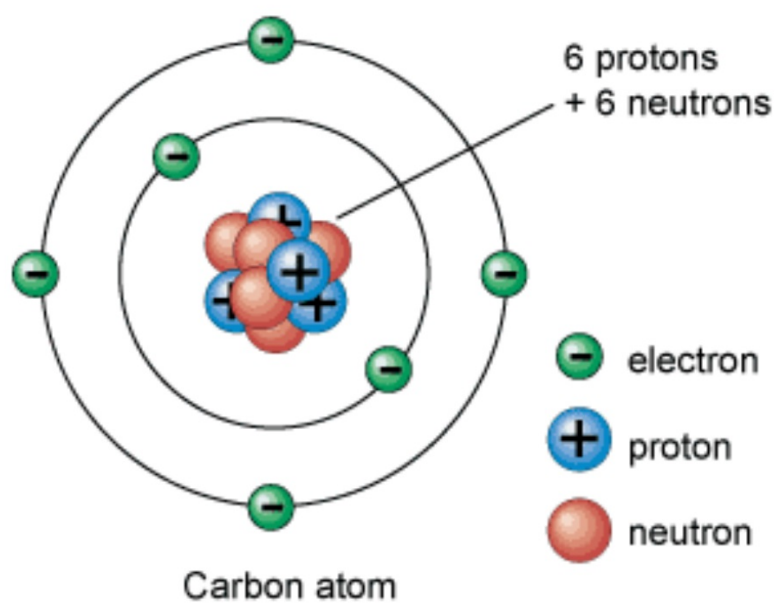


Atoms, Bonding and the Periodic Table

What Determines an Element's Chemistry?



What Determines an Element's Chemistry?

The number of protons and electrons is the same in a neutral atom.

Electrons of an atom are found in different energy levels.

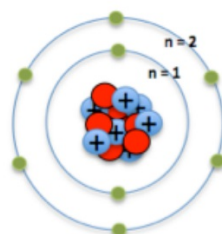
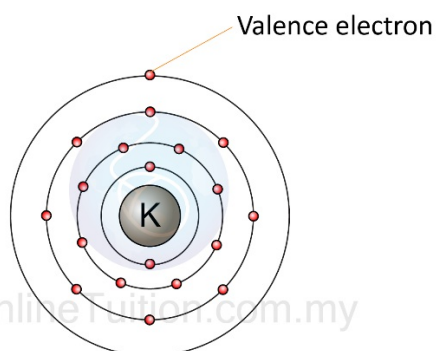


Valence Electrons

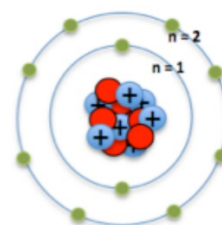
Electrons with the highest energy

They are involved in chemical bonding

The number of valence electrons in an atom determines the chemical properties of that element.



Oxygen = 8 electrons
6 valence electrons



Neon = 10 electrons
8 valence electrons

Valence Electrons of Oxygen and Neon

Electron Dot Diagrams

Each atom of an element has a certain amount of valence electrons.

Different elements have numbers 1 to 8.

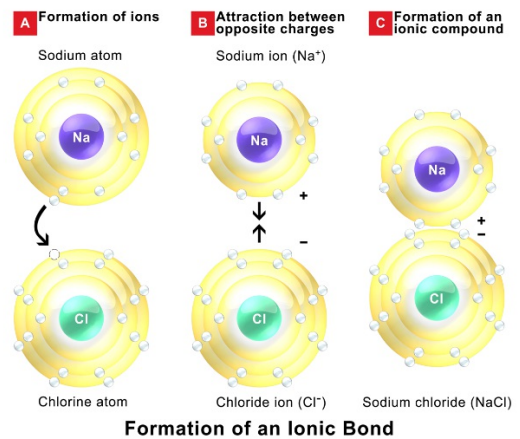
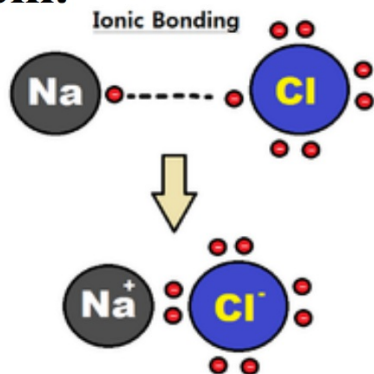
LEWIS DOT DIAGRAMS ELEMENTS 1–20							
HYDROGEN 1 H · 1.01							HELIUM 2 · He · 4.00
LITHIUM 3 Li · 6.94	BERYLLIUM 4 Be · 9.01	BORON 5 · B · 10.81	CARBON 6 · C · 12.01	NITROGEN 7 · N · 14.01	OXYGEN 8 · O · 16.00	FLUORINE 9 · F · 19.00	NEON 10 · Ne · 20.18
SODIUM 11 Na · 22.99	MAGNESIUM 12 Mg · 24.31	ALUMINUM 13 · Al · 26.98	SILICON 14 · Si · 28.09	PHOSPHORUS 15 · P · 30.97	SULFUR 16 · S · 32.07	CHLORINE 17 · Cl · 35.45	ARGON 18 · Ar · 39.95
POTASSIUM 19 K · 39.10	CALCIUM 20 · Ca · 40.08						

Bonding

Atoms are stable if they have 8 valence electrons.

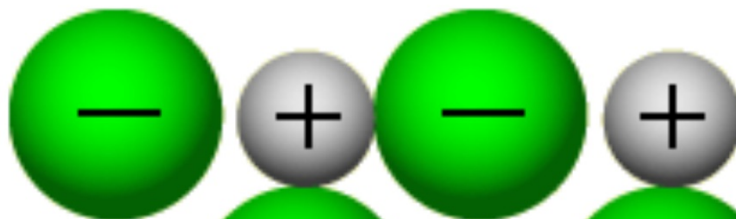
When atoms bond valence electrons transfer from one atom to another. They can also be shared.

A chemical bond is the force of attraction that holds atoms together. This is due to the rearrangement of electrons between them.

