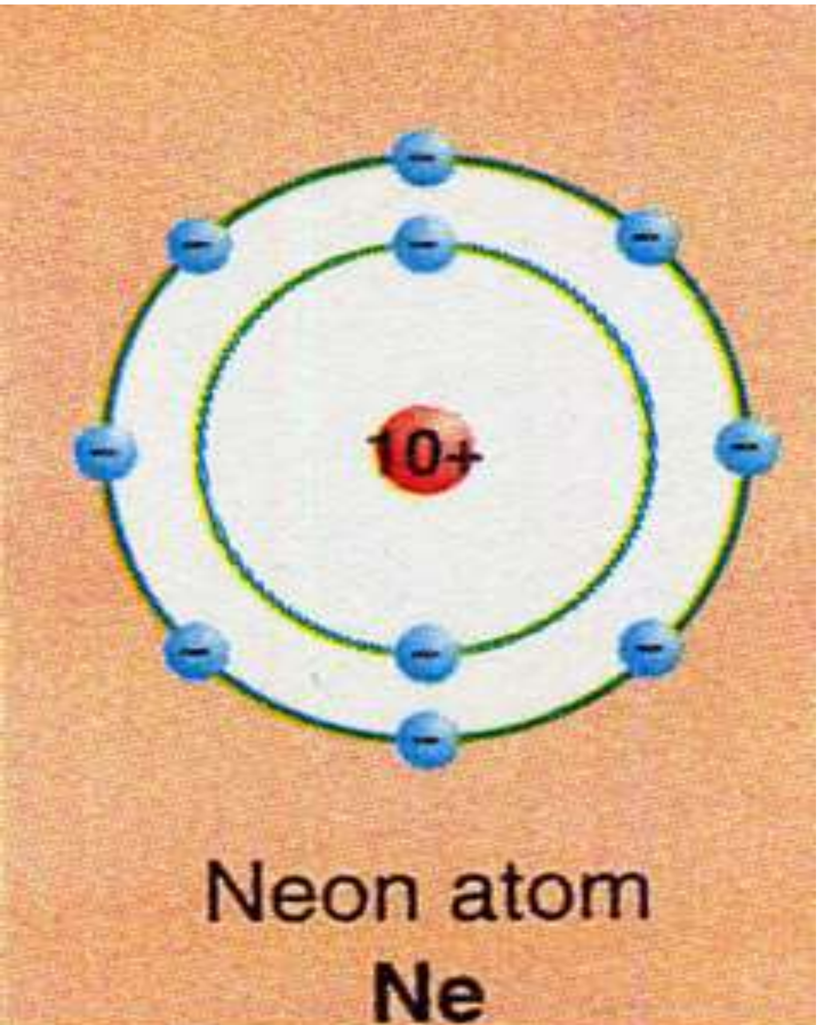
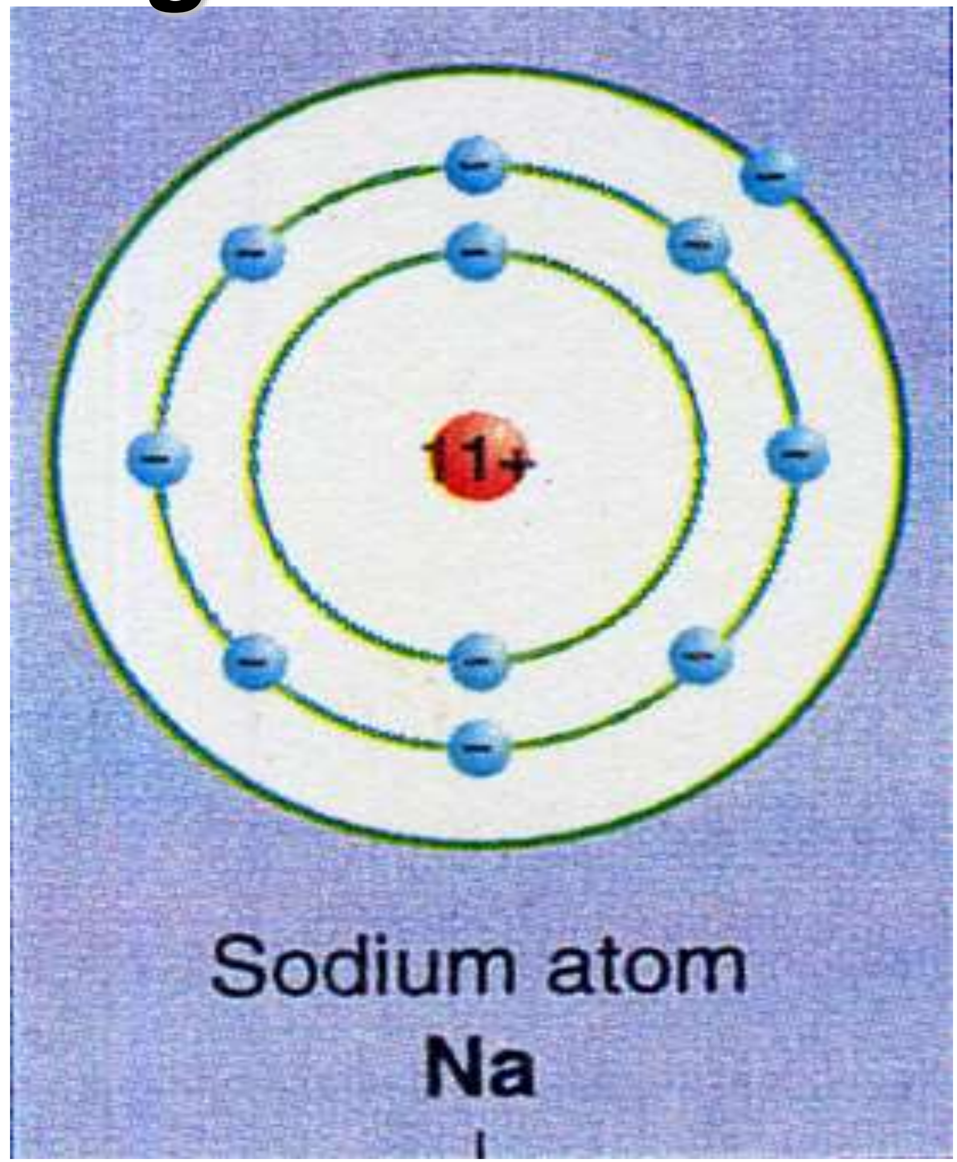
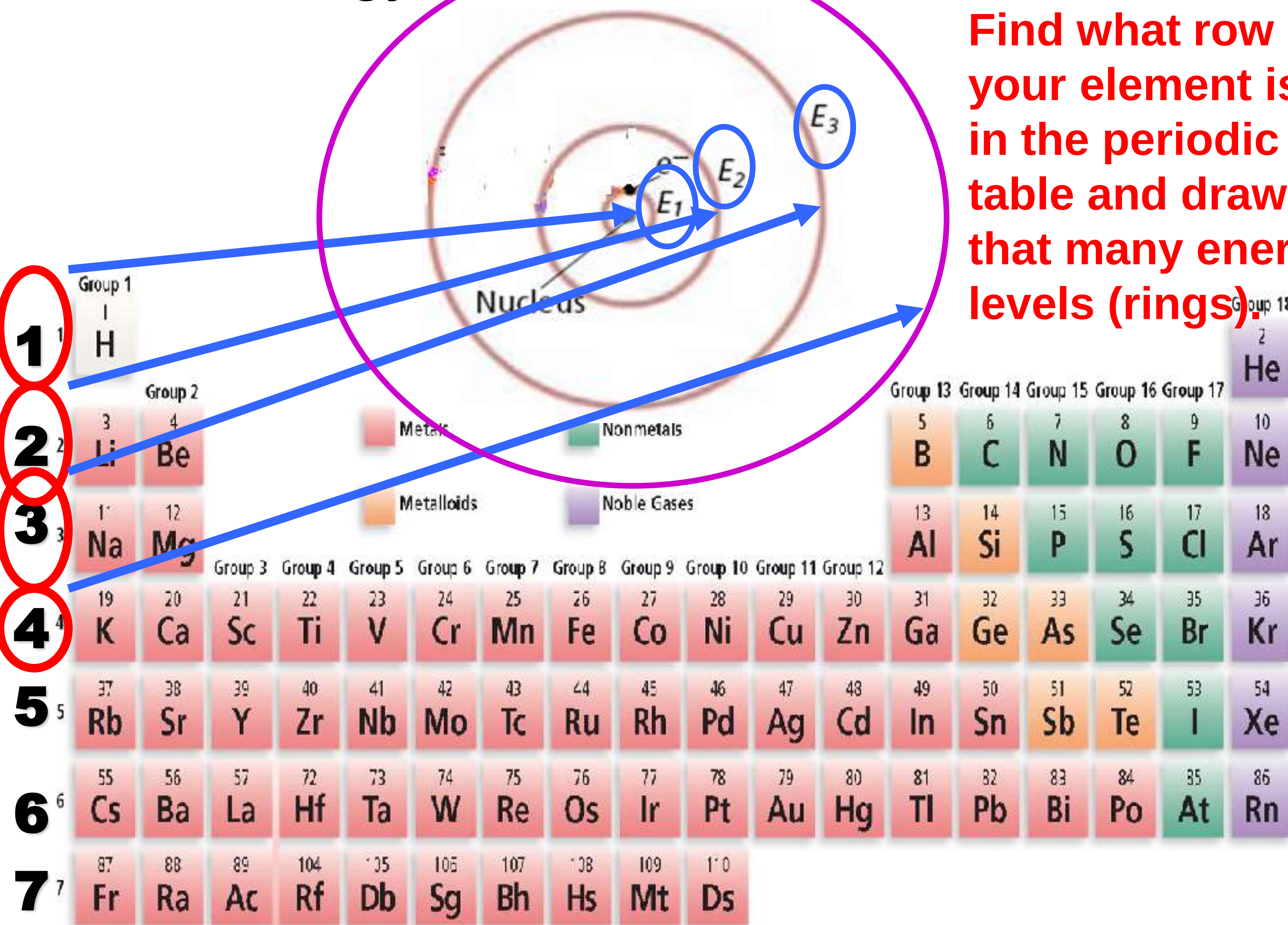
Bohr's Diagrams





Energy Levels & Electrons

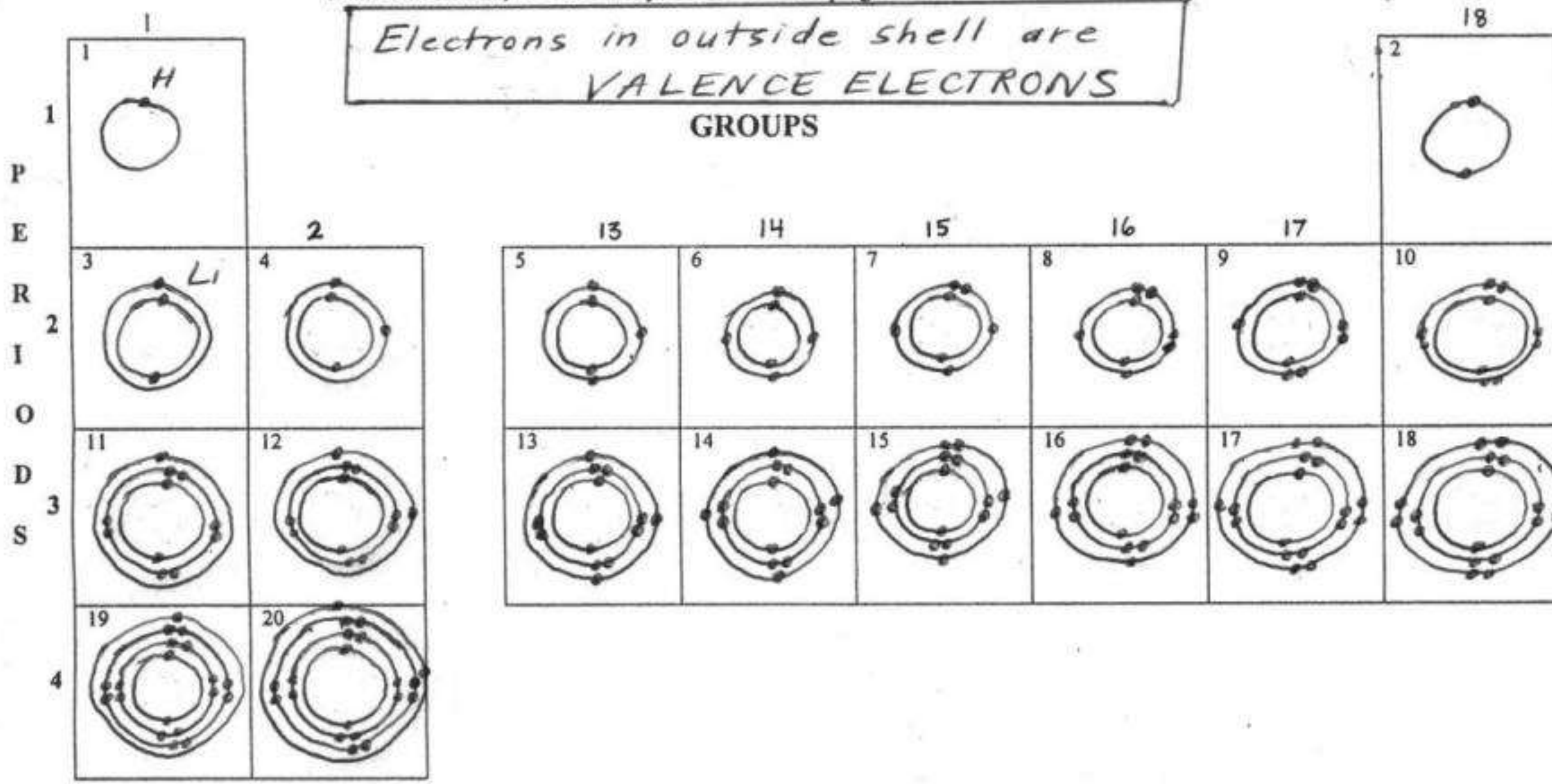
Find what row your element is on in the periodic table and draw that many energy levels (rings).



