gas configuration help in the concept of bonding formation?
_____
_____
_____

Lesson

2

Covalent Bonding

What I Need to Know

At the end of the lesson, you will be able to define and explain the formation of a Covalent bond.

Specifically, after going through this module, you will be able to:

1. Explain how covalent bonding takes place;
2. Illustrate the sharing of electrons
3. Classify the covalent compounds as polar and non- polar covalent bond

What's New

At room temperature, sodium chloride (NaCl) is a crystalline solid. It has a very high melting point while water (H_2O) is a liquid that has a low melting and boiling points. They differ in the way they form bonds. Sodium chloride is an ionic compound while water is a covalent compound. Covalent compounds are combinations of two non-metals. A covalent bond is formed by the sharing of electrons between two atoms with identical or relatively close electronegativity values.

Table 1. Covalent Bond Type

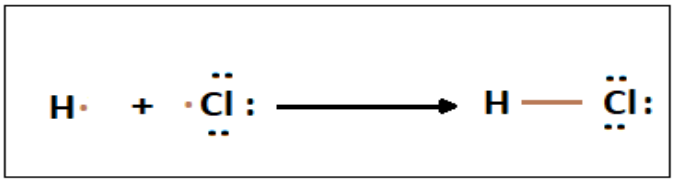
Bond Type	**Electronegativity value**
Polar Covalent Bond	0.5 to 1.9
Non-polar Covalent Bond	0 to 0.4

There are two types of covalent bonds. Polar covalent bond if the electronegativity difference is 0.5 to 1.9. If the electronegativity difference is 0 to 0.4 that is a non-polar covalent bond.
Atoms could also form

1. Single Covalent Bond
2. Double Covalent Bond
3. Triple Covalent Bond

1. **A single bond** is formed when only one pair of the electron is shared between the two participating atoms. It is represented by one dash (-). Although this form of covalent bond has a smaller density and is weaker than a double and triple bond, it is the most stable.

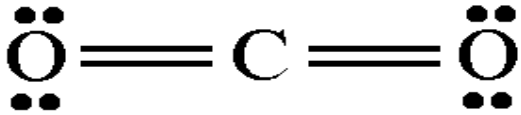
   For Example**,** HCl molecule has one Hydrogen atom with one valence electron and one Chlorine atom with seven valence electrons. In this case, a single bond is formed between hydrogen and chlorine by sharing one electron.



2. **A double bond** is formed when two pairs of electrons are shared between the two participating atoms. It is represented by two dashes. Double covalent bonds are much stronger than a single bond, but they are less stable.

   For Example, Carbon dioxide CO_2 molecule has one carbon atom with four valence electrons and two oxygen atoms with six valence electrons.

   Each oxygen atom shares its two electrons with carbon and therefore there are two double bonds in CO2.



CO_2 Molecule with Double bond

3. A **triple bond** is formed when three pairs of electrons are shared between the two participating atoms. Triple covalent bonds are represented by three dashes (≡) and are the least stable types of covalent bonds.

   For Example, in the formation of a nitrogen molecule, each nitrogen atoms having five valence electrons provides three electrons to form three electron pairs for sharing. Thus, a triple bond is formed between the two nitrogen atoms.

What Is It

As we know that the group number of the representative elements in the periodic table represents the valence electron in the outer shell, likewise it is also the same with the number of dots. The covalency number represents the number of bonds formed by the atoms. Refer to the previous table.

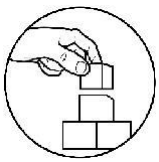
Example: show the covalent bond of oxygen gas (O_2)

The above illustration shows that the oxygen belongs to group VIA and has 6 valence electron and 6 electron dots around, the covalency number is 2, thus oxygen can form double bonds between two oxygen atoms.

Exercise

Using Lewis Dots Structure, illustrate the bonding formation of the following covalent compounds:

1. Carbon tetrachloride (CCl_4) _____
2. Sulfur trioxide (SO_3) _____
3. Ammonia (NH3) _____
4. Methane (CH_4) _____
5. Hydrogen chloride (HCl) _____

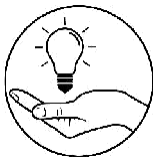


What's More

ACTIVITY NO.1

A. Show the acceptable Lewis structure to form covalent bond in the following compounds:
   a. NH_3
   b. H_2O
   c. HCl
   d. PH_3
   e. H_2

B. Classify the compounds given in part A as Polar covalent bond or Non-polar covalent bond by getting their electronegativity difference based on the electronegativity table given in the previous module.
   a._____
   b._____
   c._____
   d._____
   e._____



What I Have Learned

ACTIVITY NO.2

Complete the table below: Show the sharing of electrons given the chemical formula then identify the type of bond as polar or non-polar covalent bond.

