2. Ionic, Covalent Bonding and Types of Substances

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Ions are formed by electron loss or gain

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Charge of atoms by groups and transition metals/Compounds

- Group 1 - +(1)
- Group 2 - +2
- Group 3 - +3
- Group 5 - -3
- Group 6 - -2
- Group 7 - -(1)
- Ag+
- Cu2+
- Fe2+
- Fe3+
- Pb2+
- Zn2+
- Hydrogen (H+)
- Ammonium(NH4 +)
- Carbonate (CO3 2-)
- Nitrate (NO3 -)
- Sulfate (SO4 2-)

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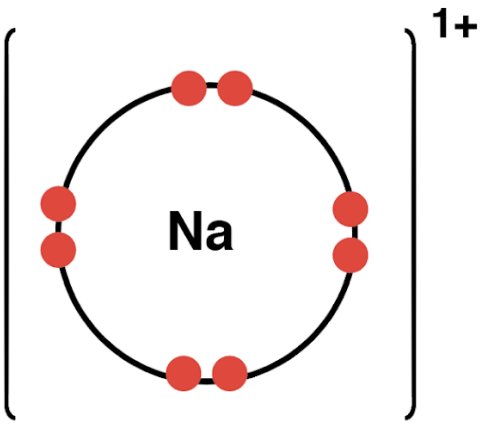
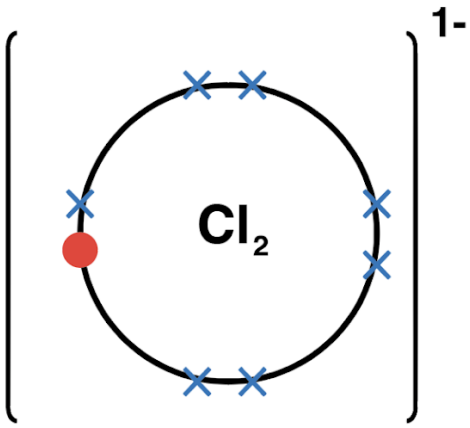
Dot and plot diagrams



Sodium Ion

Na^{1+}



Chlorine Ion

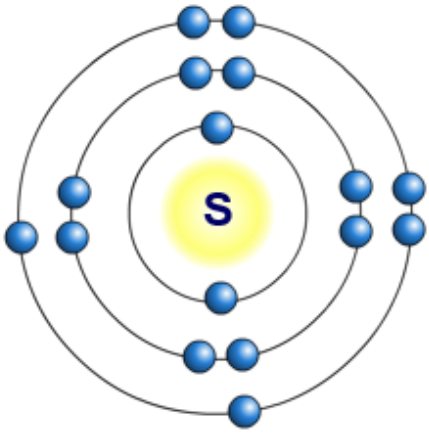
Cl^{1-}

Sulfur atom:

16 protons = +16

16 electrons = -16

Total charge = 0



2.8.6

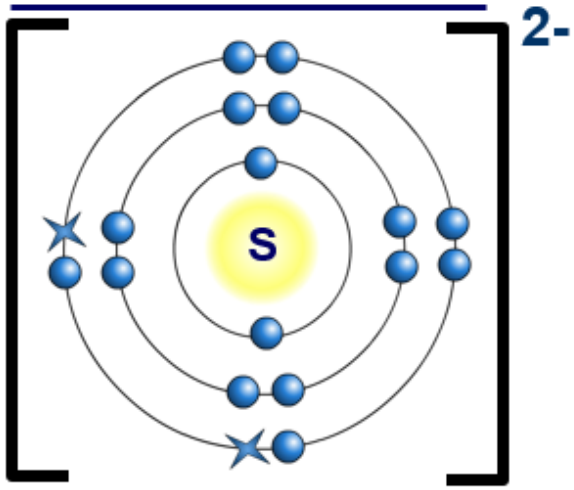
gains 2 electrons

Sulfide ion:

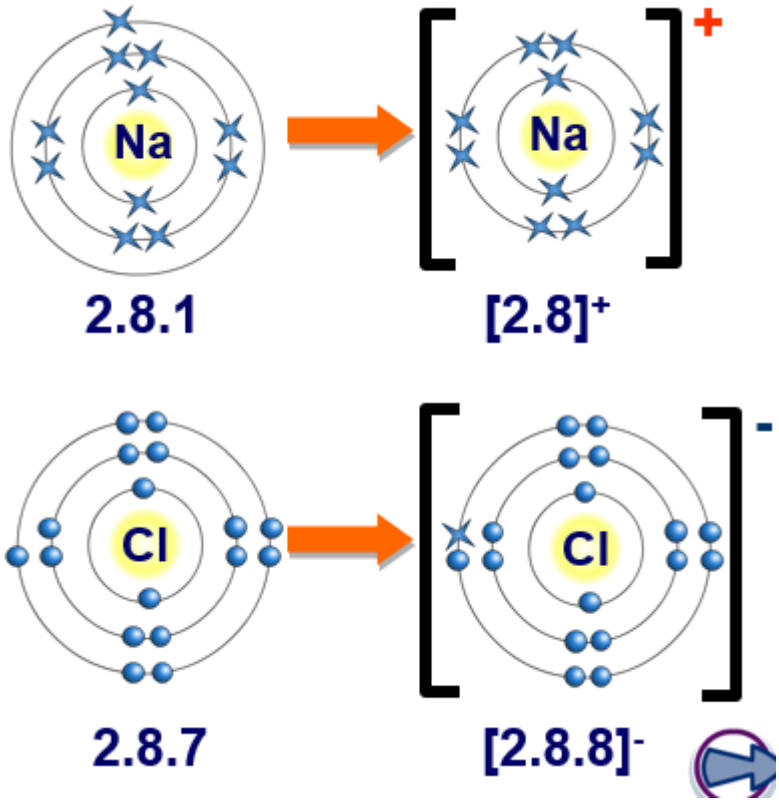
16 protons = +16

18 electrons = -18

Total charge = -2



$[2.8.8]^{2-}$



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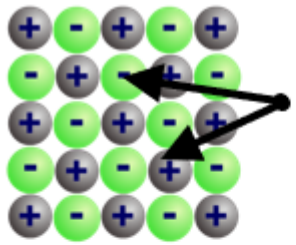
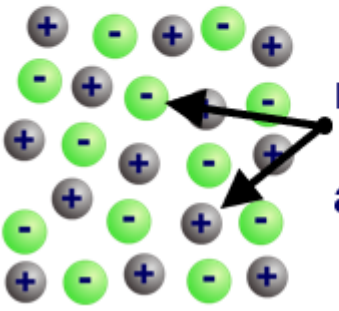
Ionic Bonding - Electrostatic attraction between a negatively charged non metal ion and positively charged metal ion.

Symbol	Al	O
Ion charge	+3	-2
Balance the number of ions	2 aluminium ions are needed for 3 oxide ions	
Ratio of ions	2 : 3	
Formula	Al_2O_3	

metals / non-metals	Li	Ca	Na	Mg	Al	K
F	LiF	CaF_2	NaF	MgF_2	AlF_3	KF
O	Li_2O	CaO	Na_2O	MgO	Al_2O_3	K_2O
N	Li_3N	Ca_3N_2	Na_3N	Mg_3N_2	AlN	K_3N
Br	LiBr	$CaBr_2$	NaBr	$MgBr_2$	$AlBr_3$	KBr
S	Li_2S	CaS	Na_2S	MgS	Al_2S_3	K_2S
Cl	LiCl	$CaCl_2$	NaCl	$MgCl_2$	$AlCl_3$	KCl



ions in solid state cannot move



ions in molten state can move and conduct electricity

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Compounds with giant ionic lattices have high melting points because more bonds must be broken to boil the compound

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Ionic compounds do not conduct electricity when solid because the ions cannot move. They do conduct electricity when molten and ions can moved.

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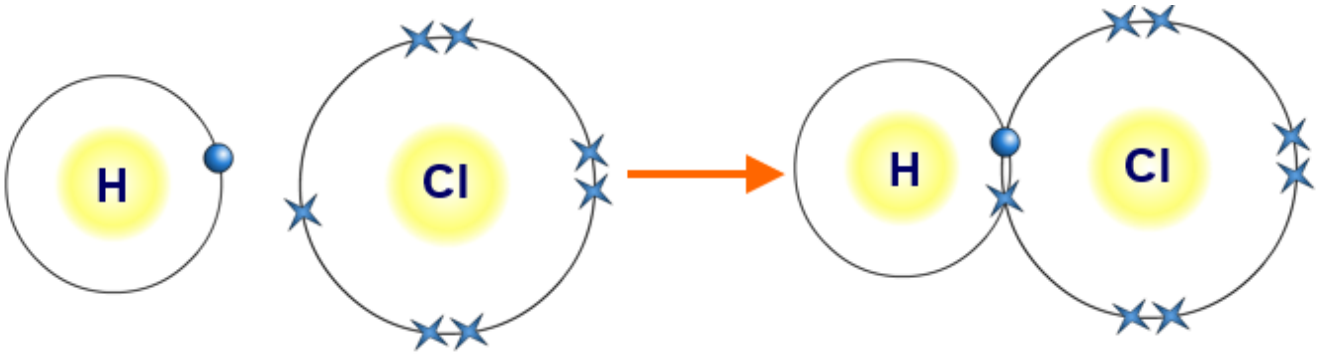
Covalent bond is formed between atoms by sharing of a pair of electrons



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Covalent bonds are electrostatic attraction between negative electrons and positive nucleolus of non metals from sharing pair of electrons.