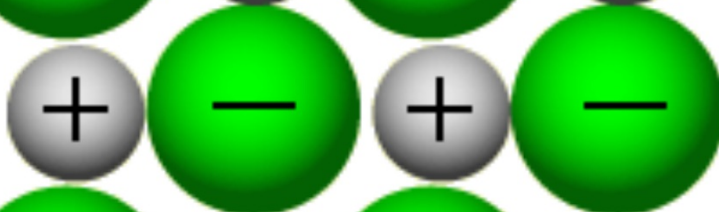


Take notes on the different groups (valence electrons and how they react with different groups):

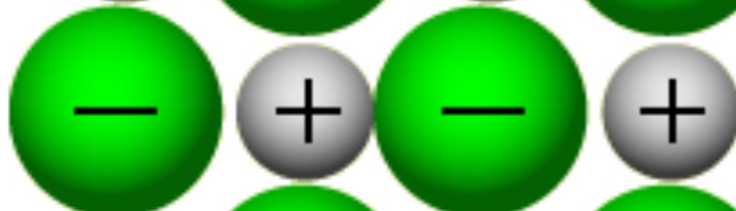
Noble Gases



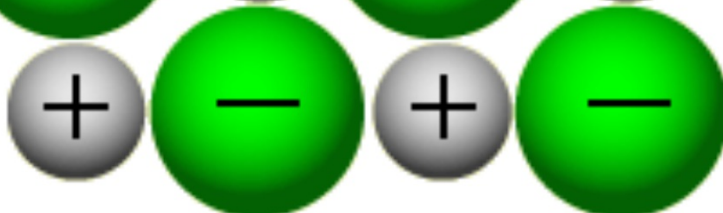
Metals



Nonmetals



Metalloids



Hydrogen

Review

What Determines an Element's Chemistry?

hydrogen 1 H 1.0079																				helium 2 He 4.0026					
lithium 3 Li 6.941	beryllium 4 Be 9.0122																			boron 5 B 10.811	carbon 6 C 12.011	nitrogen 7 N 14.007	oxygen 8 O 15.999	fluorine 9 F 18.998	neon 10 Ne 20.180
sodium 11 Na 22.990	magnesium 12 Mg 24.305																			aluminum 13 Al 26.982	silicon 14 Si 28.086	phosphorus 15 P 30.974	sulfur 16 S 32.065	chlorine 17 Cl 35.453	argon 18 Ar 39.948
potassium 19 K 39.098	calcium 20 Ca 40.078	scandium 21 Sc 44.956	titanium 22 Ti 47.867	vanadium 23 V 50.942	chromium 24 Cr 51.996	manganese 25 Mn 54.938	iron 26 Fe 55.845	cobalt 27 Co 58.933	nickel 28 Ni 58.693	copper 29 Cu 63.546	zinc 30 Zn 65.39	gallium 31 Ga 69.723	germanium 32 Ge 72.61	arsenic 33 As 74.922	selenium 34 Se 78.96	bromine 35 Br 79.904	krypton 36 Kr 83.80								
rubidium 37 Rb 85.468	strontium 38 Sr 87.62	yttrium 39 Y 88.906	zirconium 40 Zr 91.224	niobium 41 Nb 92.906	molybdenum 42 Mo 95.94	technetium 43 Tc [98]	ruthenium 44 Ru 101.07	rhodium 45 Rh 102.91	palladium 46 Pd 106.42	silver 47 Ag 107.87	cadmium 48 Cd 112.41	indium 49 In 114.82	tin 50 Sn 118.71	antimony 51 Sb 121.76	tellurium 52 Te 127.60	iodine 53 I 126.90	xenon 54 Xe 131.29								
caesium 55 Cs 132.91	barium 56 Ba 137.33	57-70 *	lutetium 71 Lu 174.97	hafnium 72 Hf 178.49	tantalum 73 Ta 180.95	tungsten 74 W 183.84	rhenium 75 Re 186.21	osmium 76 Os 190.23	iridium 77 Ir 192.22	platinum 78 Pt 195.08	gold 79 Au 196.97	mercury 80 Hg 200.59	thallium 81 Tl 204.38	lead 82 Pb 207.2	bismuth 83 Bi 208.98	polonium 84 Po [209]	astatine 85 At [210]	radon 86 Rn [222]							
francium 87 Fr [223]	radium 88 Ra [226]	89-102 * *	lawrencium 103 Lr [262]	rutherfordium 104 Rf [261]	dubnium 105 Db [262]	seaborgium 106 Sg [266]	bohrium 107 Bh [264]	hassium 108 Hs [269]	meitnerium 109 Mt [268]	unnilium 110 Uun [271]	ununium 111 Uuu [272]	unbibium 112 Uub [277]		ununquadium 114 Uuq [289]											

* Lanthanide series

lanthanum 57 La 138.91	cerium 58 Ce 140.12	praseodymium 59 Pr 140.91	neodymium 60 Nd 144.24	promethium 61 Pm [145]	samarium 62 Sm 150.36	europium 63 Eu 151.96	gadolinium 64 Gd 157.25	terbium 65 Tb 158.93	dysprosium 66 Dy 162.50	holmium 67 Ho 164.93	erbium 68 Er 167.26	thulium 69 Tm 168.93	ytterbium 70 Yb 173.04
actinium 89 Ac [227]	thorium 90 Th 232.04	protactinium 91 Pa 231.04	uranium 92 U 238.03	neptunium 93 Np [237]	plutonium 94 Pu [244]	americium 95 Am [243]	curium 96 Cm [247]	berkelium 97 Bk [247]	californium 98 Cf [251]	einsteinium 99 Es [252]	fermium 100 Fm [257]	mendeleevium 101 Md [258]	nobelium 102 No [259]

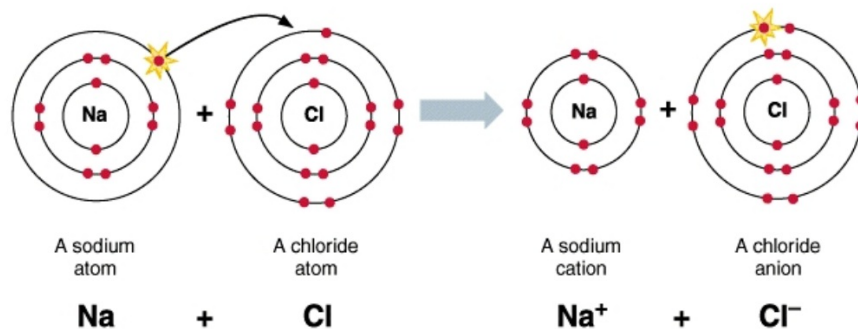
** Actinide series

Ionic Bonds

How Do Ions Form?

How Are the Formulas and Names of Ionic Compounds Written?

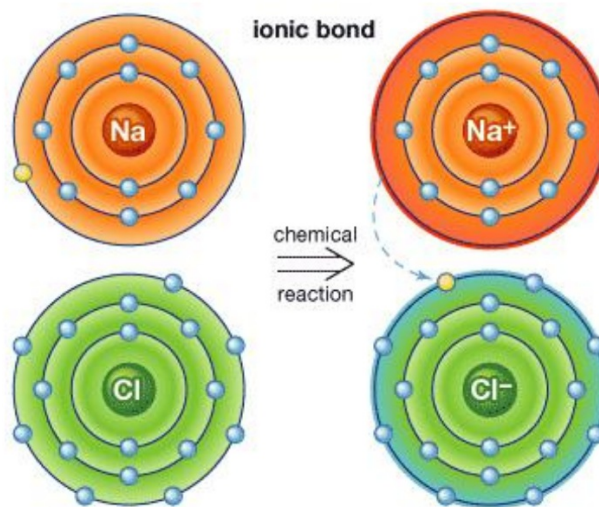
What Are Properties of Ionic Compounds?