BOHR ORBITAL ACTIVITY: **COMPLETE THE BOHR DIAGRAMS FOR THE FIRST 20 ELEMENTS**

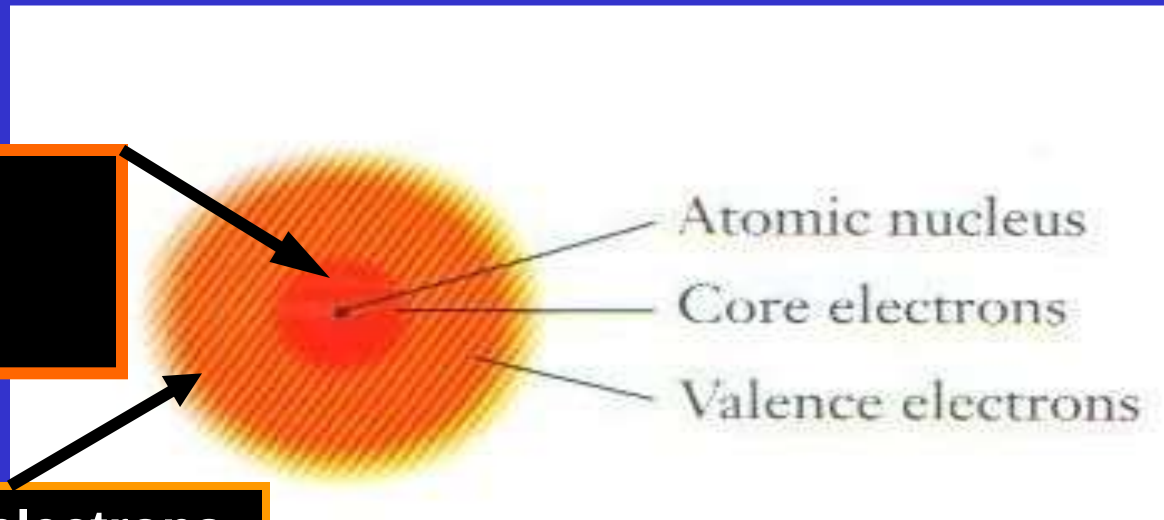
Name each element, and show the symbol for it in the top right corner!

Electrons in outside shell are VALENCE ELECTRONS



Shell Model

Electrons are filled in successive layers, from lower energy levels to higher levels.



Inner-shell (core) electrons or core electrons

Highest energy level electrons or outer level electrons

Inner-shell electrons are called **core electrons**.

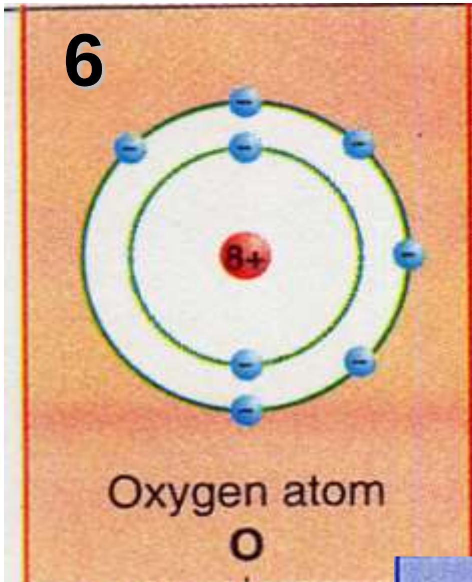
Electrons at the highest occupied energy level are called **valence electrons.**

Valence electrons are responsible for almost all chemical properties of an element.

Draw Bohr diagrams for O, F, Ne, Na, Mg

How many valence electrons do each of the atoms have?

6



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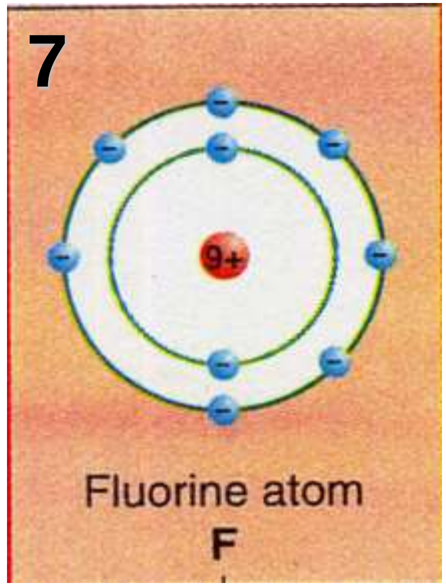

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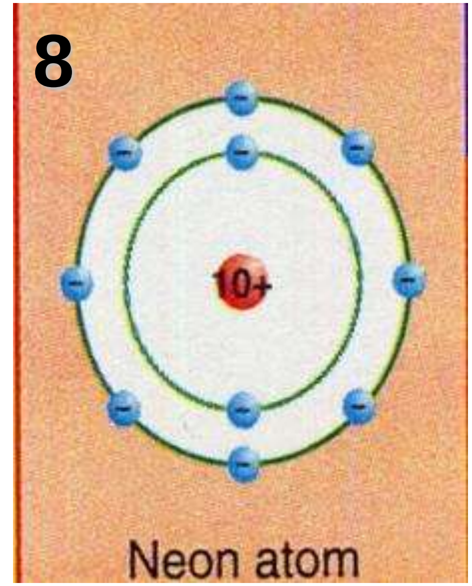
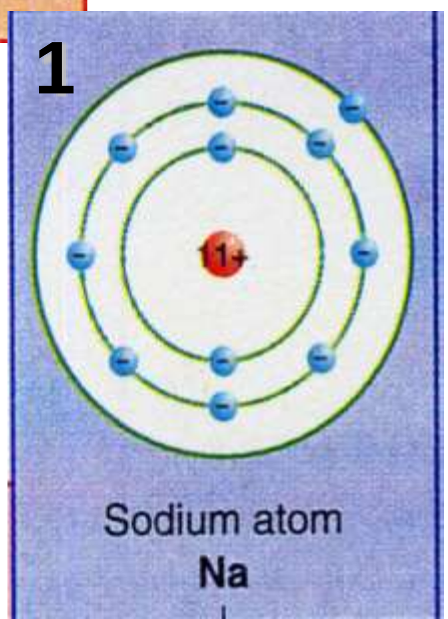


1



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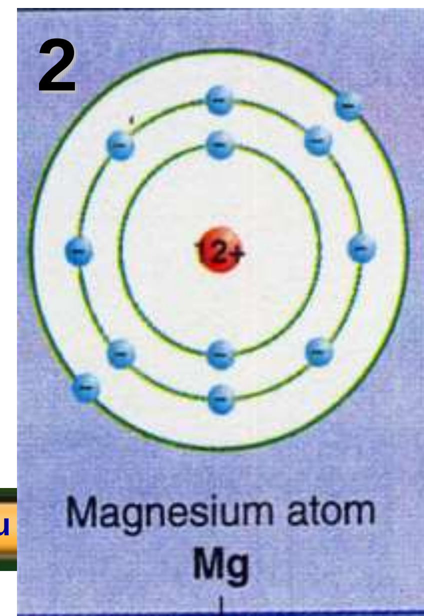
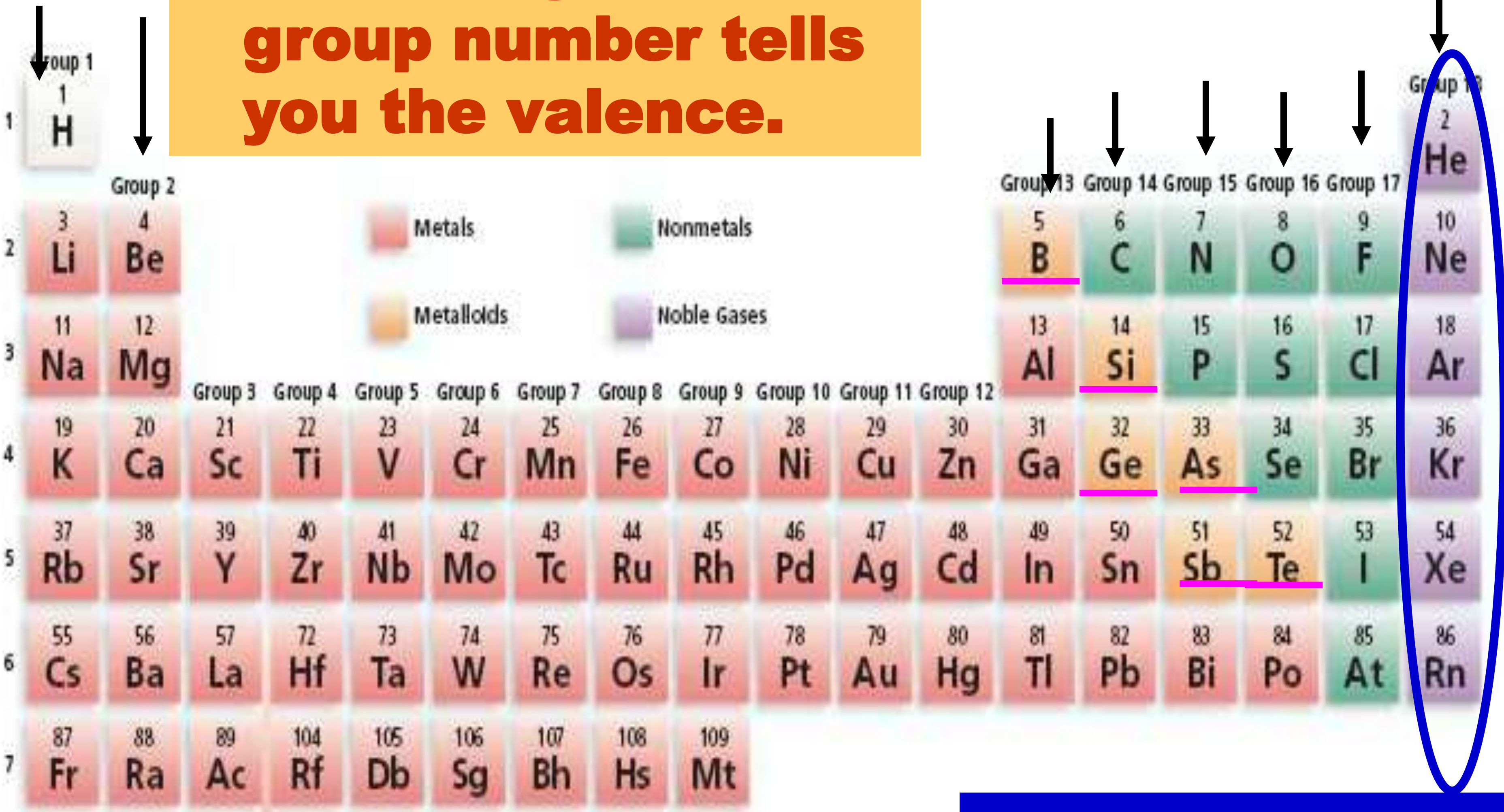


