



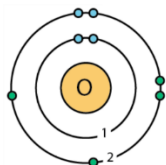
Valence Electrons

Video Workbook with Dr. B

More guides at www.breslyn.org

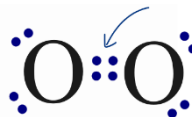
Valence electrons are the electrons in the highest energy level of an atom and *the ones that are involved in chemical bonding*.

You can think of valence electrons being in the outer shell around the nucleus of an atom.

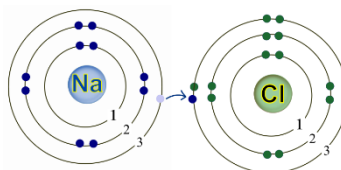


For example, Oxygen (O) is in Group 16 (6A) and has 6 valence electrons in its highest energy level.

Atoms either **share** or **transfer** valence electrons to form chemical bonds.



The O atoms are **sharing** four valence electrons in a **covalent/molecular bond**.



Na **transferred** its one valence electron to Chlorine to form an **ionic bond**.

On the Periodic Table you can find the number of valence electrons based on the Group Number.

Group (column)	Valence Electrons
1	1
2	2
13 (3A)	3
14 (4A)	4
15 (5A)	5
16 (6A)	6
17 (7A)	7
18 (8A)	8

Valence Electrons

1	2	3	4	5	6	7	8
1 H Hydrogen 1.01	2 He Helium 4.00	3 B Boron 10.81	4 C Carbon 12.01	5 N Nitrogen 14.01	6 O Oxygen 16.00	7 F Fluorine 19.00	8 Ne Neon 20.18
11 Na Sodium 22.99	12 Mg Magnesium 24.31	13 Al Aluminum 26.98	14 Si Silicon 28.09	15 P Phosphorus 30.97	16 S Sulfur 32.07	17 Cl Chlorine 35.45	18 Ar Argon 39.95
19 K Potassium 39.10	20 Ca Calcium 40.08	21 Sc Scandium 44.96	22 Ti Titanium 47.88	23 V Vanadium 50.94	24 Cr Chromium 52.00	25 Mn Manganese 54.94	26 Fe Iron 55.85
37 Rb Rubidium 85.47	38 Sr Strontium 87.62	39 Y Yttrium 88.91	40 Zr Zirconium 91.22	41 Nb Niobium 92.91	42 Mo Molybdenum 95.94	43 Tc Technetium 98.91	44 Ru Ruthenium 101.07
55 Cs Cesium 132.91	56 Ba Barium 137.33	57 La Lanthanum 138.91	58 Ce Cerium 140.12	59 Pr Praseodymium 140.91	60 Nd Neodymium 144.24	61 Pm Promethium 144.91	62 Sm Samarium 150.36
87 Fr Francium [223]	88 Ra Radium [226]	89 Ac Actinium [227]	90 Th Thorium [232]	91 Pa Protactinium [231]	92 U Uranium [238]	93 Np Neptunium [237]	94 Pu Plutonium [244]
101 Md Mendelevium [288]	102 Ds Darmstadtium [285]	103 Nh Nihonium [284]	104 Fl Flerovium [289]	105 Lv Livermorium [293]	106 Ts Tennessine [294]	107 Og Oganesson [294]	108 [292]
113 In Indium 114.82	114 Sn Tin 118.71	115 Sb Antimony 121.76	116 Te Tellurium 127.60	117 I Iodine 126.90	118 Xe Xenon 131.29	119 [288]	120 [292]



[Finding Number of Valence Electrons](#)

Note: Helium (He) is an exception with 2 valence e⁻.

Practice

How many valence electrons?

H	C
O	Ca
F	He
Al	Ne

Answers

H = 1, C = 4
O = 6, Ca = 2
F = 7, He = 2
Al = 3, Ne = 8

Number of Valence Electrons for Molecules

We can find the number of valence electrons for a molecule by adding the valence electrons for each element.

For example, for H₂O:

$$H_2 = 2(1) = 2$$

$$O = 1(6) = 6$$

So H₂O has a total of 8 valence electrons.

