

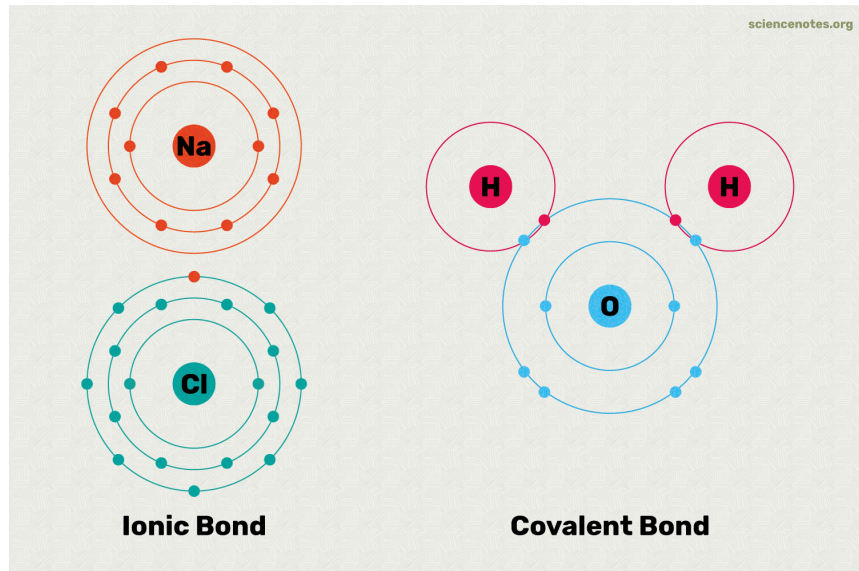


The National
Orthodox School
Shmaisani

Science summary sheet #5

Grade 8 National

Chemical bonding



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Learning Objectives:

- Describe different types of chemical bonding.
- Understand the concept of valency.
- Represent chemical bonds using Lewis structures.

Key words:

- ❖ Atom
- ❖ Ion (Anion/ Cation)
- ❖ Valence electrons
- ❖ Octet rule
- ❖ Chemical formula
- ❖ Lewis structure
- ❖ Polyatomic ions

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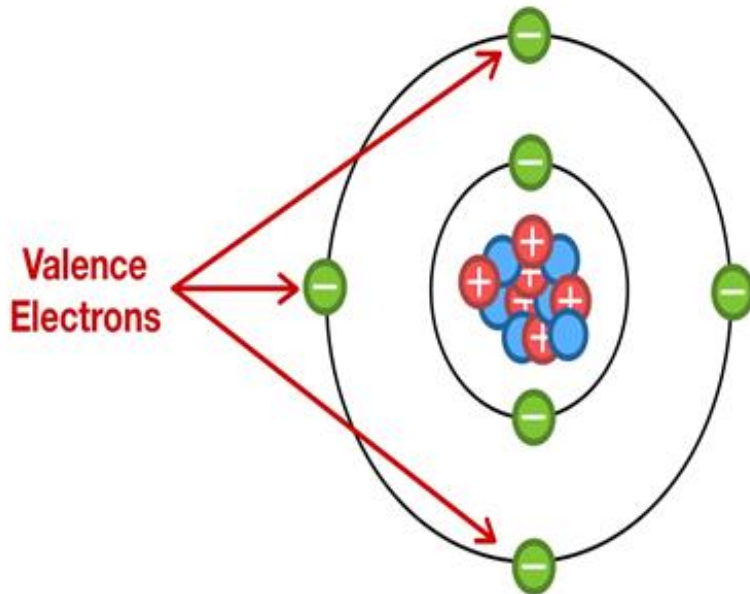
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Chemical bonds are the *forces of attraction* that tie atoms together in a molecule or compound.

Bonds are formed when valence electrons, the electrons in the outermost “shell” of an atom, interact.

Valence electrons: Number of electrons in the last shell
= Group number in the periodic table



The type of bonding between the atoms depends on their tendency to *lose* or *gain* electrons to have full outer shell of electrons.

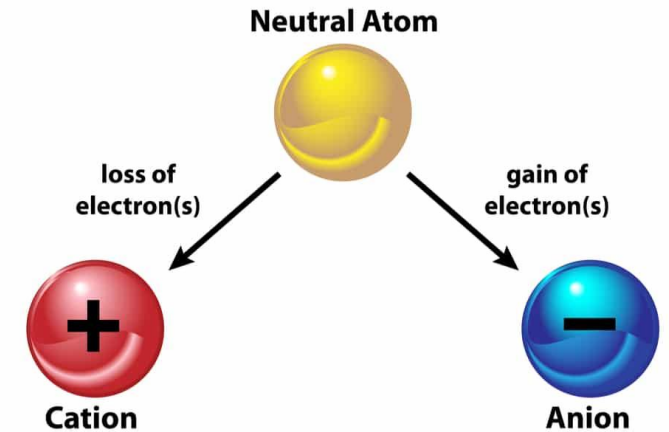
Octet rule: atoms tend to lose or gain electrons until they are surrounded by 8 *valence electrons* in their compounds, (except for elements in period#1 / Hydrogen and Helium).