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Ion

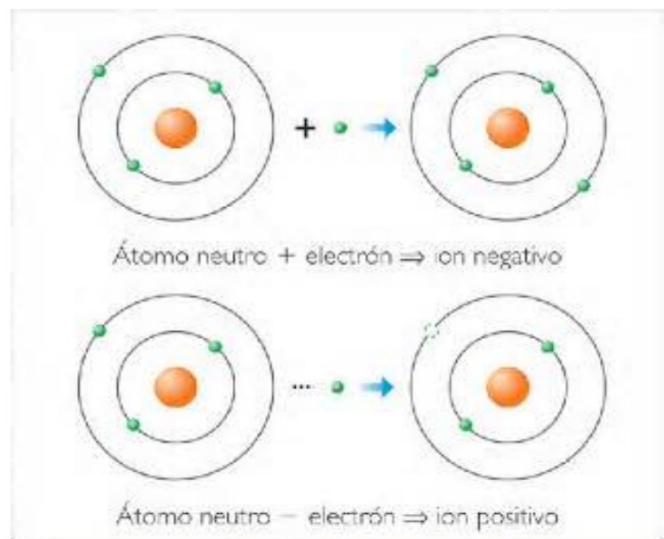
An ion is an atom or group of atoms that has an electric charge.



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How Do Ions Form?

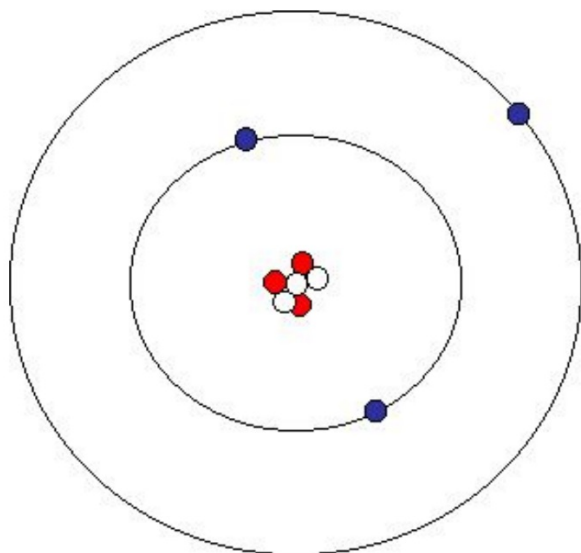
When a neutral atom loses a valence electron, it loses a negative charge. It becomes a positive ion.



When neutral atom gains an electron, it gains a negative charge. It becomes a negative ion.



Common Ions



Common Ion Chart

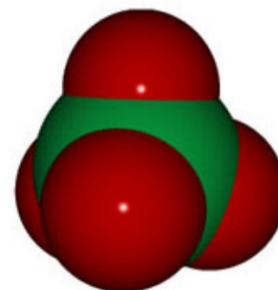
Positive Ions (Cations)		Negative Ions (Anions)	
Aluminum	Al ⁺³	Acetate	C ₂ H ₃ O ₂ ⁻ / CH ₃ COO ⁻
Ammonium	NH ₄ ⁺	Bromide	Br ⁻
Barium	Ba ⁺²	Carbonate	CO ₃ ⁻²
Cadmium	Cd ⁺²	Hydrogen Carbonate Ion / Bicarbonate	HCO ₃ ⁻
Calcium	Ca ⁺²	Chlorate	ClO ₃ ⁻
Chromium (II)	Cr ⁺²	Chloride	Cl ⁻
Chromium (III)	Cr ⁺³	Chlorite	ClO ₂ ⁻
Cobalt (II)	Co ⁺²	Chromate	CrO ₄ ⁻²
Copper (I)	Cu ⁺	Cyanide	CN ⁻
Copper (II)	Cu ⁺²	Dichromate	Cr ₂ O ₇ ⁻²
Hydrogen	H ⁺	Fluoride	F ⁻
Hydronium	H ₃ O ⁺	Hydride	H ⁻
Iron (II)	Fe ⁺²	Hydroxide	OH ⁻
Iron (III)	Fe ⁺³	Hypochlorite	ClO ⁻
Lead (II)	Pb ⁺²	Iodate	IO ₃ ⁻
Lead (IV)	Pb ⁺⁴	Iodide	I ⁻
Lithium	Li ⁺	Nitrate	NO ₃ ⁻
Magnesium	Mg ⁺²	Nitride	N ⁻³
Manganese (II)	Mn ⁺²	Nitrite	NO ₂ ⁻
Mercury (I)	Hg ₂ ⁺²	Oxalate	C ₂ O ₄ ⁻²
Mercury (II)	Hg ⁺²	Oxide	O ⁻²
Potassium	K ⁺	Hydrogen Oxalate Ion	HC ₂ O ₄ ⁻
Silver	Ag ⁺	Perchlorate	ClO ₄ ⁻
Strontium	Sr ⁺²	Permanganate	MnO ₄ ⁻
Sodium	Na ⁺	Peroxide Ion	O ₂ ⁻²
Tin (II)	Sn ⁺²	Phosphate	PO ₄ ⁻³
Tin (IV)	Sn ⁺⁴	Monohydrogen Phosphate	HPO ₄ ⁻²
Zinc	Zn ⁺²	Dihydrogen Phosphate	H ₂ PO ₄ ⁻
		Silicate	SiO ₃ ⁻²
		Sulfate	SO ₄ ⁻²
		Hydrogen Sulfate Ion / Bisulfate	HSO ₄ ⁻
		Thiosulfate	S ₂ O ₃ ⁻²
		Sulfide	S ⁻²
		Hydrogen Sulfide Ion / Bisulfide	HS ⁻
		Sulfite	SO ₃ ⁻²
		Hydrogen Sulfite Ion / Bisulfite	HSO ₃ ⁻

1 - mono	5 - penta	9 - nona
2 - di	6 - hexa	10 - deca
3 - tri	7 - hepta	
4 - tetra	8 - octa	

Polyatomic Ions

Polyatomic Ion	Formula	Ionic Formula	Charge
Ammonium	NH ₄	[NH ₄] ⁺	1+
Hydroxide	OH	[OH] ⁻	1-
Nitrate	NO ₃	[NO ₃] ⁻	1-
Sulfate	SO ₄	[SO ₄] ²⁻	2-
Carbonate	CO ₃	[CO ₃] ²⁻	2-
Phosphate	PO ₄	[PO ₄] ³⁻	3-

Ions made of more than one atom

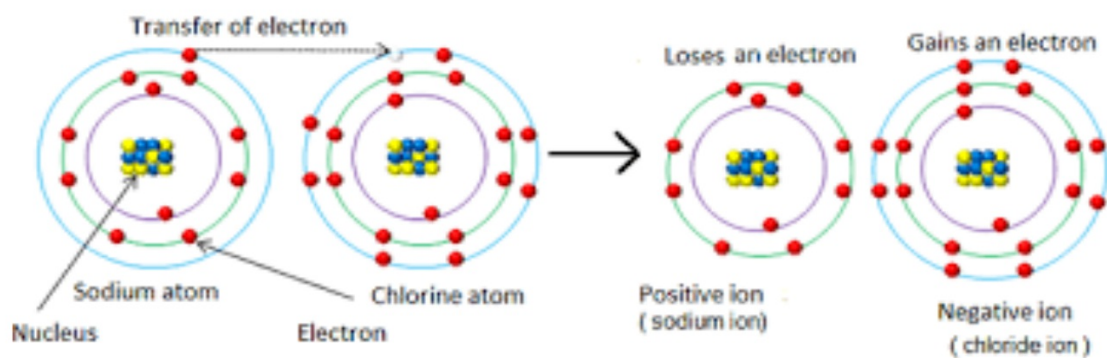


Have an overall positive or negative charge

Ionic Bond

The attraction between two oppositely charged ions.