Chemical Formula	**Lewis structure/sharing of electrons**	**Type of bond Polar or non-polar**
H_2O		
BF_3		
Cl_2		
NH_3		
CH_4		

QUESTIONS:

1. What kind of elements usually forms covalent bond?

   _____
   _____
   _____

2. How do the covalent bonds form between atoms?

   _____
   _____
   _____
   _____

What I Can Do

You have learned that covalent bonds result from sharing of electrons in order to attain stable configuration like noble gases and covalent compound is formed.

Activity no.3

1. Why do atoms combine? Justify your answer.

   _____
   _____
   _____

2. Why is it that diatomic molecule such as N_2, Cl_2, and O_2 always form nonpolar covalent bonding?

   _____
   _____
   _____

3. How would you differentiate polar and nonpolar based on its electronegativity difference?

   _____
   _____
   _____

4. Apply to the real situation: why is stability important? How do people become stable?

   _____
   _____
   _____
   _____

Summary

- Atoms combine to have stability. This could be achieved by either losing or gaining an electron.
- By losing or gaining electron or electrons, the atom takes the electronic configuration of a noble gas, in which the outermost configurations or the outermost ***s*** and ***p*** configurations are being filled up, having a total of 8 electrons.
- In forming an ionic bond, there is a total or net transfer of electron or electrons from a very reactive metal to a very reactive nonmetal.
- Lewis symbol is composed of the symbol of the element and dots which represent the number of valence electrons of an atom that can easily be determined through the group/ family number in the Periodic Table of Elements.
- Covalent bond involves the sharing of electrons that results in the formation of a covalent compound.
- Covalent bonds may be polar and nonpolar.
- Diatomic molecules always form nonpolar covalent compounds such as O_2, N_2, H_2, F_2, and Cl_2.

Glossary:

- **Chemical bonding** is the process of linking or joining together of atoms to gain stability and to form a compound or molecule.
- A **chemical bond** is a force of attraction that holds atoms together in a compound or a molecule.
- **Anion** is an atom that gains an electron or electrons and carries a negative charge that corresponds to the number of electron or electrons it gained.
- **Cation** is an atom that loses an electron or electrons and carries a positive charge that corresponds to the number of electron or electrons it lost.
- **Covalency number** refers to the number of bonds that an atom can form.
- **Oxidation number** refers to the charge that an atom carries when it becomes an ion. It could have a positive value or a negative value.
- **Lewis Electron Dot Structure (LEDS)** is a convention illustrating an atom's symbol surrounded by dots which represent the outermost electron/s or valence electron/s. It was developed by Gilbert Newton Lewis
- **Isoelectric** or **isoelectronic** species are atoms or ions that have the same electronic configurations.

Assessment: (Post-Test)

I. **Multiple Choice.** Choose the letter that corresponds to the correct answer. Write the letter of your choice on your answer sheet.

1) How many bonds can Sr atom form?
   a) 5 c) 3
   b) 4 d) 2

2) How many electrons must an N atom accept to gain stability?
   a) 2 c) 4
   b) 3 d) 5

3) Which of the following statements best describes the formation of KF?
   a) potassium must accept 1 electron from chlorine.
   b) Fluorine must gain 3 electrons from Potassium.
   c) Fluorine must accept 1 electron from Potassium.
   d) Potassium must gain 2 electrons from chlorine.

4) Aluminum ion has a formula of, Al^{3+}, it indicates that Aluminum can:
   a) Lost 2 electrons c) Lost 3 electrons
   b) Gain 2 electrons d) Gain 5 electrons

5) Sulfide has the formula S^{2-}, this means that sulfur can gain two electrons from ___

a) Lithium
b) Chlorine
c) Magnesium
d) Helium

6) How is covalent bond form?

a) transfer of electrons
b) sharing of electrons
c) losing of electrons
d) gaining of electrons

7) How many types of bonds can oxygen atom form?

a) 1
b) 2
c) 3
d) 4

8) What kind of bond will result when two non-metallic atoms combine?

a) Ionic bond
b) Metallic bond
c) Covalent bond
d) Nonpolar covalent bond

9) H reacts with S to form

a) HS_2
b) H_2S
c) HS
d) H_2S_2

10) In H_2O molecule, the atoms are held by

a) Ionic bond
b) Metallic bond
c) Polar covalent bond
d) Nonpolar covalent bond

11) A covalent bond

a) Involves shared electrons
b) Is formed by sharing protons
c) Results from the transfer of electrons
d) Is also called electrovalent

Questions 12 -15, Classify the following compounds as <u>polar</u> or <u>nonpolar.</u>

12) SO_2
13) N_2
14) Cl_2
15) NH_3

Answer Key

Questions`

1. nonmetals
2. by sharing electrons

What 'can I do

Possible answers:

1) To attain stability

   To attain noble gases electron configuration

2) Because their electronegativity difference is zero

3) Polar covalent bond their electronegativity difference ranges from 0.5 to 1.9
   While non-polar range from 0 to 0.4

4) A. - it is important because it makes you feel in control, comfortable and happy.