1		2												3	4	5	6	7	8						
														H Hydrogen 1											He Helium 2
7 Li Lithium 3	9 Be Beryllium 4											11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10								
23 Na Sodium 11	24 Mg Magnesium 12											27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulfur 16	35.5 Cl Chlorine 17	40 Ar Argon 18								
39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	63.5 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36								
85 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	99 Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54								
133 Cs Caesium 55	137 Ba Barium 56	57-71	178 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	210 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86								
(223) Fr Francium 87	(226) Ra Radium 88	89-103	(261) Rf Rutherfordium 104	(262) Db Dubnium 105	(264) Sg Seaborgium 106	(264) Bh Bohrium 107	(269) Hs Hassium 108	(268) Mt Meitnerium 109	(269) Ds Darmstadtium 110	(272) Rg Roentgenium 111	(285) Cn Copernicium 112	(286) Nh Nihonium 113	(289) Fl Flerovium 114	(289) Mc Moscovium 115	(293) Lv Livermorium 116	(294) Ts Tennessine 117	(294) Og Oganesson 118								
Lanthanide Series		139 La Lanthanum 57	140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	(145) Pm Promethium 61	(150) Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	159 Tb Terbium 65	163 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71									
Actinide Series		(227) Ac Actinium 89	232 Th Thorium 90	231 Pa Protactinium 91	238 U Uranium 92	(237) Np Neptunium 93	(244) Pu Plutonium 94	(243) Am Americium 95	(247) Cm Curium 96	(247) Bk Berkelium 97	(251) Cf Californium 98	(252) Es Einsteinium 99	(257) Fm Fermium 100	(258) Md Mendelevium 101	(259) No Nobelium 102	(266) Lr Lawrencium 103									

Types of chemical bonds:

1- Ionic bond:

- It is an electrostatic force formed between ***oppositely charged ions***.
- The ions are formed from atoms by transfer of one or more electrons from a metal to a non- metal.



Ions:

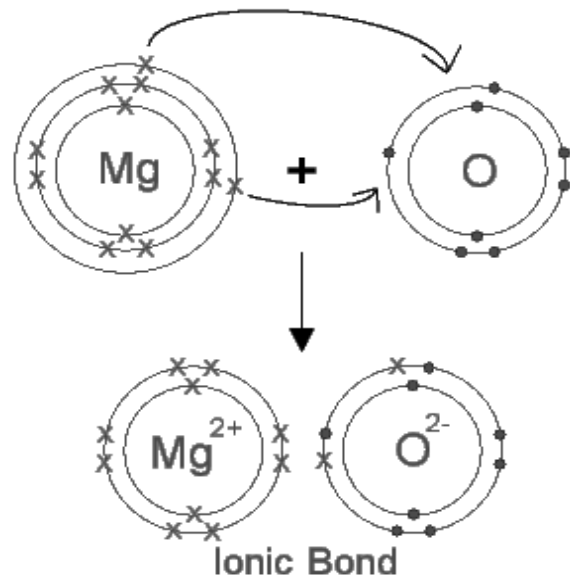
- Positive Ion: (cation) Atoms that lost valence electrons (mainly metals)
- Negative Ions: (anion) Atoms that gained electrons to have full outer shell.
- All ions are stable with electron distribution similar to the closest Noble gas.

- ***ionic bonding*** is the complete transfer of valence electron(s) between atoms.
- It is a type of chemical bond that generates two oppositely charged ions.
- In ionic bonds, the metal loses electrons to become a positively charged cation, whereas the nonmetal accepts those electrons to become a negatively charged anion.
- Ionic bonds require an electron donor, often a metal, and an electron acceptor, a nonmetal.