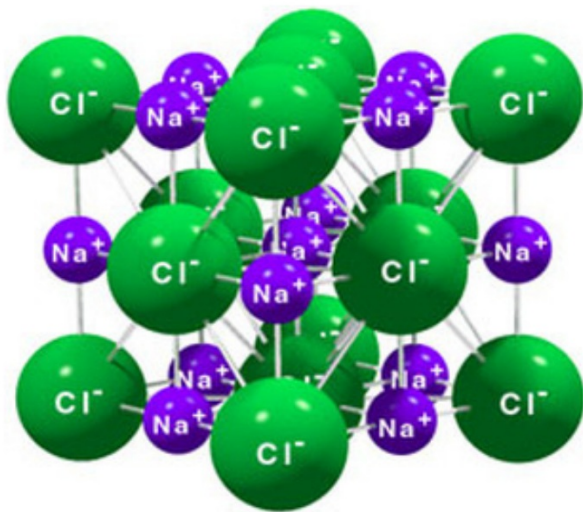
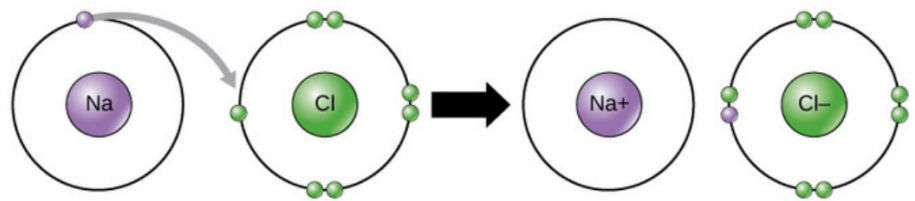
Usually form when a metal combines with a nonmetal.



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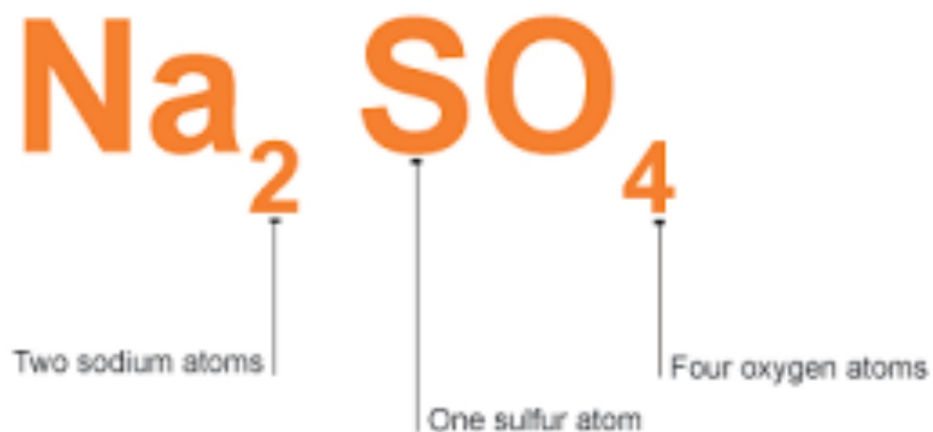
Ionic Compound

A compound made up of positive and negative charged ions.



Chemical Formula

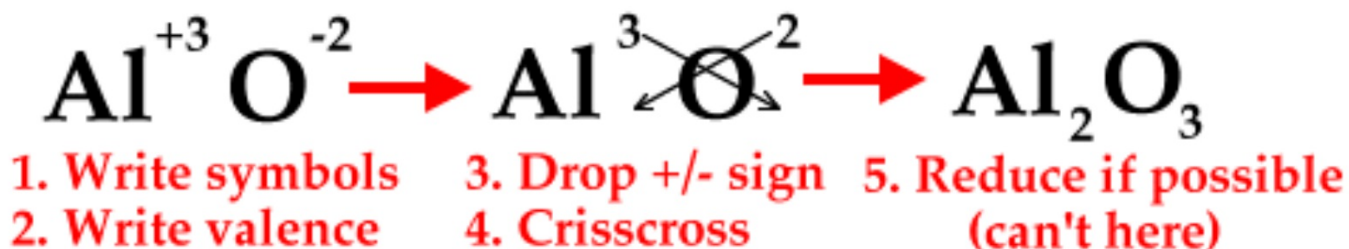
A group of symbols that show the ratio of elements in a compound.



Subscripts tell the ratio of elements in a compound.

How Are the Formulas and Names of Ionic Compounds Written?

To write the formula for an ionic compound, write the symbol of the positive ion and the symbol of the negative ion. Add the subscripts that are needed to balance the charges.



<https://www.youtube.com/watch?v=tz5SAGQZDj8>

Naming Ionic Compounds

For an ionic compound the name of the positive ion comes first, followed by the name of the negative ion.

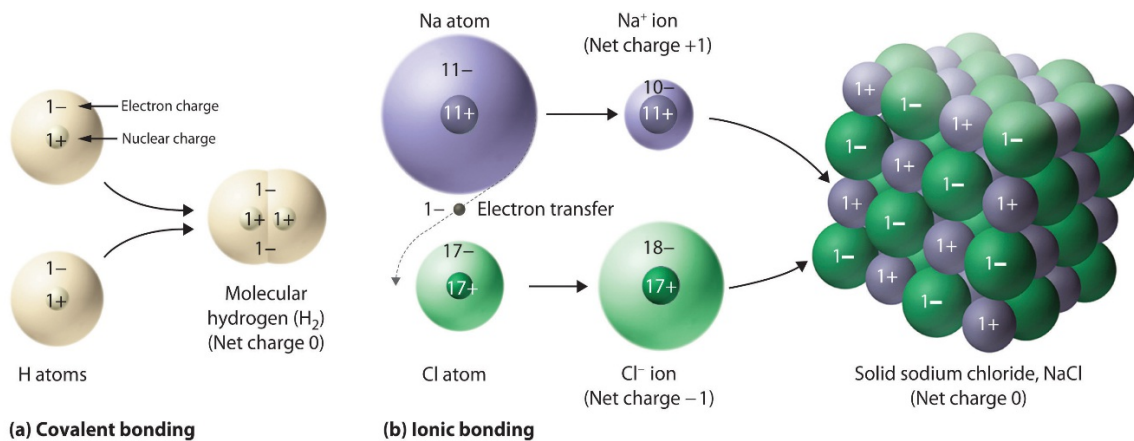
formula	systematic name
CuCl	copper(I) chloride
CuCl ₂	copper(II) chloride
Hg ₂ Cl ₂	mercury(I) chloride
HgO	mercury(II) oxide
FeS	iron(II) sulfide
Fe ₂ S ₃	iron(III) sulfide

Review

How Do Ions Form?