   - You can support your family financially

   B. people become stable when He /She landed a permanent job

Assessment (Post Test)

1) D	6) B	11) A
2) B	7) B	12) POLAR
3) C	8) C	13) NON - POLAR
4) C	9) B	14) NON - POLAR
5) C	10) C	15) POAR

What's More

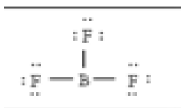
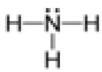
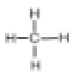
A.

1. Hydrogen Chloride
2. Carbon disulfide
3. Boron trifluoride
4. Sulfur dioxide
5. Phosphorus trichloride

B

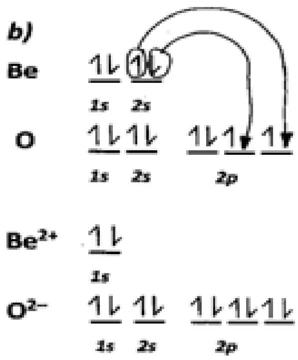
1) CCl_4
2) SO_3
3) NH_3
4) CH_4
5) HCl

What I Have Learned

Name of the compound	**Chemical Formula**	**Lewis structure/sharing of electrons**	**Type of bond Polar or non-polar**
Water	H_2O		polar
Boron trifluoride	BF_3		polar
Chlorine gas	Cl_2		Non-polar
Ammonia	NH_3		Polar
Methane	CH_4		Polar

Me

b)



$Be^{2+} + O^{2-} \longrightarrow BeO$

c)

Q1: Metals and Nonmetals

Q2: Net transfer of electrons

Activity 2:

1) Gaining or losing electron/s is a way of achieving stability. Here the atom that gained or lost an electron or electrons took the configuration of a noble gas which is a filled configuration, a very stable configuration.

2) It is very important to consider the covalency number and the oxidation number of the atom. The covalency number tells how many bonds an atom can form and the oxidation number tells how many electron or electrons an atom is capable of losing or gaining.

3) The noble gas configuration is very important in the concept of bonding formation because it tells how many electron/s must be gained or lost by an atom to form a bond. Ones an atom attained the noble gas configuration, it means it has gained stability.

Lesson 2 (Covalent Bonding)

What I know- Pre - test

1. C
2. A
3. B
4. D
5. D

6) B
7) NON - POLAR
8) POLAR
9) POLAR
10) NON – POLAR

Activity1

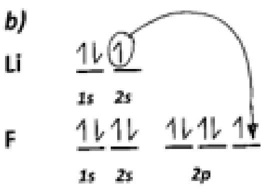
Li and F

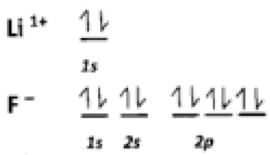
a) Li $1s^2\,2s^1$ ⟶ Li^+ $1s^2$

F $1s^2\,2s^2\,2p^5$ ⟶ F^- $1s^2\,2s^2\,2p^6$

Li^+ + F^- ⟶ LiF

b)





Li^+ + F^- ⟶ LiF

c)

1) Be and O

a)

Be $1s^2\,2s^2$ —(-2 electrons)⟶ Be^{2+} $1s^2$

O $1s^2\,2s^2\,2p^4$ —(+2 electrons)⟶ O^{2-} $1s^2\,2s^2\,2p^6$

Be^{2+} + O^{2-} or BeO

Pre - Test

1) C	6) A	11) C	16) B
2) C	7) B	12) A	17) NON – POLAR
3) D	8) C	13) B	18) POLAR
4) D	9) A	14) D	19) POLAR
5) B	10) C	15) D	20) NON - POLAR

Lesson 1: Ionic Bonding

Exercises 1:

A) .

Elements	Group Number	Covalency Number	Oxidation number
1) Li	Already answered		
2) Ca	IIA or 2	2	2+
3) Br	VIIA or 17	1	1 -
4) N	VA or 15	3	3 -
5) F	VIIA or 17	1	1-

B)

Element	Number of electron/s involved	Gain or lost
1) K	Already	answered
2) P	3	gain
3) F	1	gain
4) Al	3	lost
5) Ba	2	lost

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