- Examples of formation for 2 ionic compounds:

$_{12}\text{Mg}$: 2,8,2

$_{8}\text{O}$: 2,6

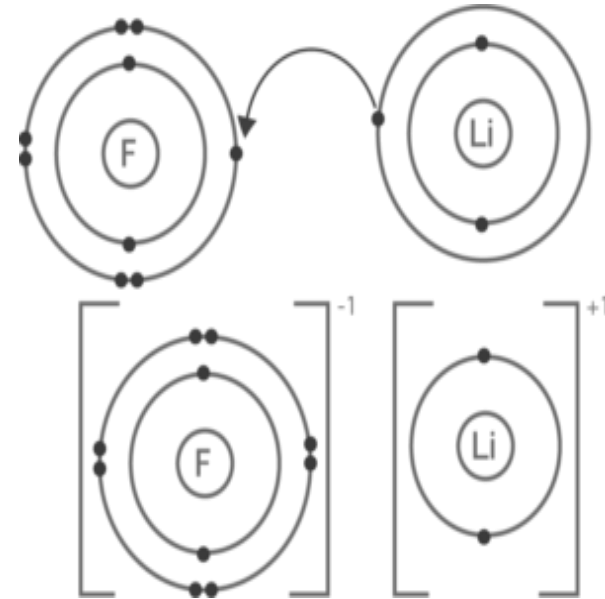


$_{12}\text{Mg}^{+2}$: 2,8

$_{8}\text{O}^{-2}$: 2,8

$_{3}\text{Li}$: 2,1

$_{9}\text{F}$: 2,7



$_{3}\text{Li}^{+1}$: 2

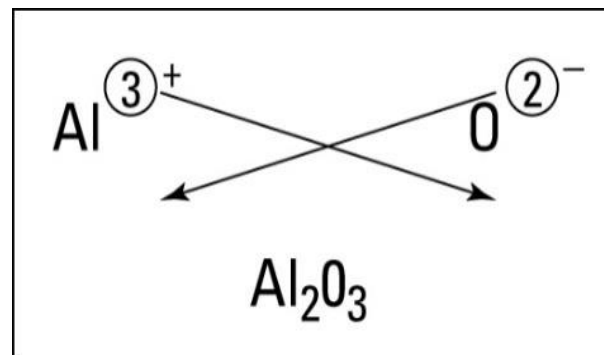
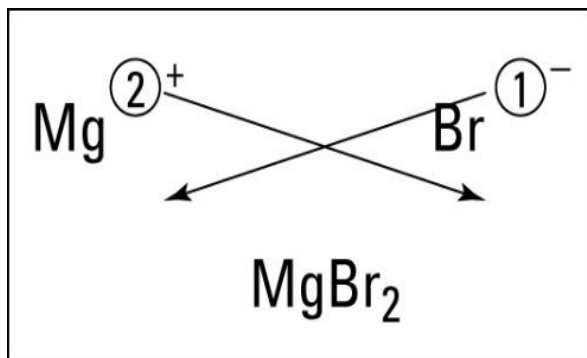
$_{9}\text{F}^{-1}$: 2,8

- Attraction forces between the positive and negative ions formed is called Ionic Bonding.

Chemical Formulae for Ionic Compounds:

- 1- Write the symbols of the positive and negative ions.
- 2- Exchange the numbers of the charges (valences) as subscripts (below the symbols).
- 3- Take the smallest ratio of the numbers.

Examples of molecular formula for ionic compounds with single atomic ions:



Ionic compounds can form with ions that have many atoms:

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-

calcium nitrate



aluminum hydroxide



barium sulfate



sodium phosphate



only use parenthesis with polyatomic ions

potassium sulfate



can't reduce polyatomic formula

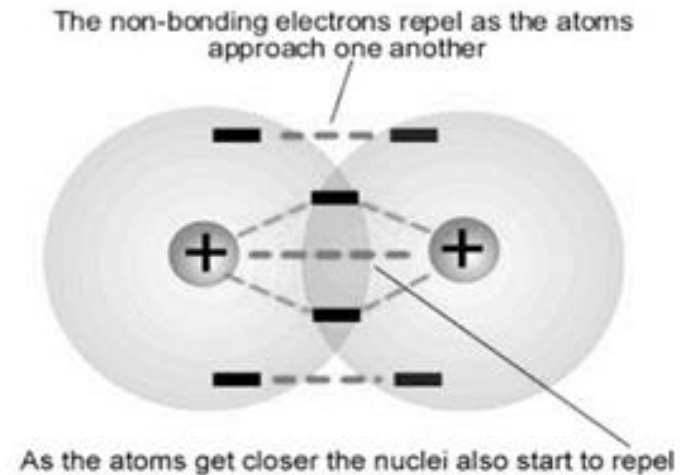
Types of chemical bonds:

2- Covalent bond:

- The sharing of electrons between atoms. This type of bonding occurs between two atoms of the same element or of elements close to each other in the periodic table. This bonding occurs primarily between *nonmetals*.