Chapter menu

1 2 valence 3 4 5 6 7 8

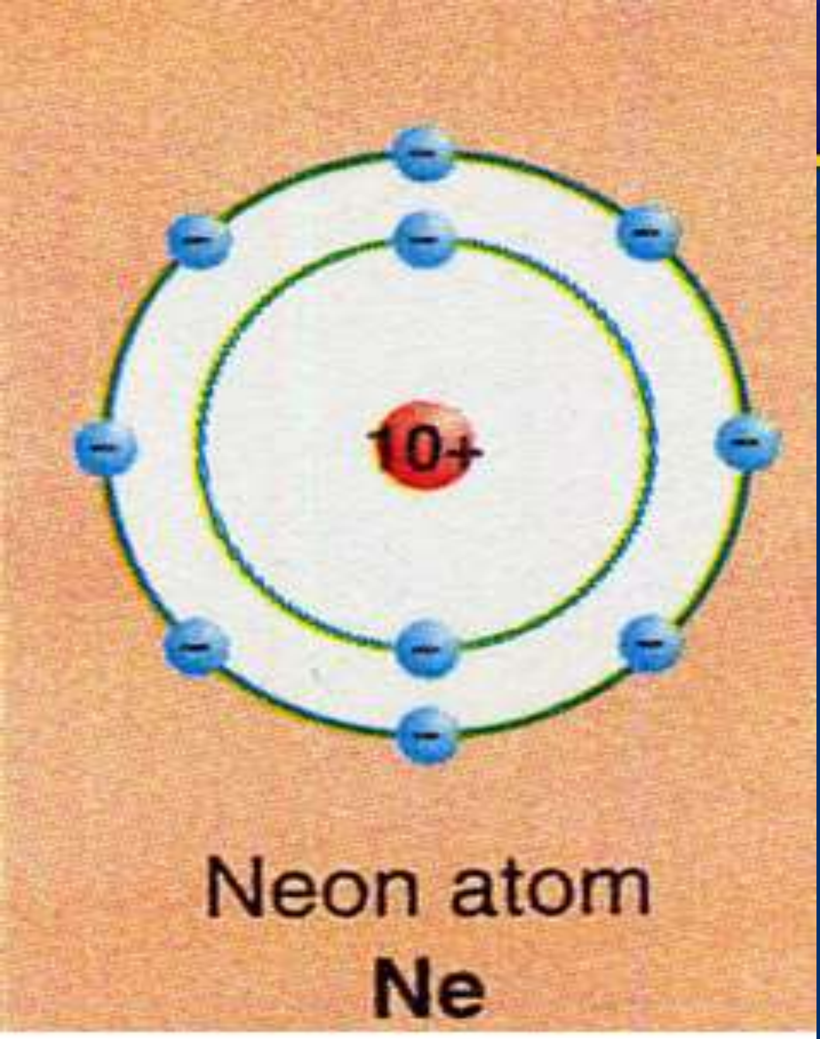
The last digit of the group number tells you the valence.



Nobel Gasses

The Octet Rule

- Noble gas atoms are unreactive because their electron configurations are especially stable.
- **Nobel gasses have an octet (8) of electrons in their highest occupied energy levels.**
  - Except He which has a duet (2) of electrons.
- ***The octet rule:*** **Ions and chemical compounds tend to form so that each atom, by gaining, losing, or sharing electrons, has an octet (8) of electrons in its highest occupied energy level.**



How many electrons does neon have in the lowest energy level? 2

How many electrons does Ne have in the 2nd energy level ? 8

How many electrons does Ne have have in the highest energy level? 8

How many valence electrons does Ne have?

Eight, which is the number of e^- at the highest occupied level.

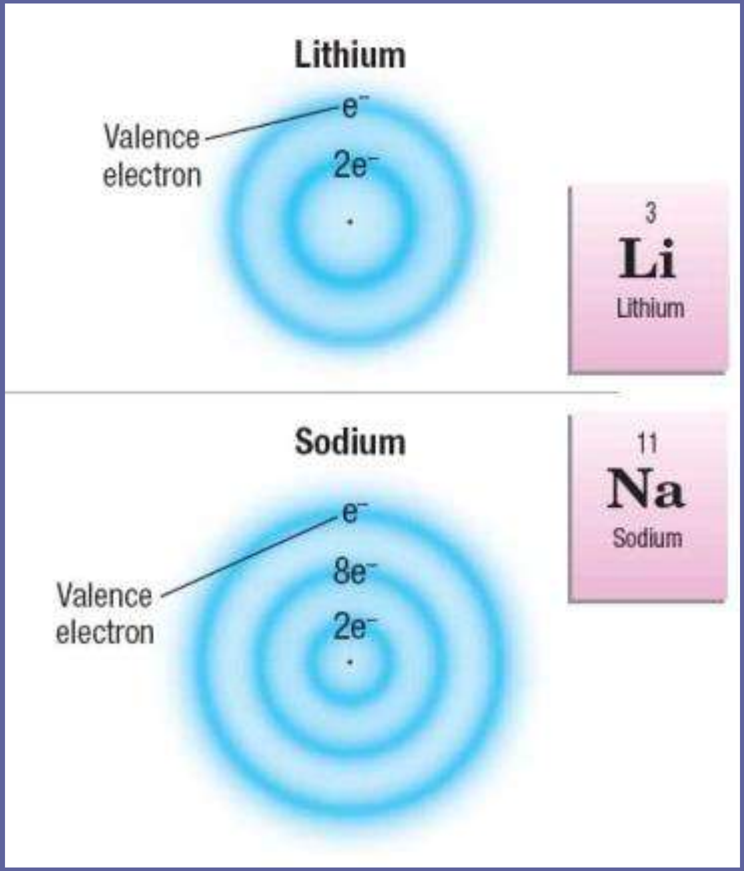
- **Note that the outer energy level is full with eight electrons.**

The Role of Electrons

- Why do elements within a group of the periodic table have similar chemical properties?
- The periodic trends in the periodic table are the result of electron arrangement.

The Role of Electrons, *continued*

- Valence electrons account for similar properties.
- An element's location in the periodic table is related to electron arrangement.
  - Example: Lithium and sodium, in Group 1, each have one valence electron.



Ion Formation

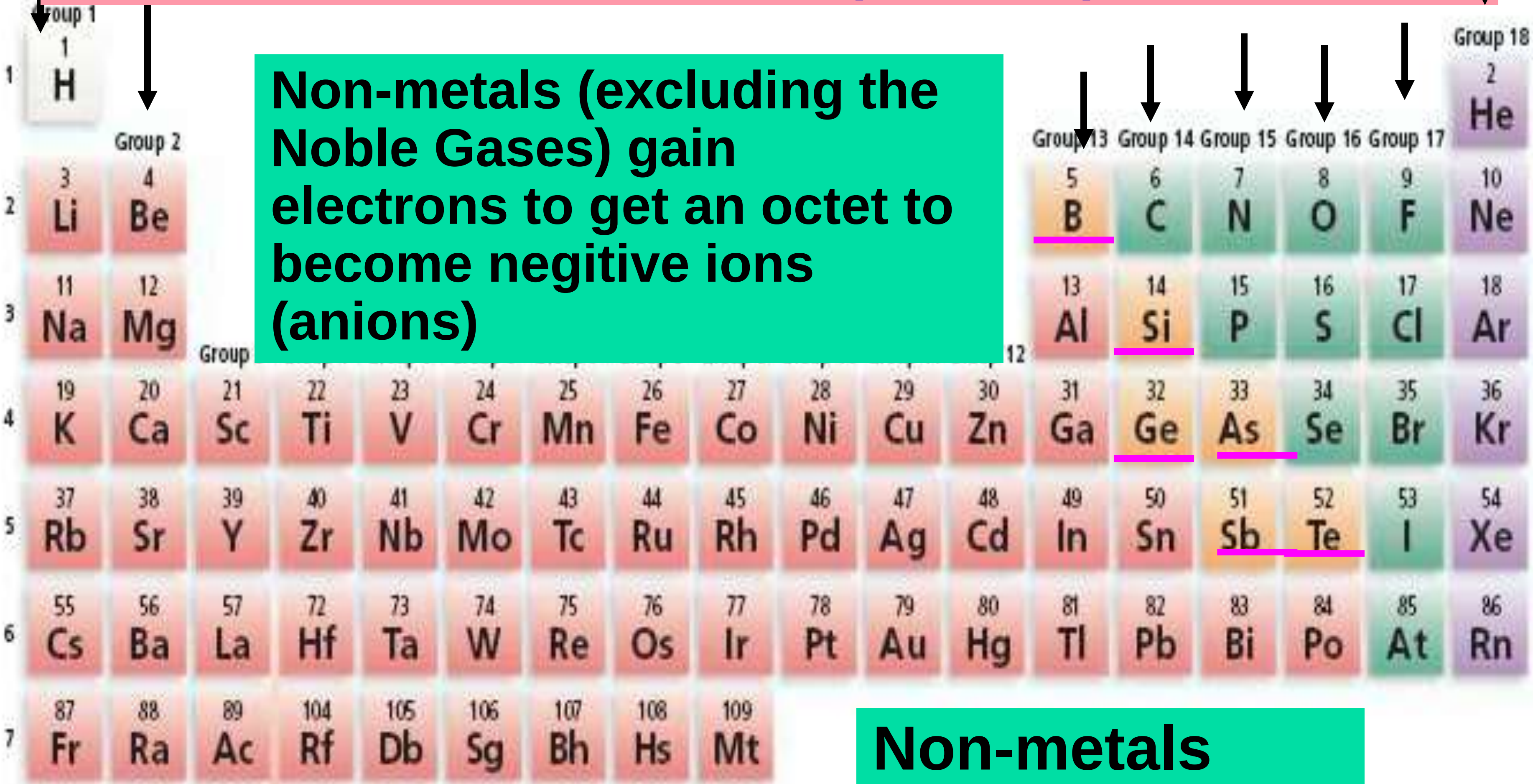
- What happens to an atom that gains or loses electrons?

- If an atom gains or loses electrons, it no longer has an equal number of electrons and protons. Because the charges do not cancel completely, the atom has a net electric charge.

1 2 valence 3 4 5 6 7 8

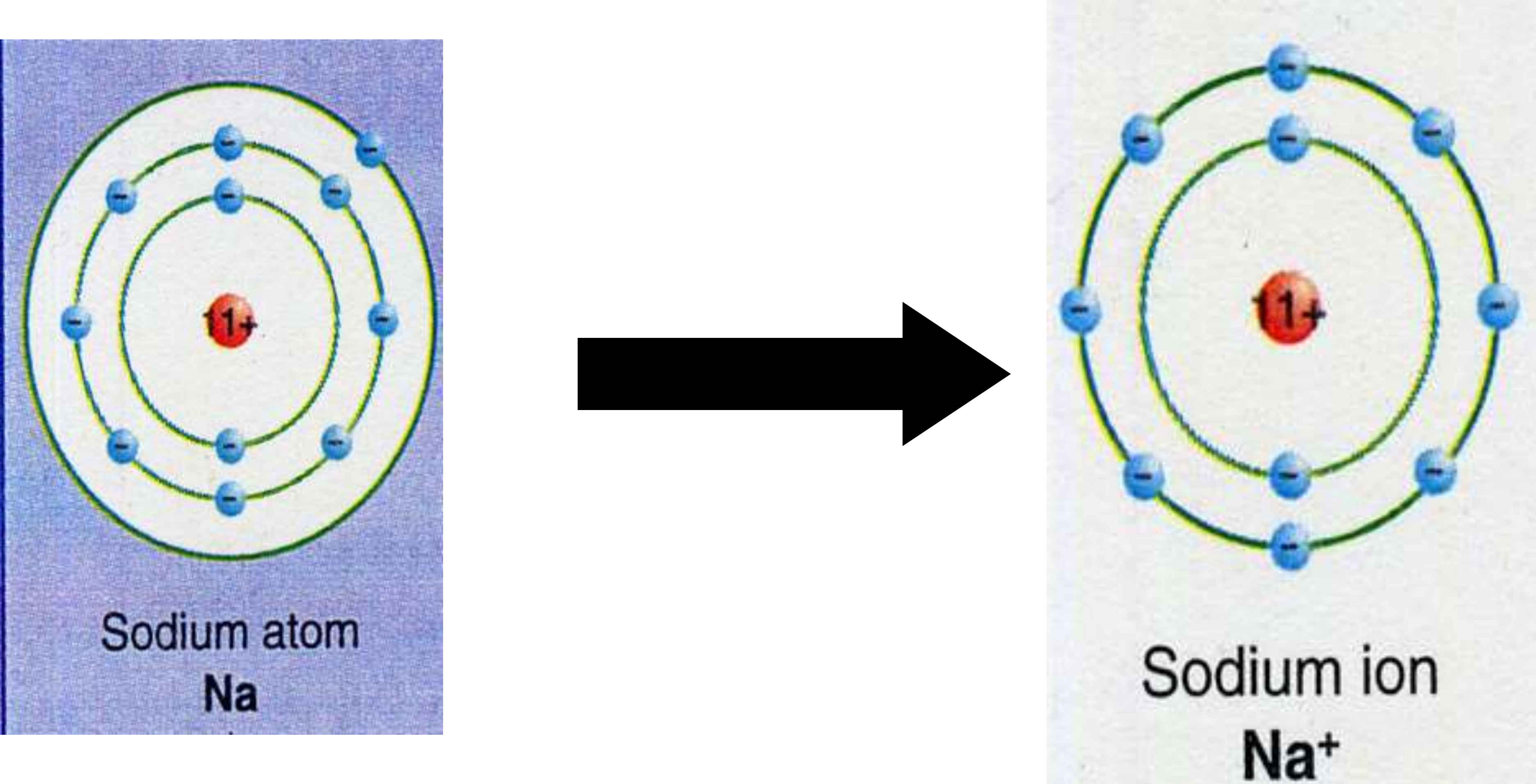
Metals lose their valence electrons to become positive ions (cations)