How Are the Formulas and Names of Ionic Compounds Written?

What Are Properties of Ionic Compounds?

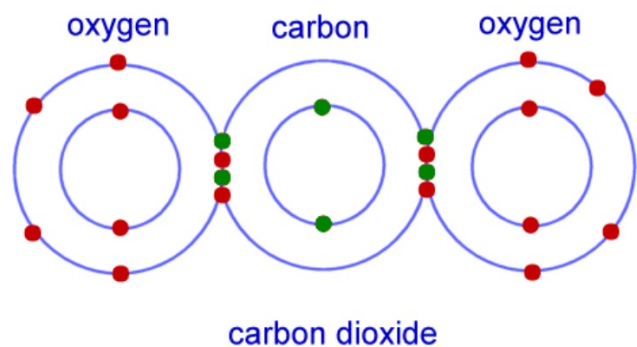
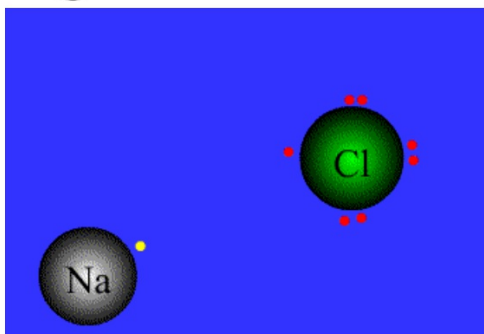


Covalent Bonds

How Are Atoms Held Together in a Covalent Bond?

What Are Properties of Molecular Compounds?

How Do Bonded Atoms Become Partially Charged?

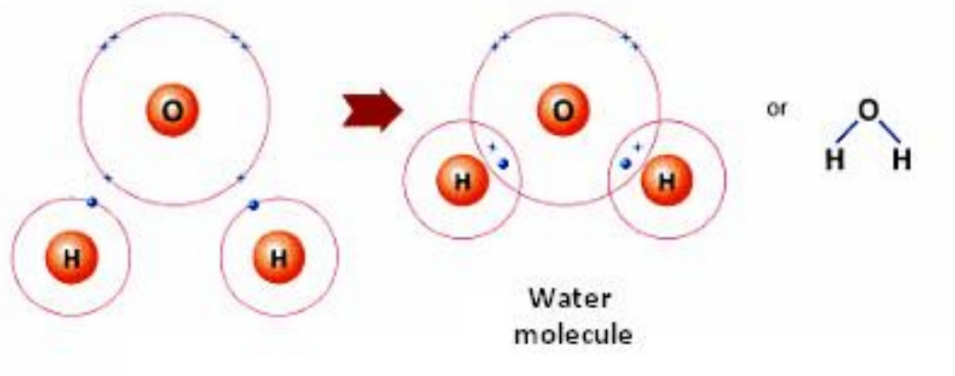


Covalent Bonds

The chemical bond formed when 2 atoms share an electron.

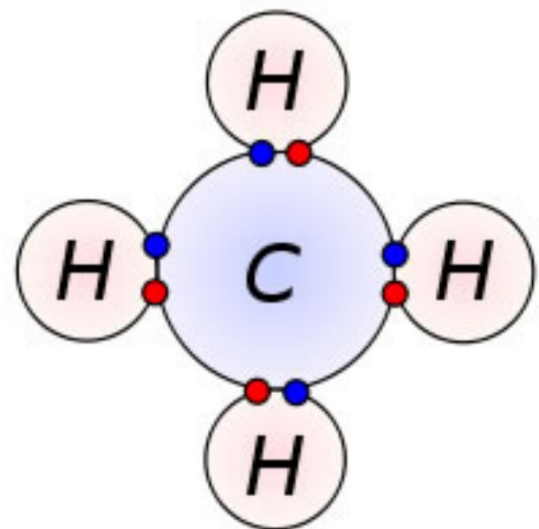
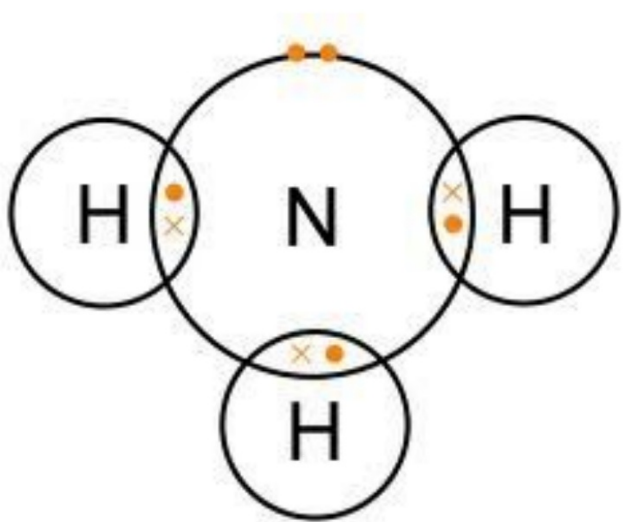
Usually form between nonmetal atoms.

Usually form when a metal combines with a nonmetal



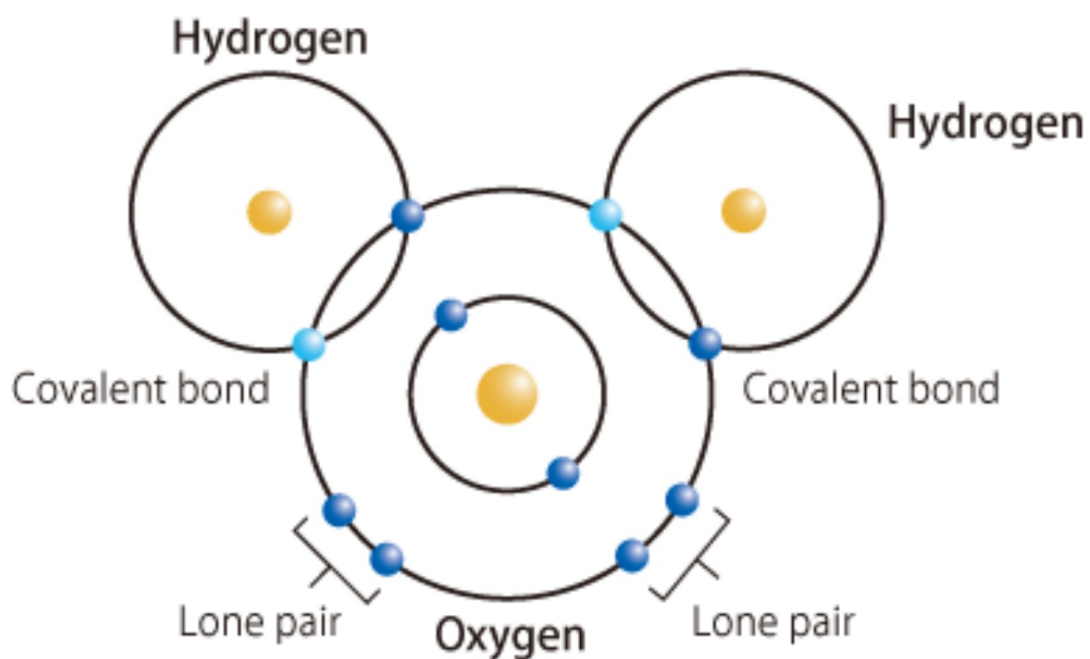
Nonmetals bond to other nonmetals by sharing electrons.