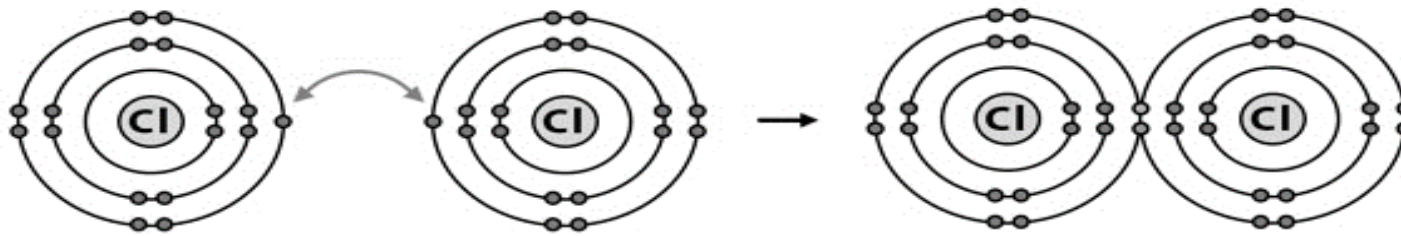
Formation of Bonds

- Atoms are attracted to each other by the opposite charges of their electrons and the other atom's protons. Although the electrons of the two atoms repel each other, the attraction forces are greater

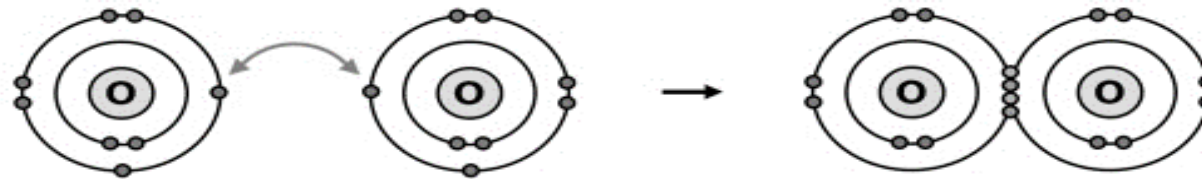


Covalent Bond Examples

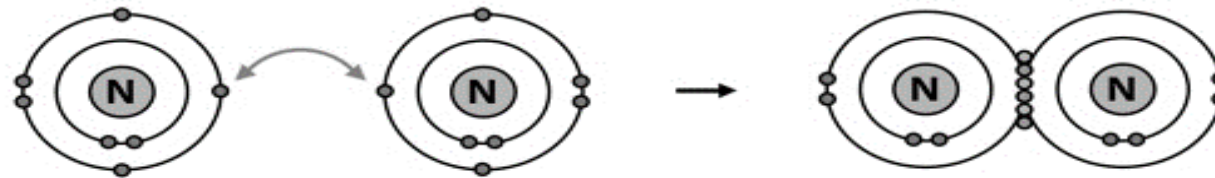
1. Chlorine (Cl_2)



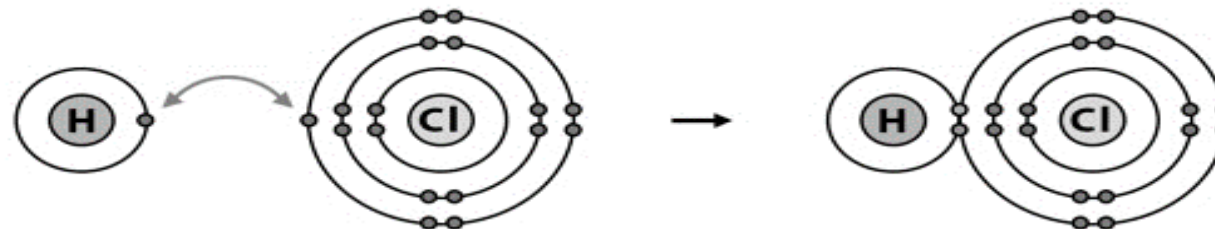
2. Oxygen (O_2)