Non-metals (excluding the Noble Gases) gain electrons to get an octet to become negitive ions (anions)

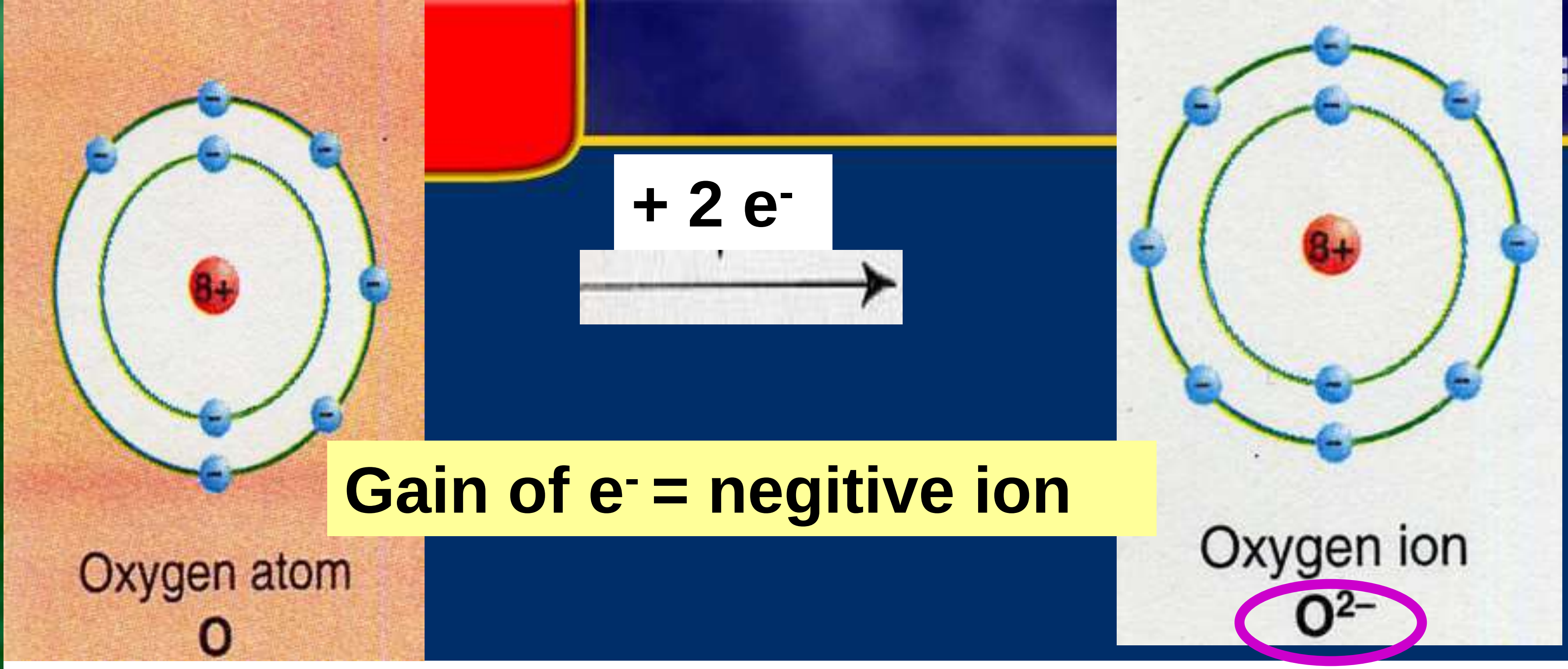


Metals **(H is a non-metal)**

Non-metals (includes the Nobel Gasses)



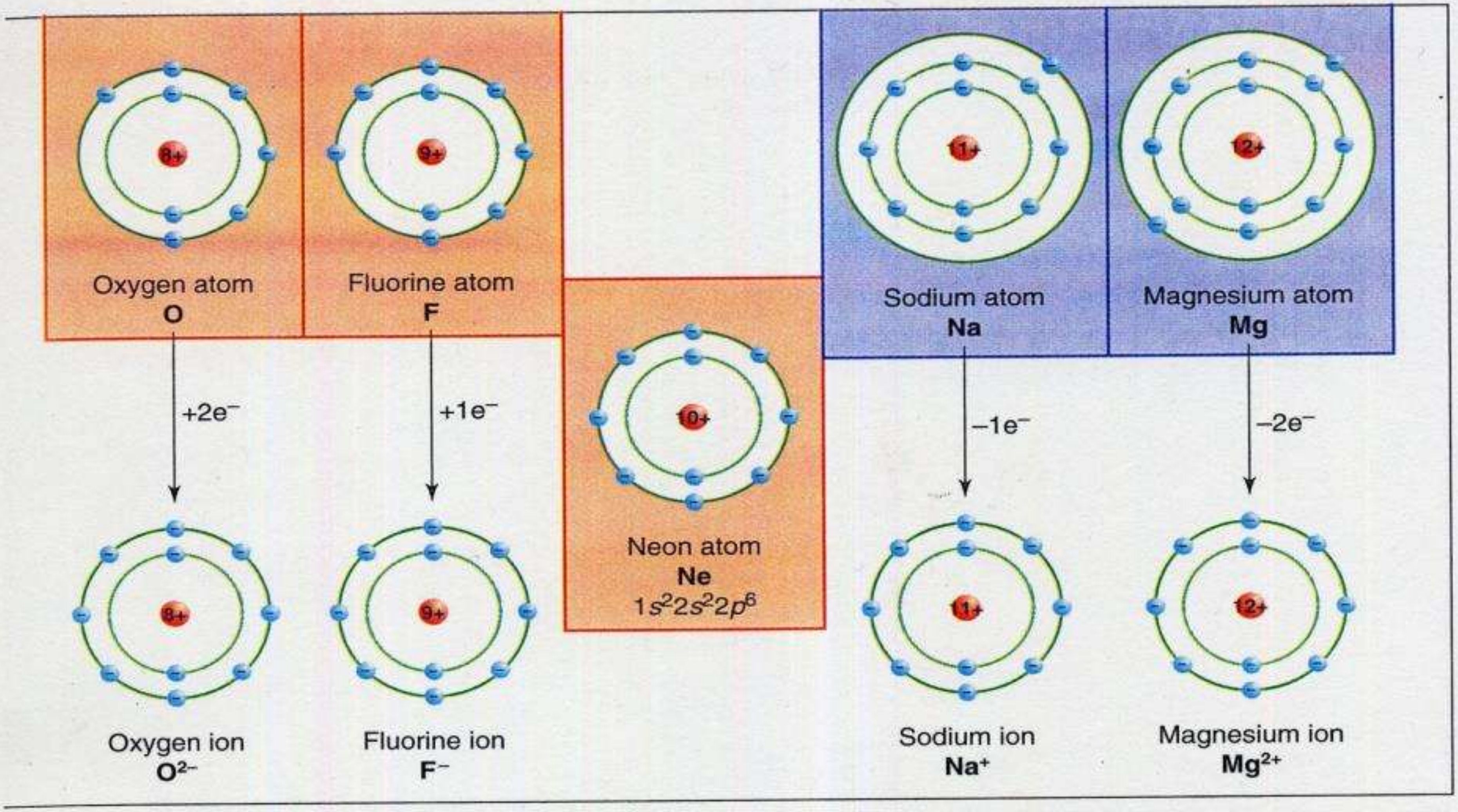
<u>The octet rule:</u> **Ions and chemical compounds tend to form so that each atom, by gaining, losing, or sharing electrons, has an octet (8) of electrons in its highest occupied energy level.**



Formulas of anions (negative ions) are written with the element’s symbol and a superscript “-” sign **Example: Cl^-**

If the charge is -2, -3, -4, the number comes before the “-” sign

Example, oxygen ion is written: O^{2-}



The most stable ion that each of these elements forms is the ion that has an octet of electrons (which is a Nobel gas config) in its highest occupied energy level (the outer level).

In each case, each ion has the same e^- config. as neon.

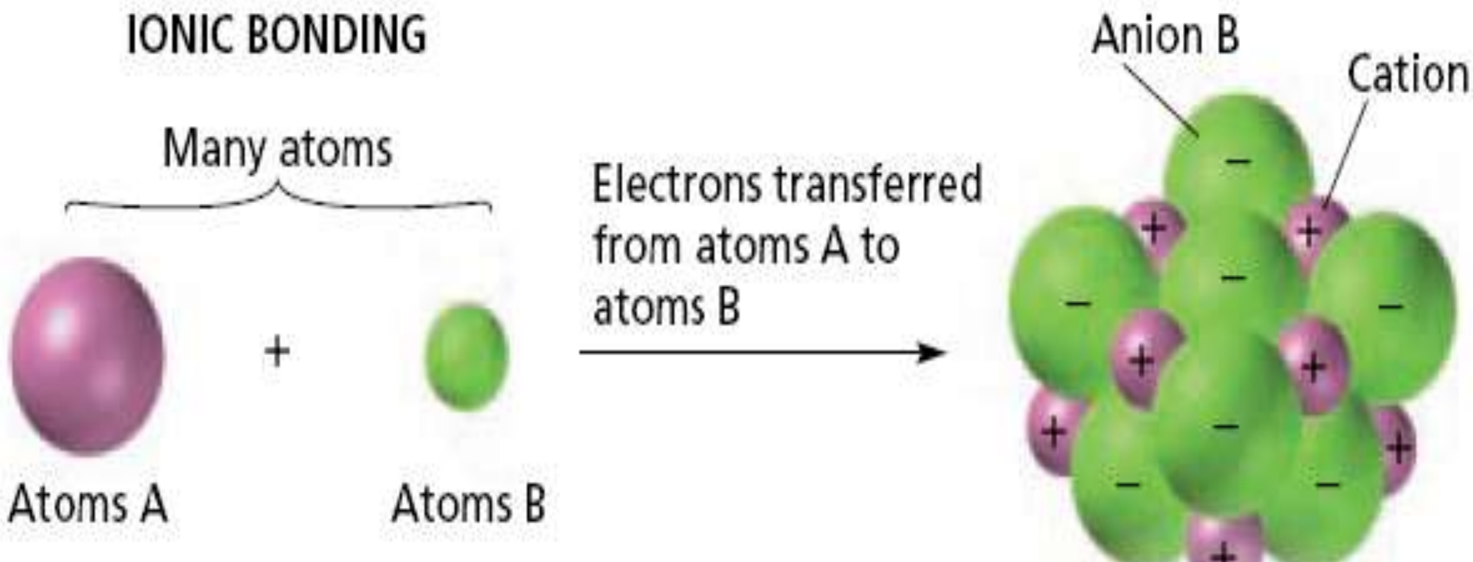
Stable Ion Charge

1+ 2+

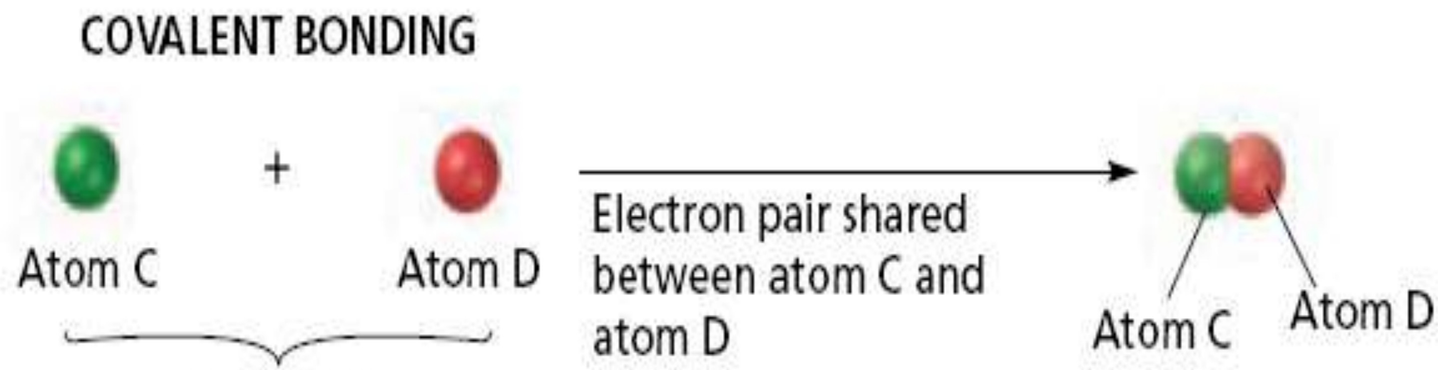
3+ 4- 3- 2- 1- 0

How many e^- needed to get an octet?