Atoms of some nonmetals can bond with each other.

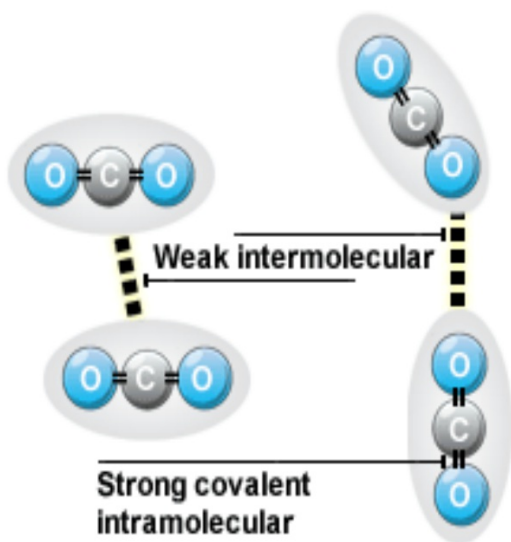


- Electron from hydrogen
- Electron from carbon

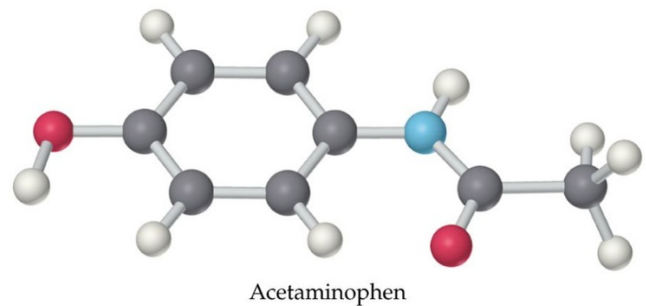
The attractions between the shared electrons and the protons in the nucleus of each atom hold the atoms together in a covalent bond.



Molecules are neutral groups of atoms joined by covalent bonds.

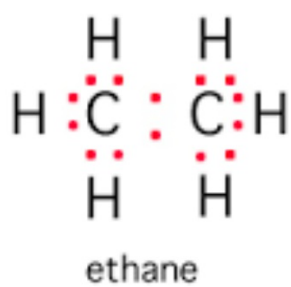


Covalent Bonding

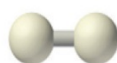
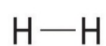
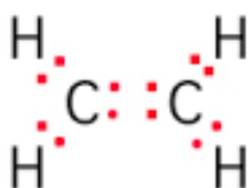


Bonds

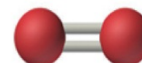
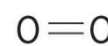
Single, double and triple bonds.



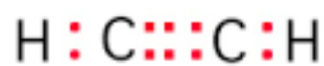
ethylene (ethene)



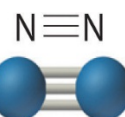
Single bond



Double bond



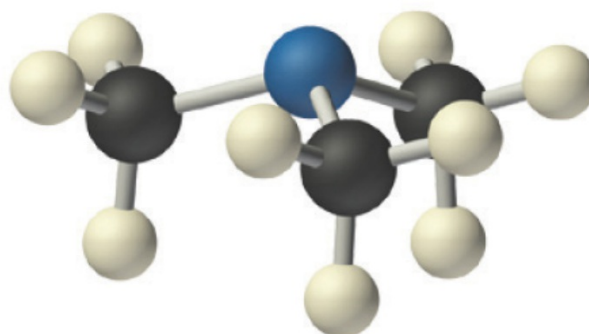
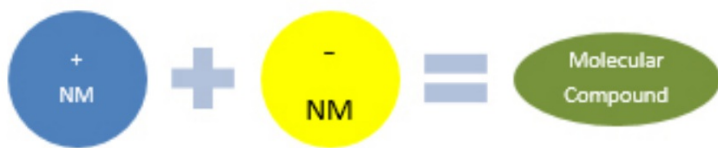
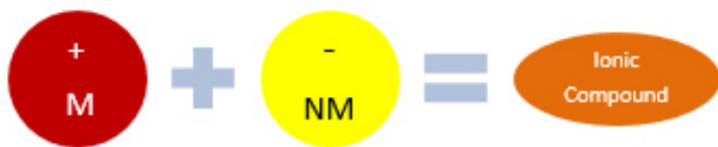
acetylene (ethyne)



Triple bond

Molecular Compound

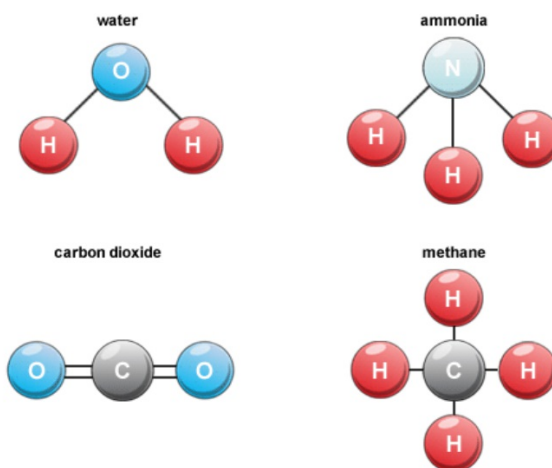
A compound made out of molecules.



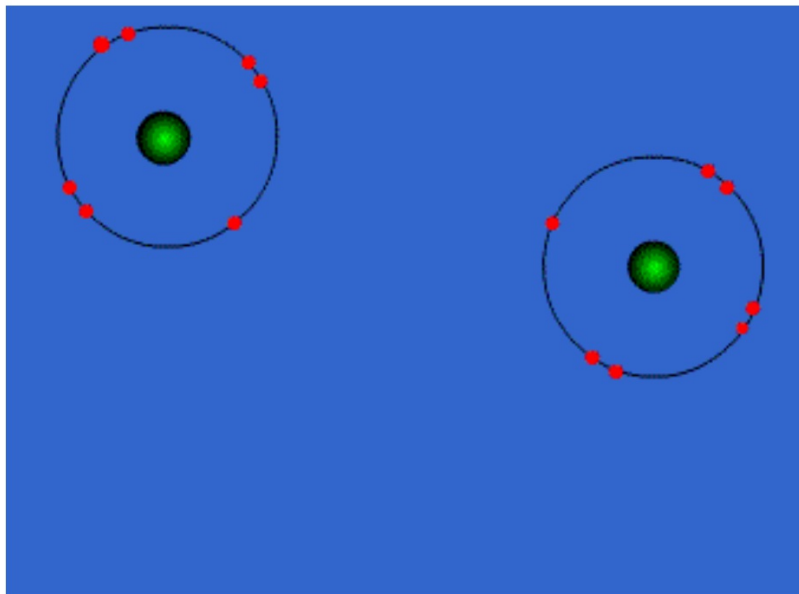
Trimethylamine

Unlike ionic compounds, molecular compounds usually do not conduct electric current when melted or dissolved in water.