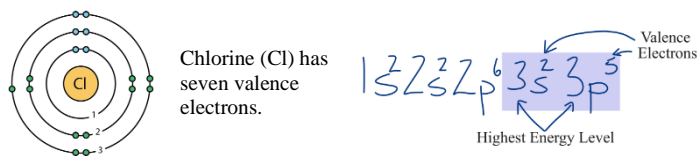
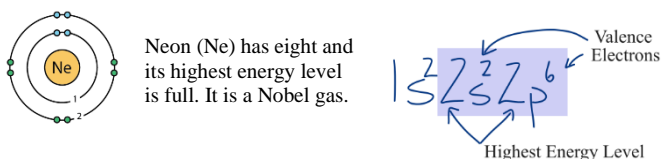
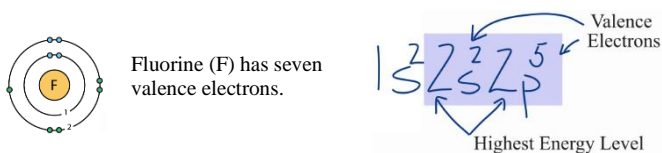


[Valence Electrons for Molecules](#)



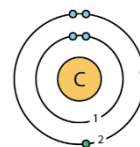
Electron Configurations & Valence Electrons

We can find the number of valence electrons [by writing the electron configuration](#) for an atom.

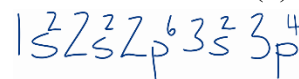


Practice

1. Based on the Bohr diagram, how many valence electrons does Carbon (C) have?



2. Based on the electron configuration, how many valence electrons does Sulfur (S) have?



3. Write the electron configuration for Beryllium (it has one more valence electron than Lithium). How many valence electrons does Be have?



4. Why are valence electrons the ones involved in forming chemical bonds?

5. Based on the number of valence electrons, how would Calcium and Chlorine bond to form CaCl_2 ?

Answers:

1. Four. They are the ones in the highest energy level (second energy level).
2. Six. They are the ones in the highest energy level (third energy level).
3. $1s^2 2s^2$. So there are two in the highest energy level (second energy level).
4. Because they are on the outside of the atom and come in contact with other atoms first.
5. See [video explanation](#).

Transition Metals & Valence Electrons

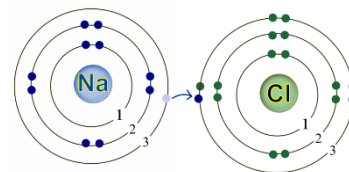
Determining the number of valence electrons for transition metals is more difficult because:

- In most elements valence electrons are in s and p orbitals. But transition metals there are also *d orbitals*, which can make it more difficult.
- Variability in oxidation states (e.g. Fe^{2+} vs Fe^{3+}).
- More complex electron configurations including partial filling of *d orbitals*.

For more help see:

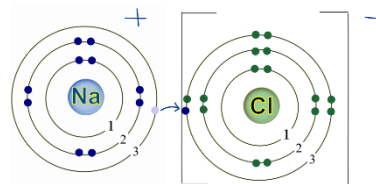
 [Valence Electrons for Transition Metals](#)

Valence Electrons & Ionic Charge



Atoms will often lose or gain valence electrons and become ions.

Sodium (Na) lost an electron. The second energy level is now the highest and has an Octet. Sodium is now the Sodium ion (Na^+) and has a positive charge.



Chlorine gained an electron and now has eight in its highest energy level. This is called an Octet and is very stable. Chlorine is now the Chloride ion (Cl^-) and is negative.

 [Valence Electrons & Ionic Charge](#)

Key Terms

A **valence electron** is an electron in the highest energy level or an atom.

A **chemical bond** forms when valence electrons are transferred (ionic) or shared (molecular) between atoms.

Bonds are formed to fill atoms' highest energy level (often called an **Octet**). Noble gases have octets.

Ionic Bond—a strong bond between a metal cation (positive ions) and non-metal anion (negative ions).

Ion—atoms that have a charge (+ or -).

Lost electron = + charge = cation.

Gained electron = - charge = anion.

Molecular (Covalent) Bond—a semi-strong bond between two non-metals.

If your time is extremely limited, watch these videos and do the practice problems:

Counting Valence Electrons: <https://youtu.be/VBp7mKdcrDk>

Lewis Structures Made Simple: <https://youtu.be/1ZlnzyHahvo>

More Lewis Structures Practice: <https://youtu.be/DQclmBeIKTc>

The Octet Rule: <https://youtu.be/6Ecr7m-0E0E>

Exceptions to the Octet Rule: <https://youtu.be/Dkj-SMBLQzM>

Lewis Structures for Ionic Compounds: <https://youtu.be/2urppjeSfgA>

Please report errors and suggestions to DrB@breslyn.org !

www.Breslyn.org