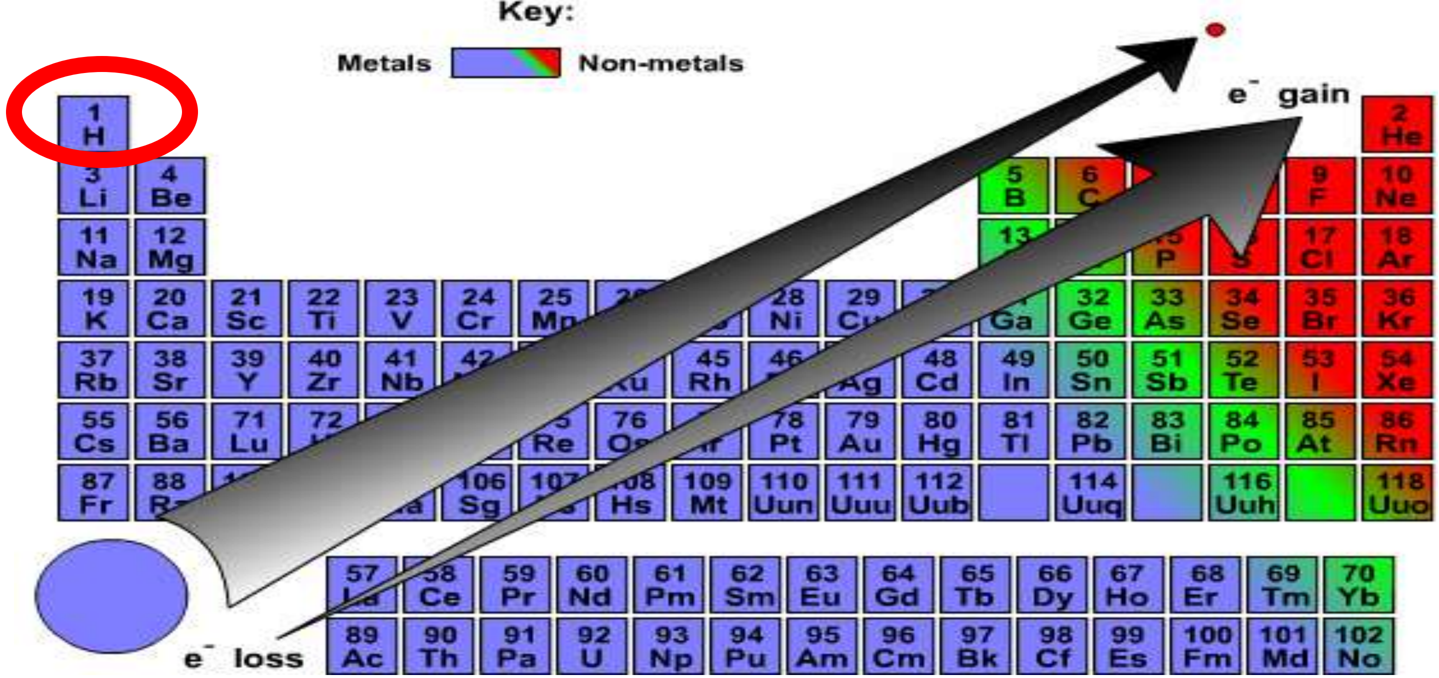
Chemical Bonding



Positive ions attracted to negative ions = electrical attraction



Electrons are shared by neutral elements



Hydrogen is a non-metal

Elements from opposite ends of the table usually form ionic compounds.

Metal + non-metal = ionic bond

Non-metal + non-metal = covalent bond

Except: Hydrogen + group 17 = ionic bond

Noble gases usually don't bond

valence e^-

1 2 — metals ← → Non-metals — 3 4 5 6 7 8

Number of Bonds =

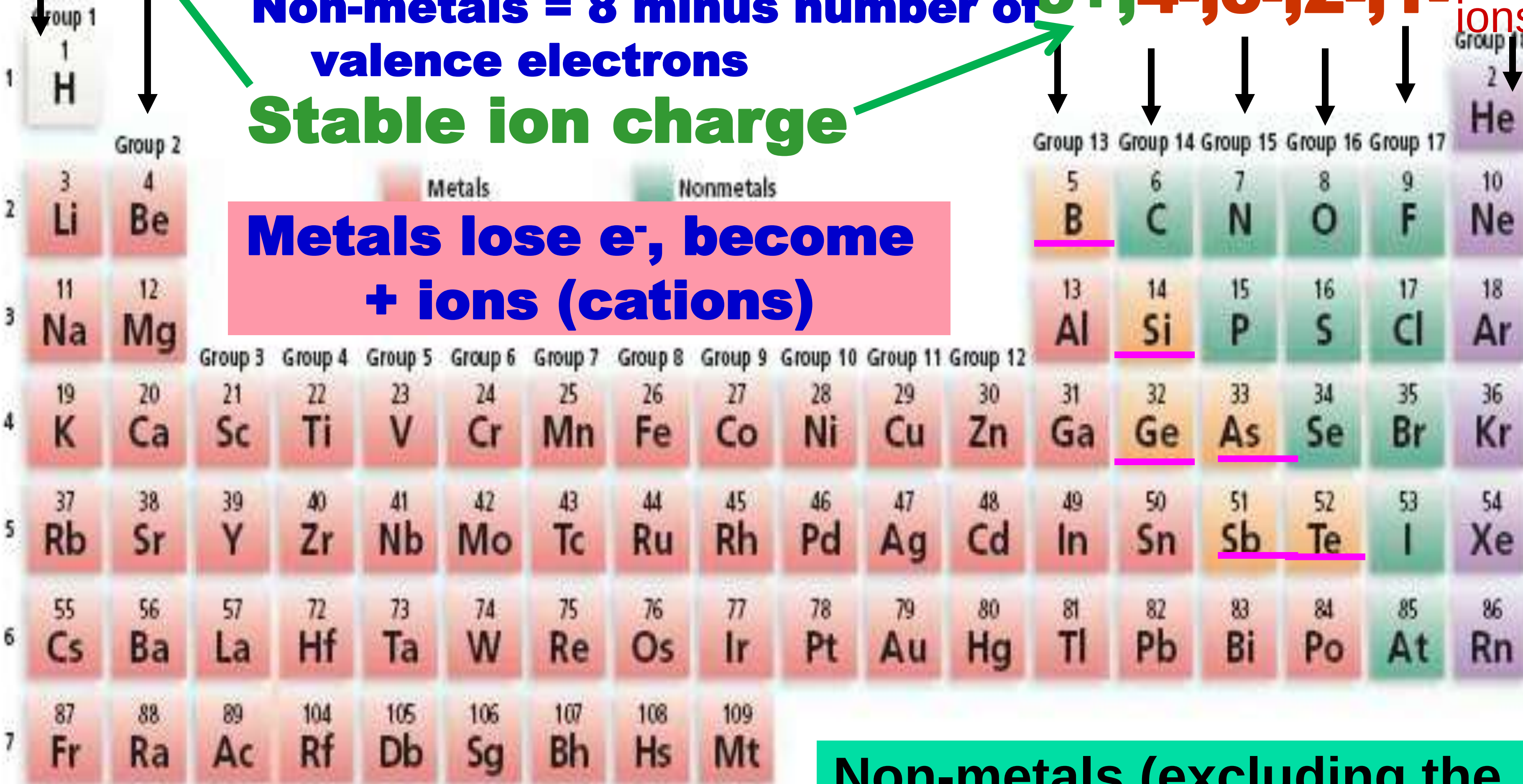
1, 2 — 3 , 4, 3, 2, 1, 0

1+, 2+ — 3+, 4-, 3-, 2-, 1- — No ions

Metals = # valence e^-

Non-metals = 8 minus number of valence electrons

Stable ion charge



Metals lose e^-, become + ions (cations)

Metals (H is a non-metal but it Usually forms positive(1+) ion

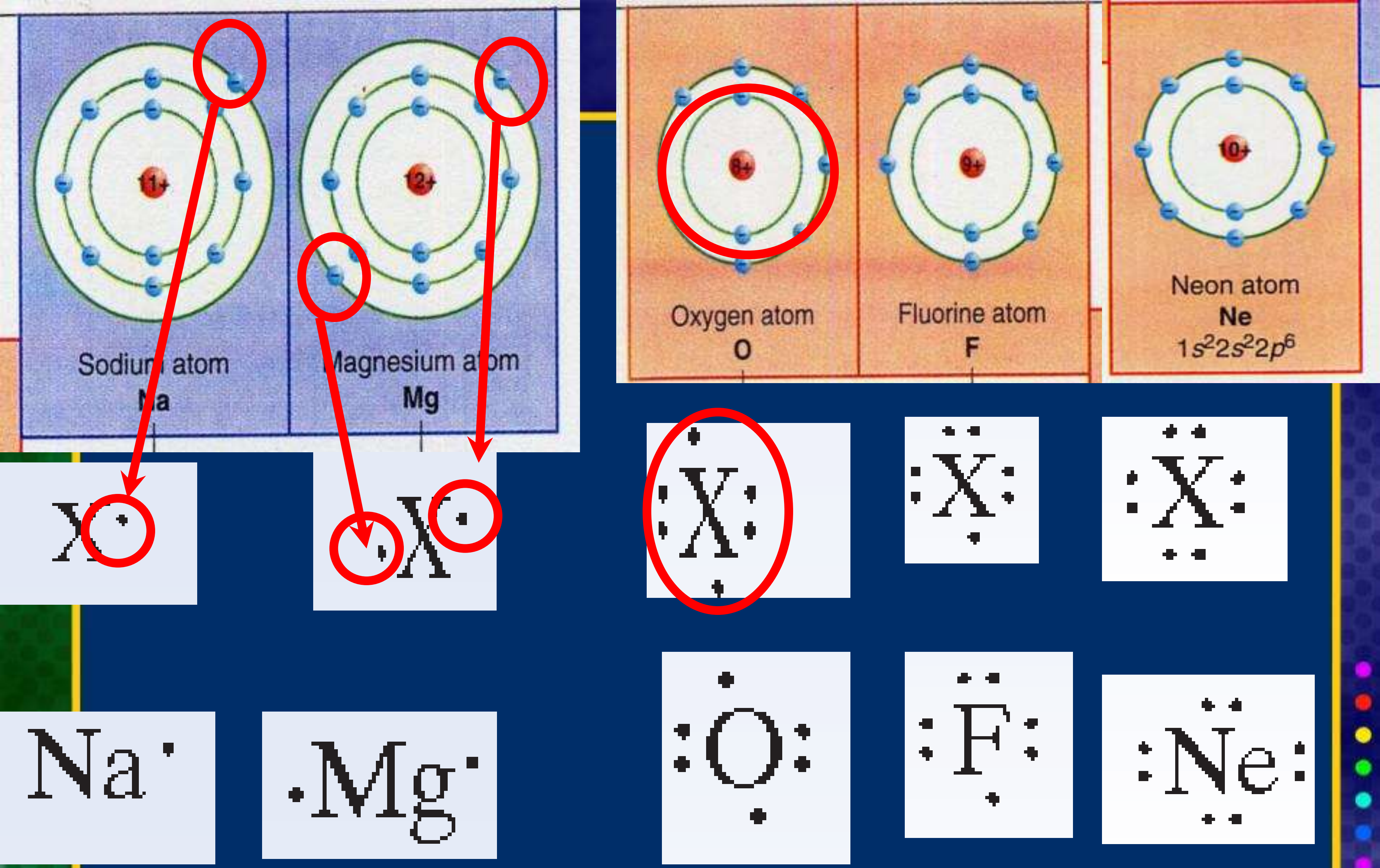
Non-metals (excluding the Nobel Gasses) gain e-, become – ions (anions)

Electron-Dot Notation

- To keep track of valence electrons, it is helpful to use electron-dot notation.