3. Nitrogen (N_2)

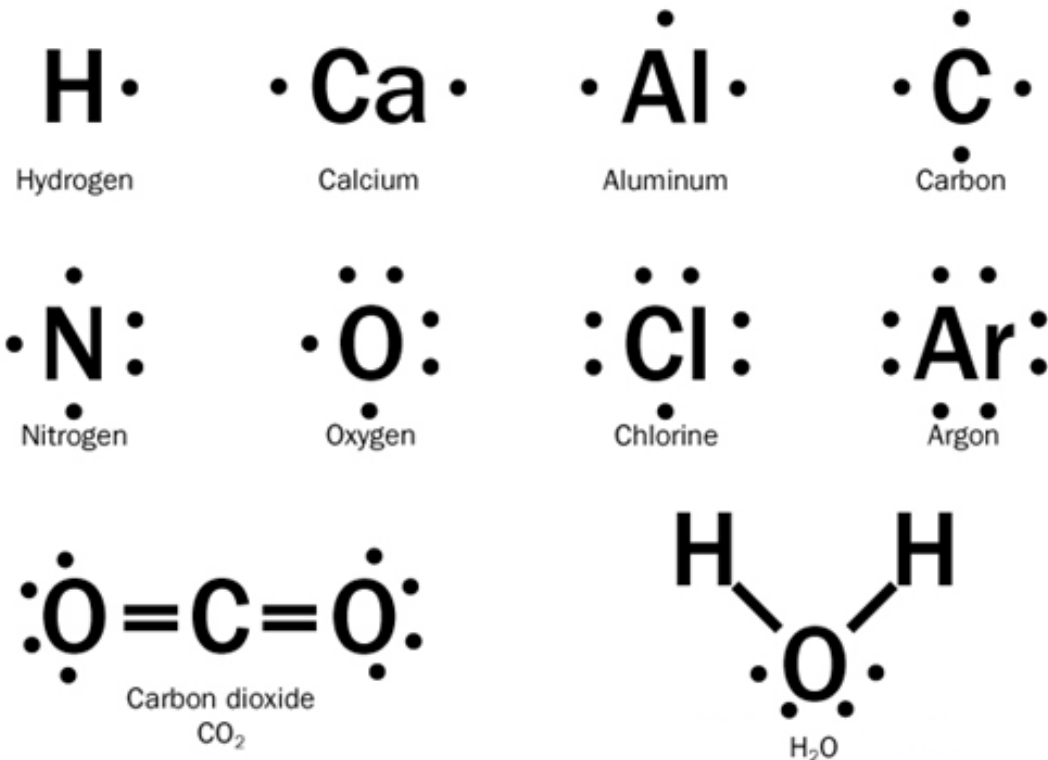


4. Hydrogen Chloride (HCl)

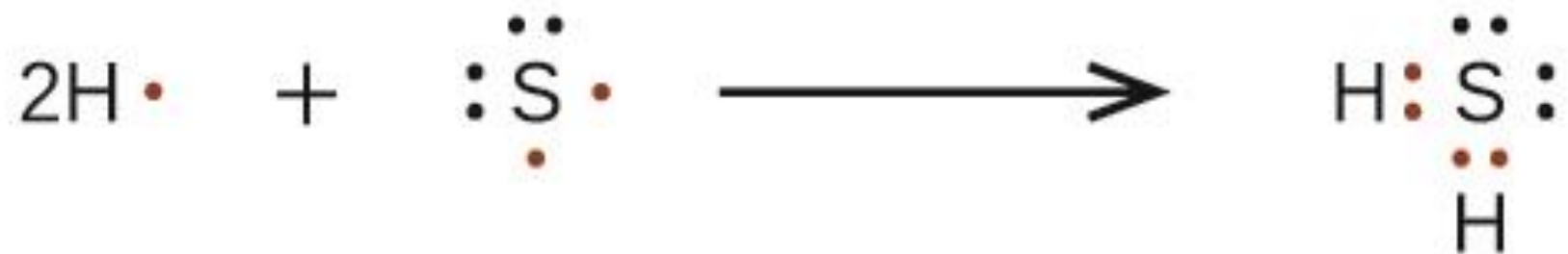


Using Lewis structure:

- Only draw the valence electrons of each element (as dot or cross), then pair the single electrons between the two atoms.
- The number of valence electrons of any representative element is the same as the group number of the element in the periodic table



Examples of forming covalent bonds



Comparing properties of Ionic compounds and covalent compounds:

Ionic compounds	Covalent compounds
1. Ionic compounds are formed by the complete transfer of electrons.	Covalent compounds are formed by the sharing of electrons between two atoms.
2. They exist in solid-state	They exist in all three states - solid, liquid, gases
3. They have high melting and boiling point.	They have low melting and boiling point.
4. They are soluble in water	They are generally insoluble in water.
5. Ionic compounds are good conductors of electricity in the molten state as well as in aqueous solutions.	They are insulators i.e they do not conduct electricity in the molten state as well as in aqueous solutions.

As ionic compounds are made of CHARGED IONS, they can CONDUCT ELECTRICITY but ONLY if the ions can MOVE.