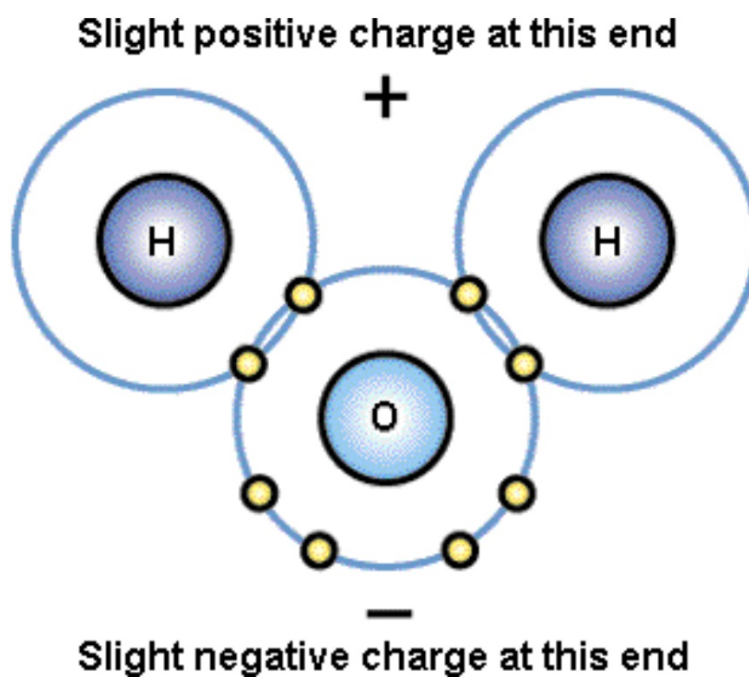
Compared to ionic compounds, molecular compounds generally have lower melting points and boiling points.



Atoms of some elements pull more strongly on the shared electrons of a covalent bond than do atoms of other elements.



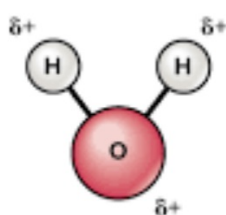
Unequal sharing of electrons causes covalently bonded atoms to have slight electric charges.



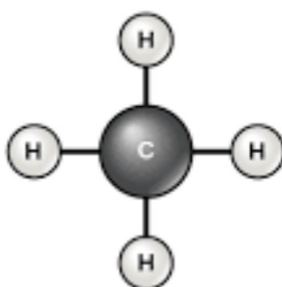
Nonpolar Bonds - covalent bonds which electrons are shared equally.

Polar Bonds - covalent bond which electrons are shared unequally.

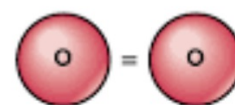
Polar covalent bond



Nonpolar covalent bond



Nonpolar covalent bond



https://www.youtube.com/watch?v=_M9khs87xQ8

Review

How Are Atoms Held Together in a Covalent Bond?

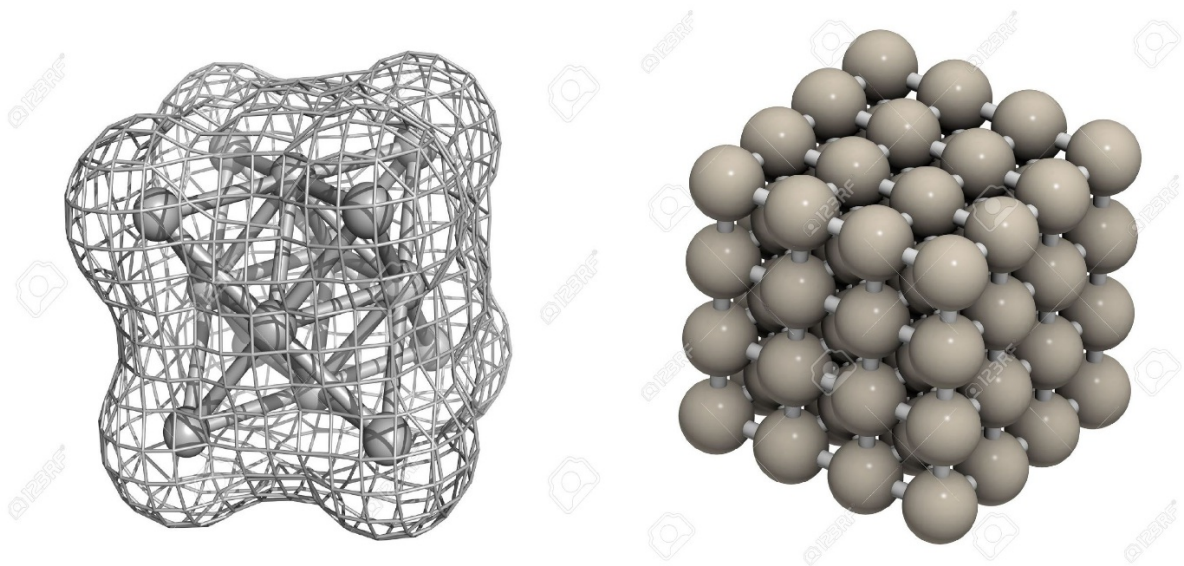
What Are Properties of Molecular Compounds?

How Do Bonded Atoms Become Partially Charged?

Bonding in Metals

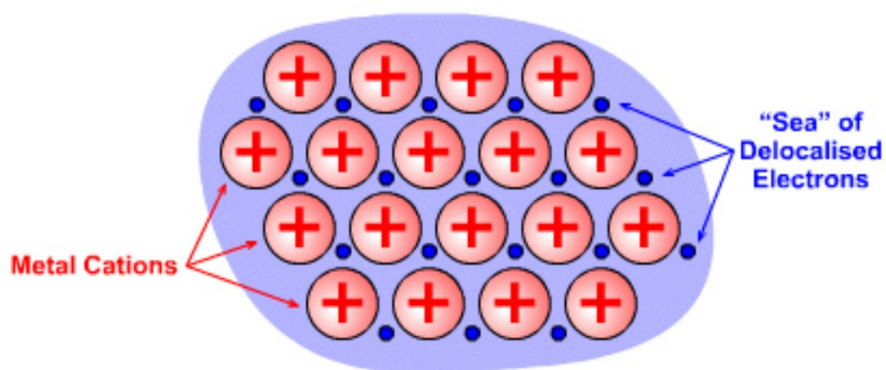
What Is the Structure of a Metal Crystal?