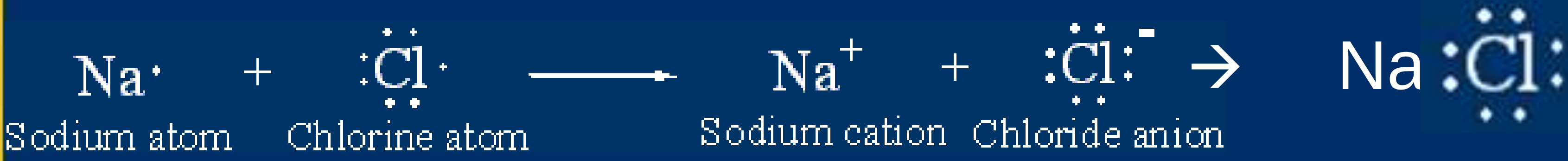
- **Electron-dot notation** is an electron-configuration notation in which only the valence electrons of an atom of a particular element are shown, indicated by dots placed around the element's symbol. The inner-shell electrons are not shown.

Number of valence electrons	Electron-dot notation	Example
1	X·	Na·
2	·X·	·Mg·
3	·X··	·B··
4	··X··	··C··
5	··X:·	··N:·
6	:X:··	:O:··
7	:X:·:·	:F:·:·
8	:X:::·	:Ne:::·

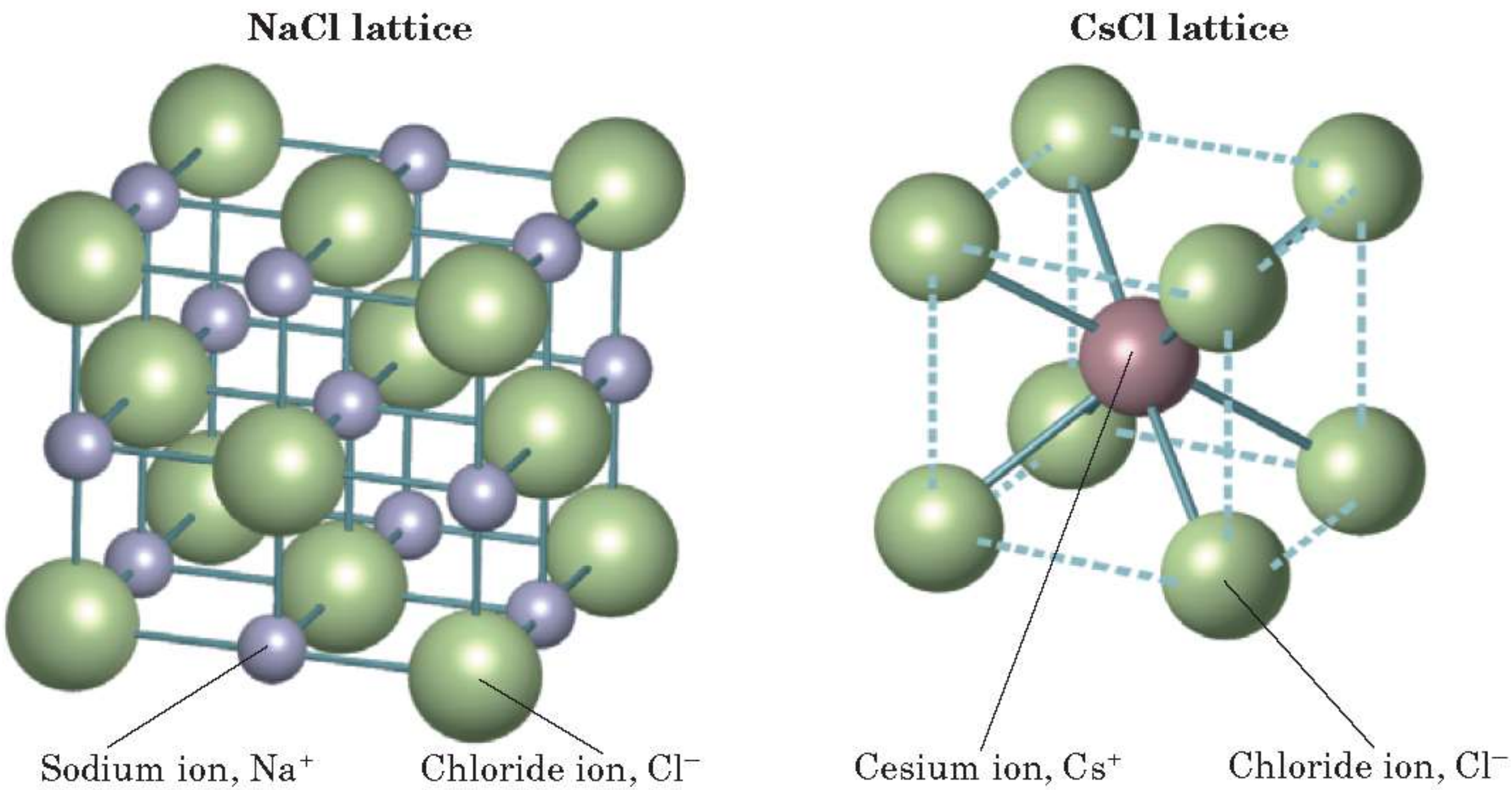

11+
Sodium atom
Na
12+
Magnesium atom
Mg
8+
Oxygen atom
O
9+
Fluorine atom
F
10+
Neon atom
Ne
$1s^22s^22p^6$
X
X
X
X
X
Na
Mg
O
F
Ne

Formation of Ionic Bonds

- The sodium atom has one valence electrons and the chlorine atom has seven valence electrons.
- Atoms of sodium and other alkali metals easily lose one electron to form cations (positive ion).
- Atoms of chlorine and other halogens easily gain one electron to form anions (negative ion).
- Positive & negative ions attract & form an ionic bond.



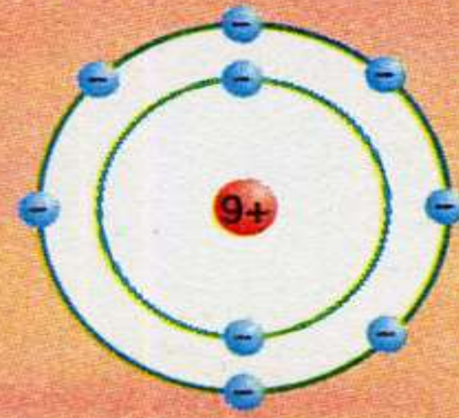
Ions form crystals made up of trillions of atoms.



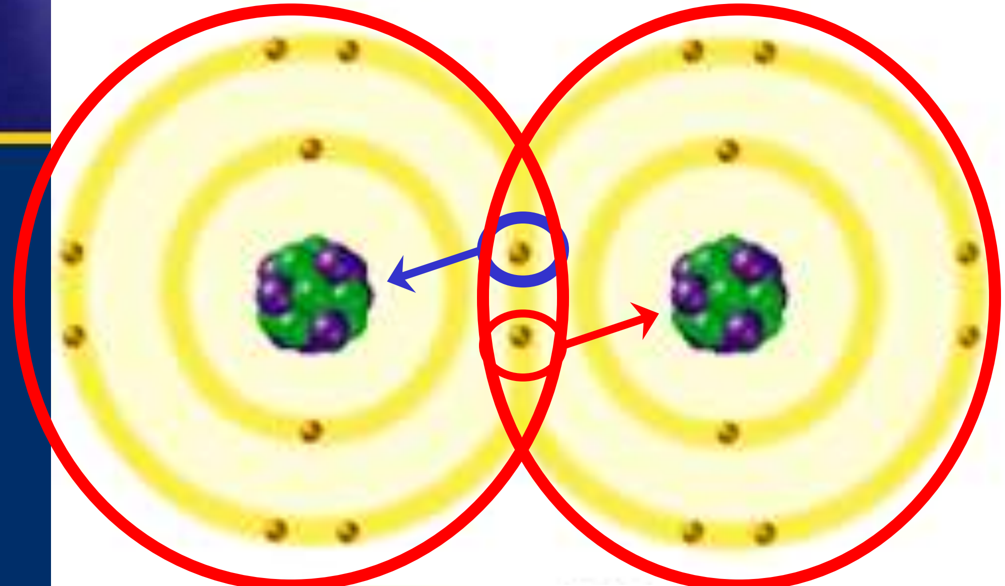
Covalent Bonding

- Non-metals form covalent bonds.
- Atoms share valence electrons so that the highest occupied (by electrons) energy level (rings) has an octet (8) of electrons.
- Exception: Hydrogen only can have a duet of electrons (2).
- Thus the atoms share a pair of electrons.

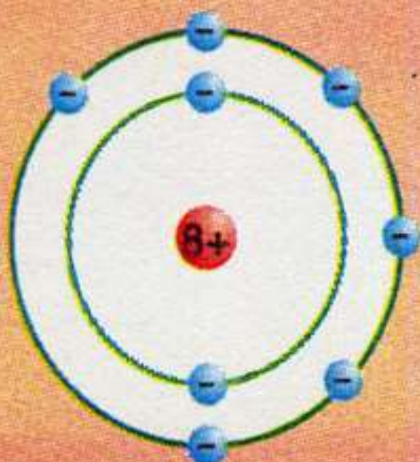
7 valence electrons



Fluorine atom
F

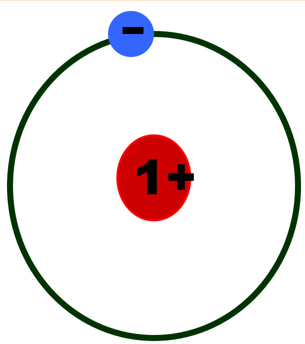


F_2, fluorine



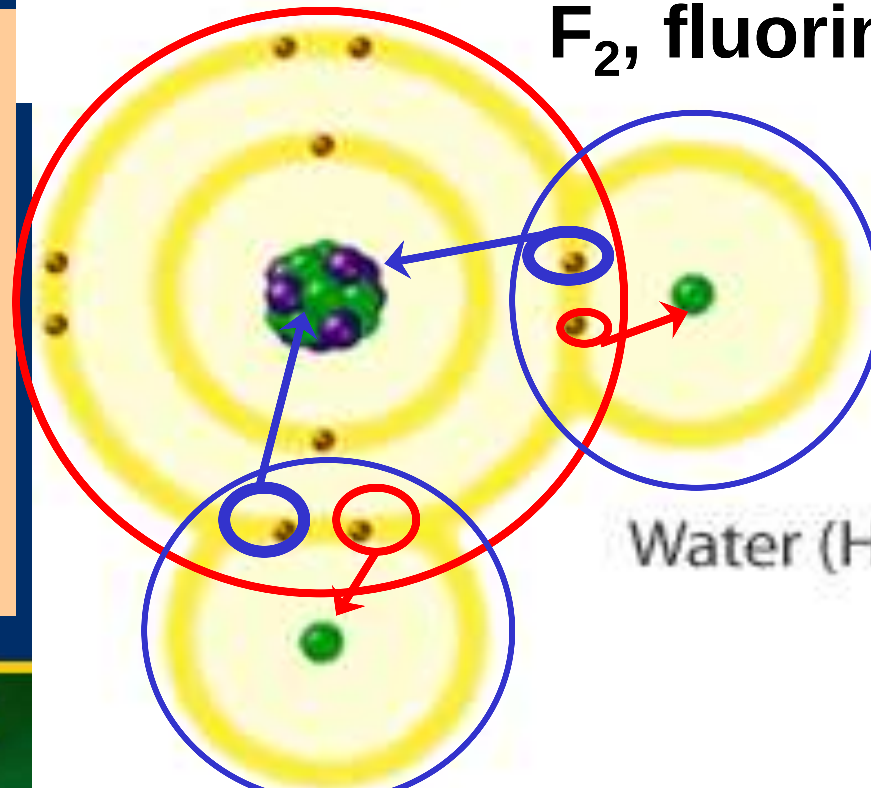
Oxygen atom
O

6 valence electrons



Hydrogen atom

1 valence electrons



Water (H_2O)

Lewis Structures

- Electron-dot notation can also be used to represent molecules.

- The pair of dots between the two symbols represents the shared electron pair of the hydrogen-hydrogen covalent bond.

  - For a molecule of fluorine, F_2, the electron-dot notations of two fluorine atoms are combined.

Lewis Structures

- The Lewis structures and the structural formulas for many molecules can be drawn if one knows the composition of the molecule and which atoms are bonded to each other.

- A single covalent bond, or **single bond,** is a covalent bond in which **one pair** of electrons is shared between two atoms.

Lewis Structures

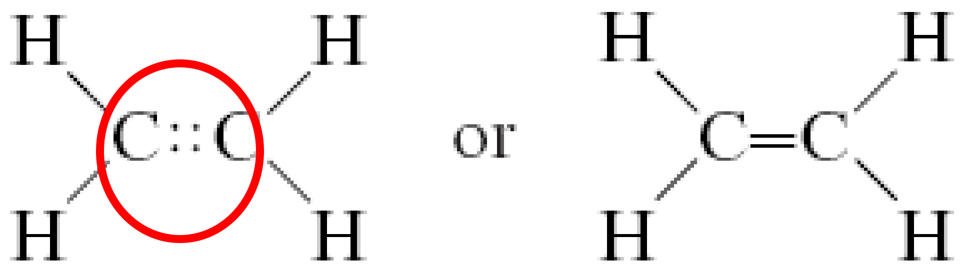
- The pair of dots representing a shared pair of electrons in a covalent bond is often replaced by a long dash.
  - example:

$$H:H \;=\; H\text{—}H$$

Multiple Covalent Bonds

Atoms of some elements, especially carbon, nitrogen, and oxygen, can share more than one electron pair.

A double covalent bond, or simply a <u>**double bond**</u>**,** ***is a covalent bond produced by the sharing of two pairs of electrons between two atoms.***

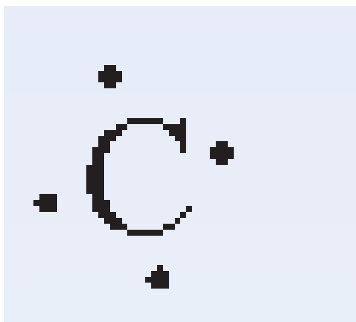


All four electrons in a double bond "belong" to both atoms

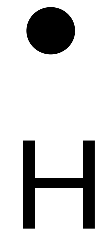
A triple covalent bond, or simply a **triple bond,** *is a covalent bond produced by* ***the sharing of three pairs of electrons between two atoms****.*

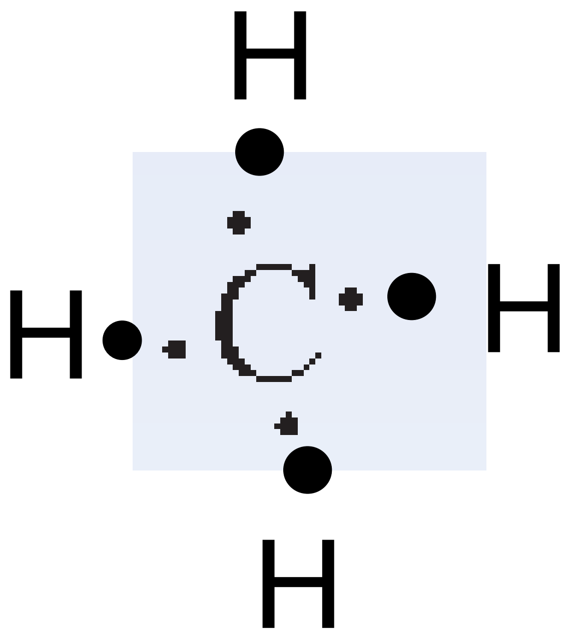
Double and triple bonds are referred to as **multiple bonds,** or multiple covalent bonds.

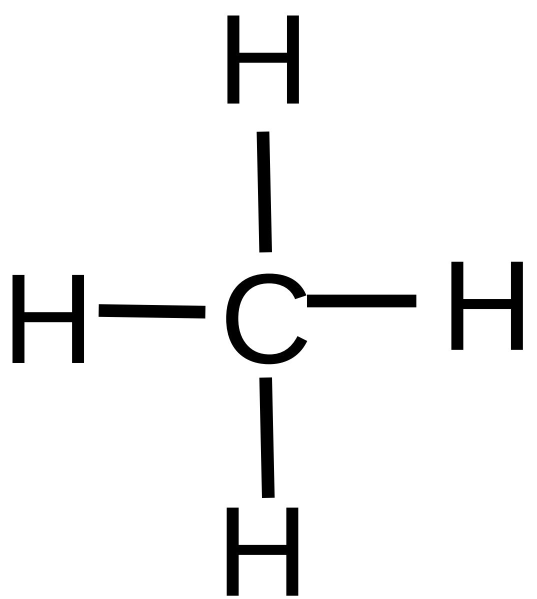
How many bonds can carbon form?