What Are Properties of Metals?



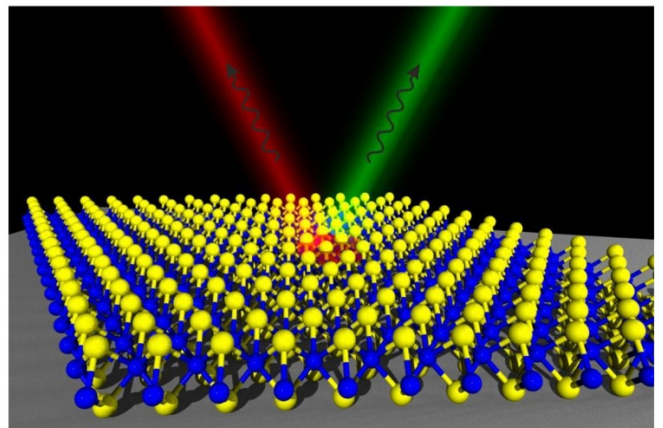
A metal crystal is composed of closely packed, positively charged metal ions. The valence electrons drift among the ions.

Each metal ion is held in the crystal by a metallic bond (attraction between a positive metal ion and the surrounding electrons).



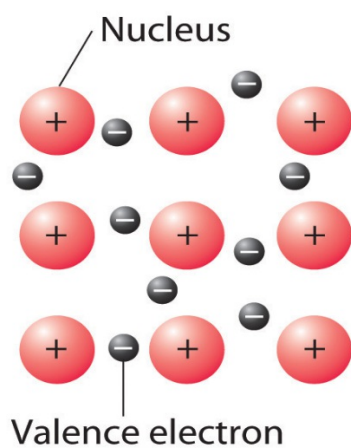
Luster

Luster of a metal is due to its valence electrons. When light strikes these electrons, they absorb the light and re-emit the light.

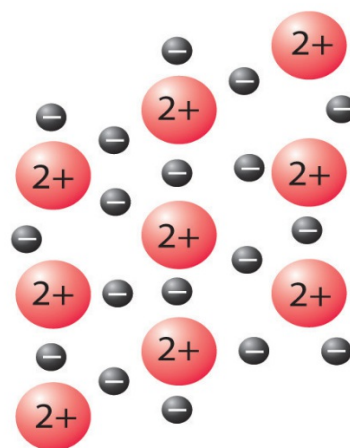


Malleability and Ductility

Metals act this way because the positive metal ions are attracted to the loose electrons all around rather than to other metal ions.



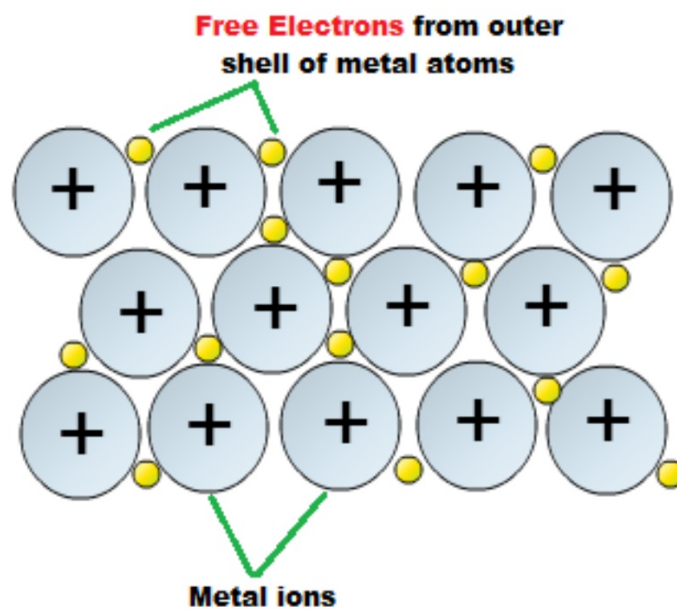
(a) Group 1 metal



(b) Group 2 metal

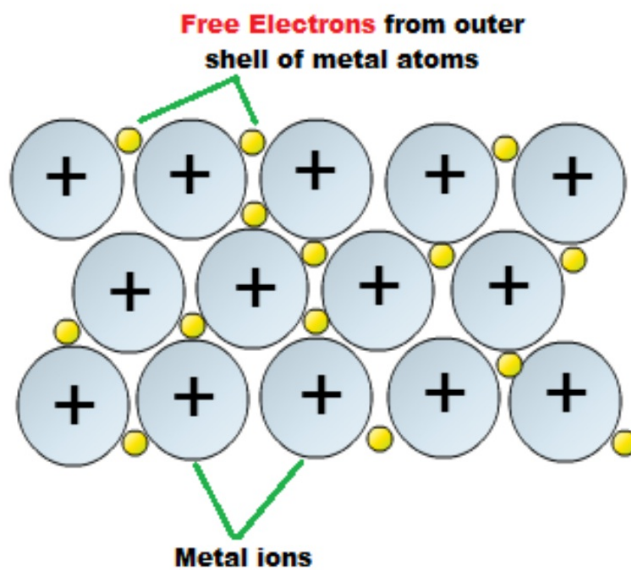
Thermal Conductivity

Metals conduct heat easily because the valence electrons within a metal are free to move.



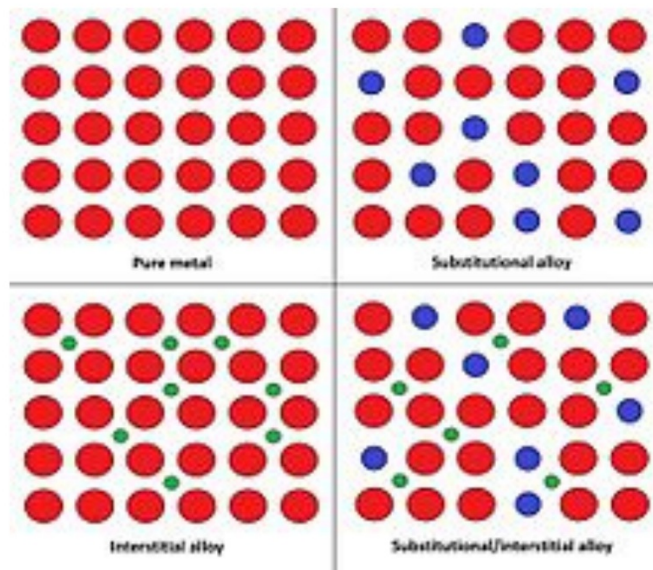
Electrical Conductivity

Metals conduct electrical current easily because the valence electrons in a metal can move freely among atoms.



Alloys

Mixture made up of two or more elements, one of which is a metal.



Review

What Is the Structure of a Metal Crystal?

What Are Properties of Metals?