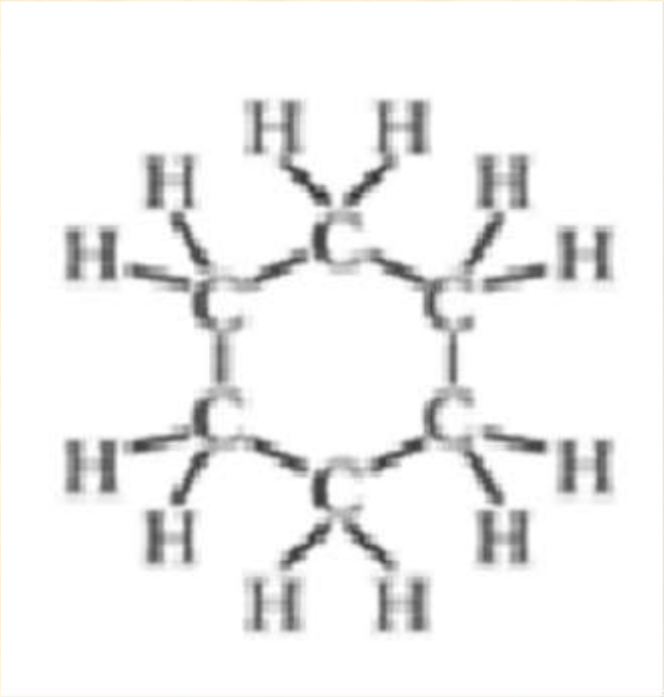


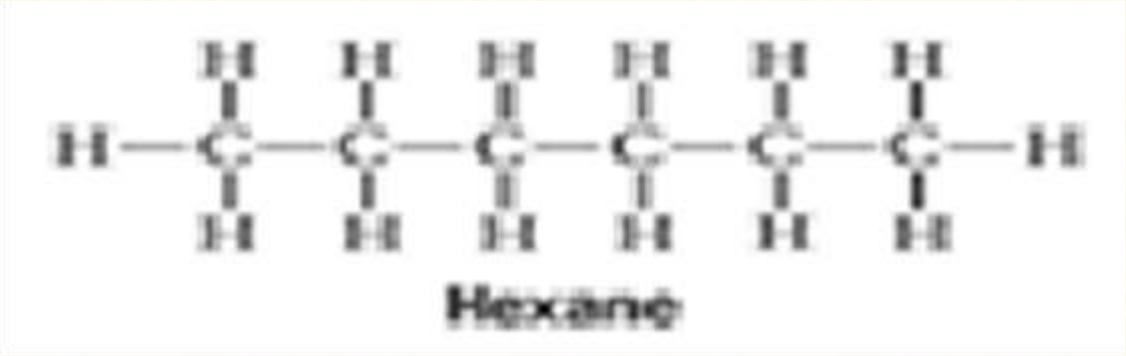
Each lonely electron can form a bond











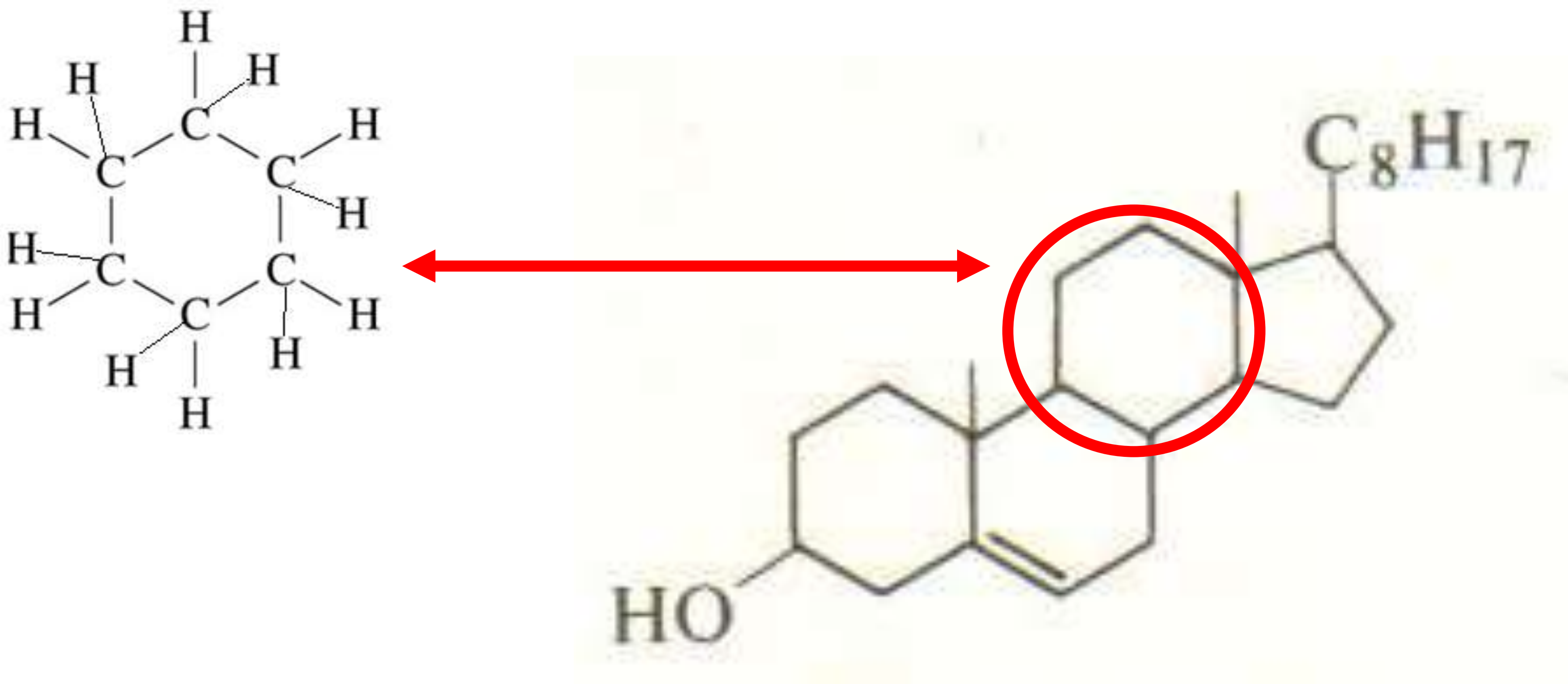
B

hexane

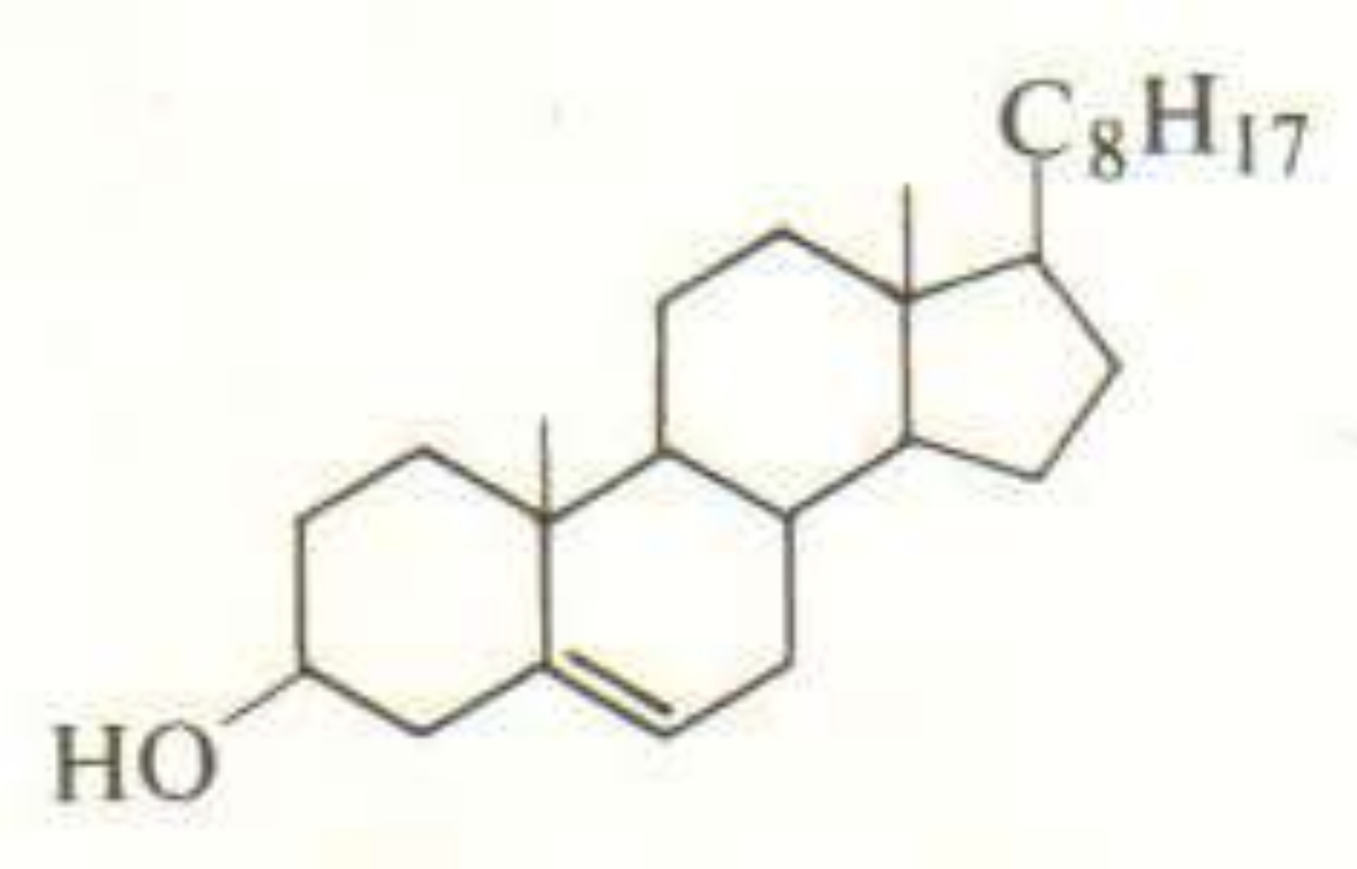
A

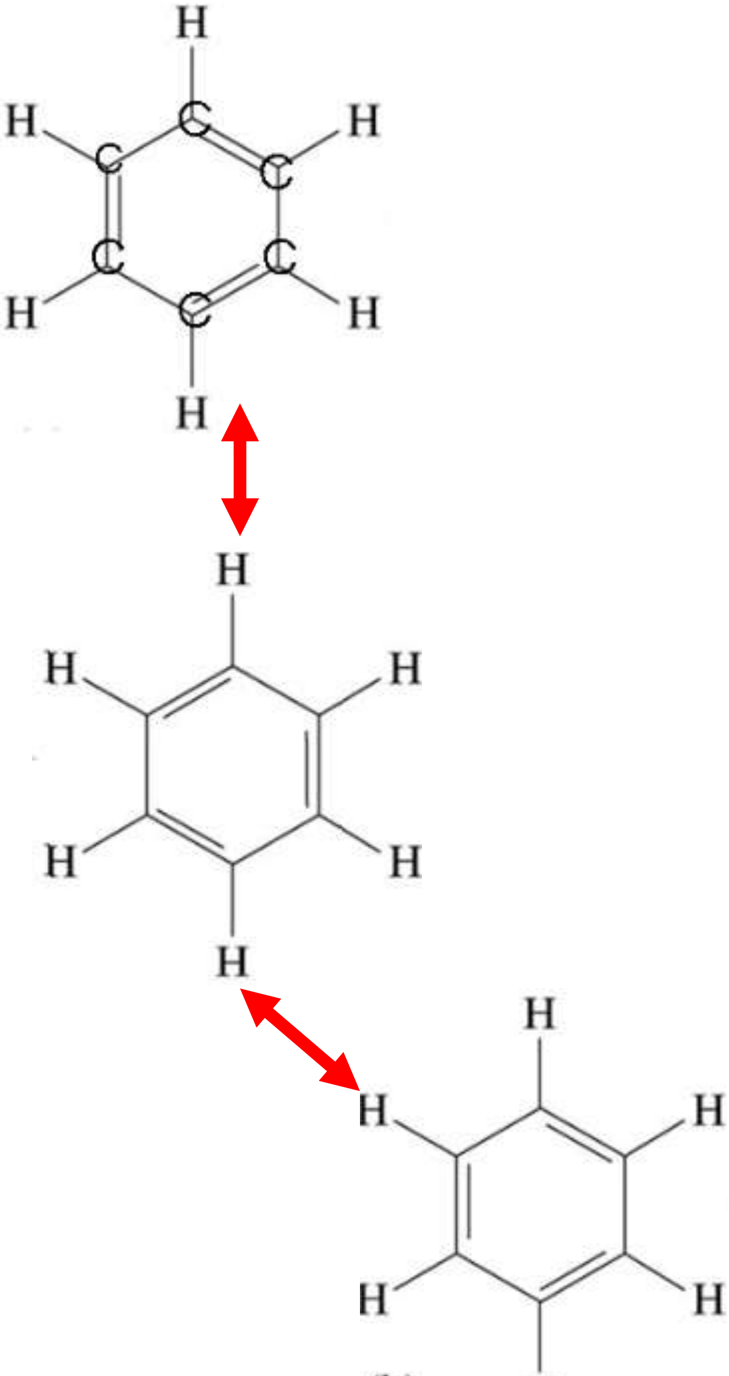
Cyclohexane

Chemical Bonding



Cholesterol





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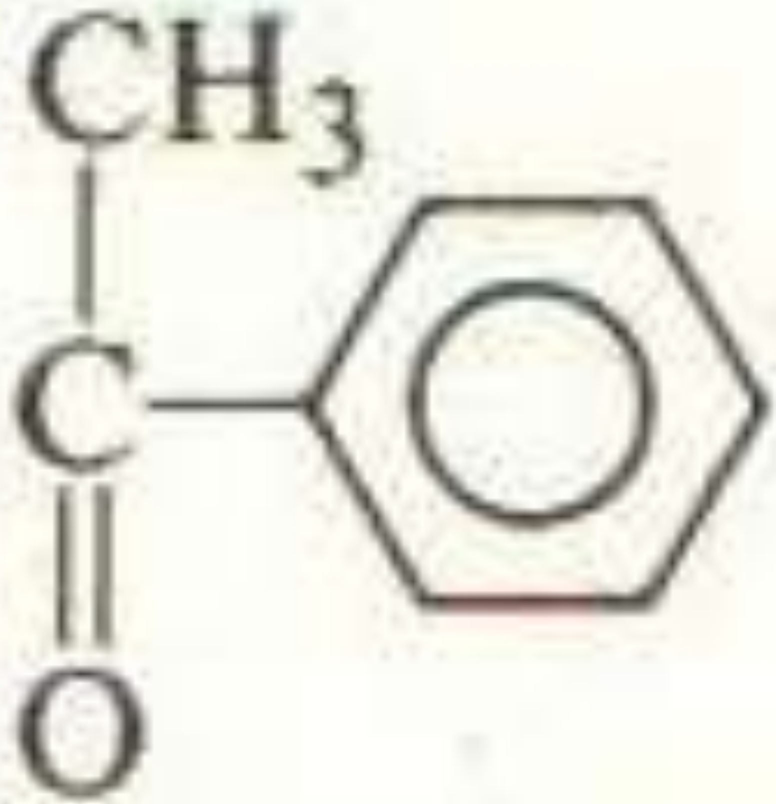
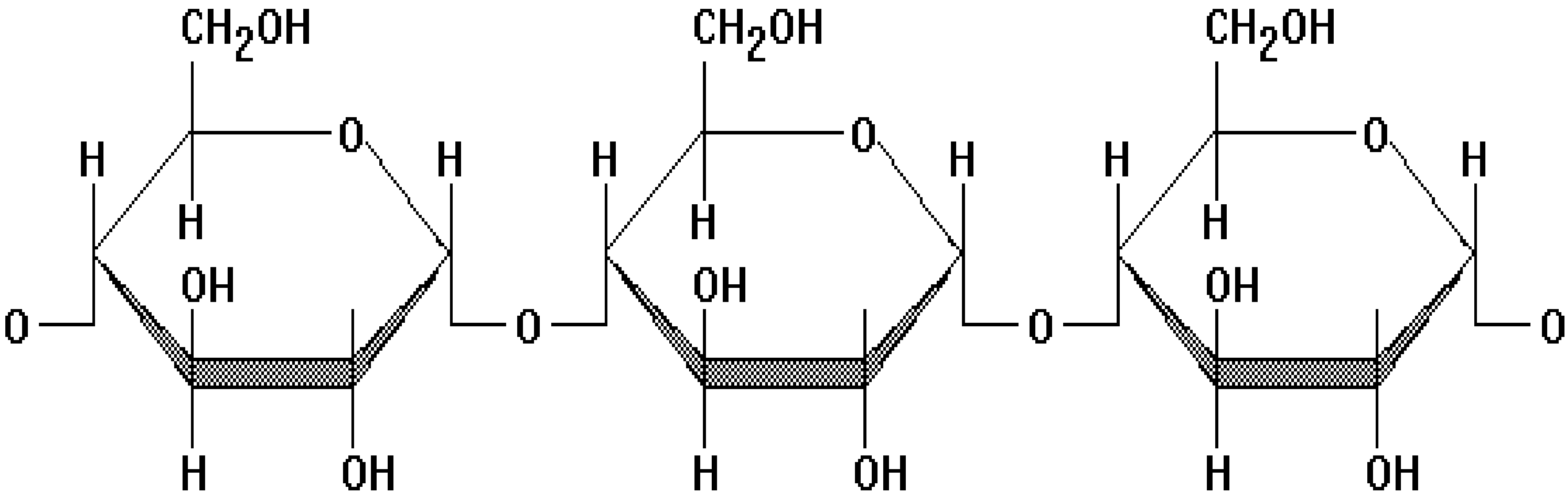
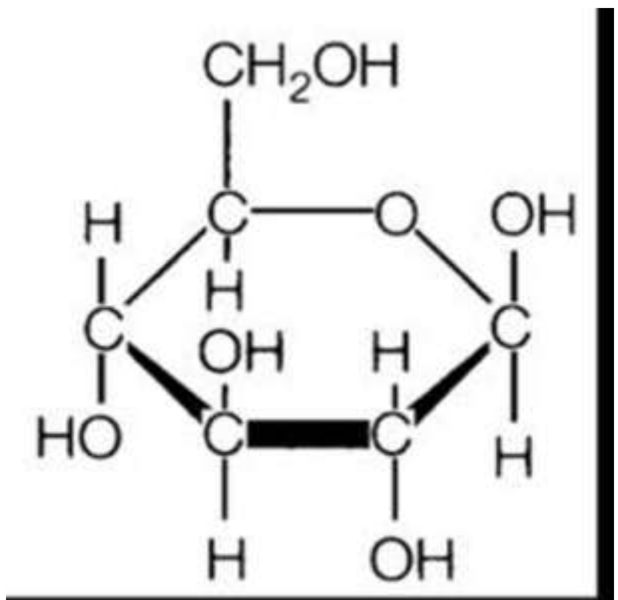


Acetophenone

Starch is poly glucose



starch



glucose

DNA