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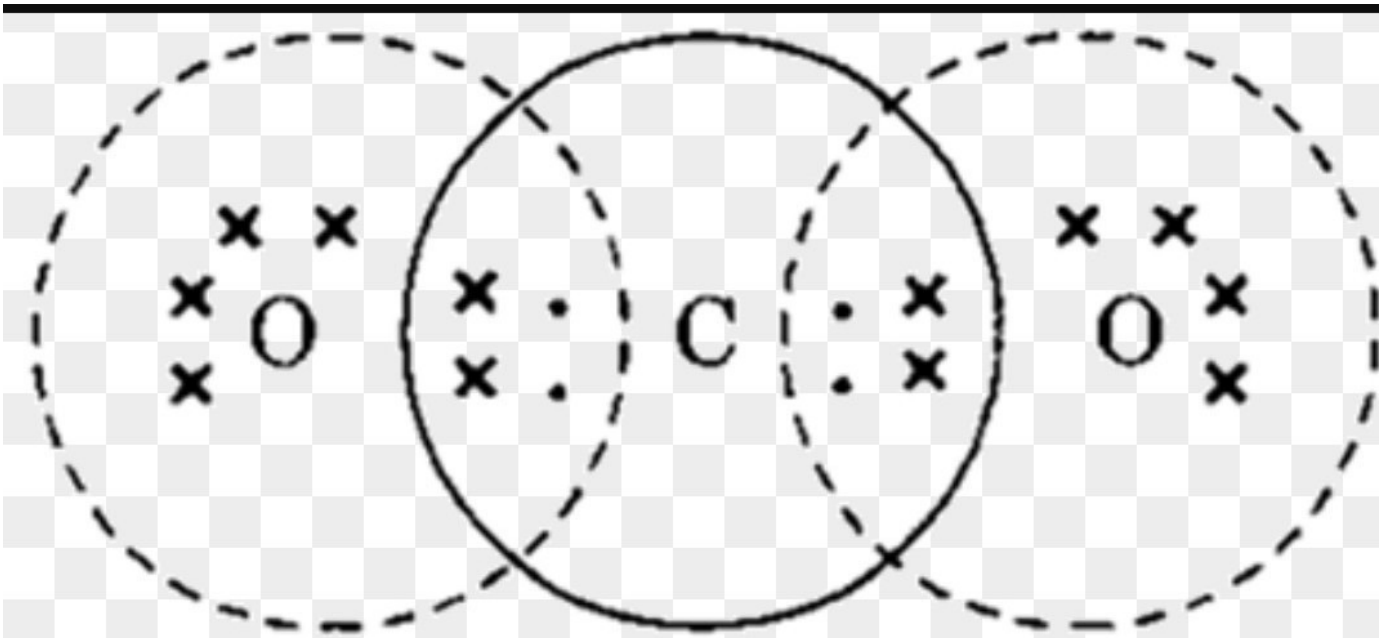
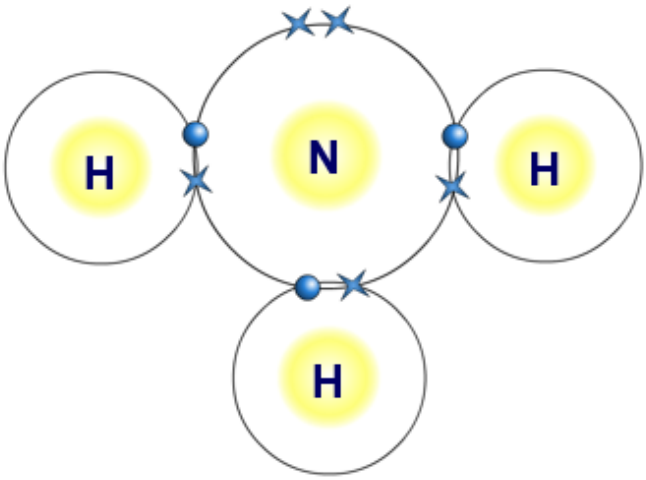


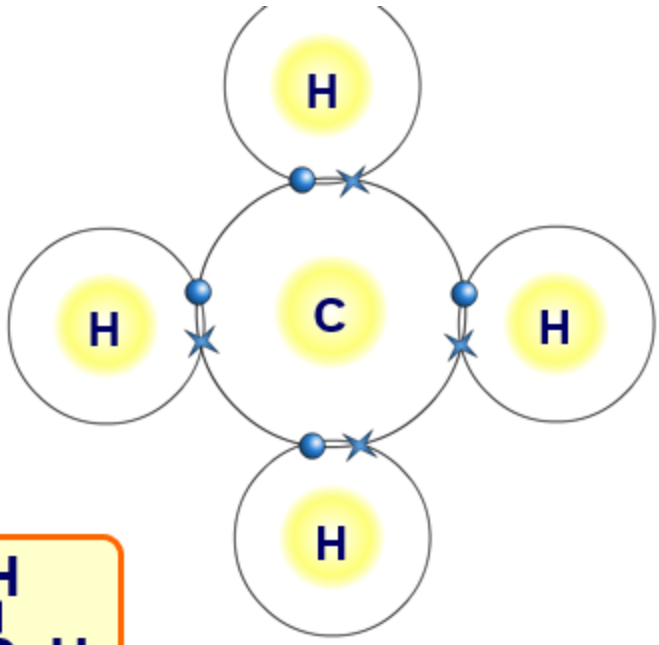
Carbon dioxide

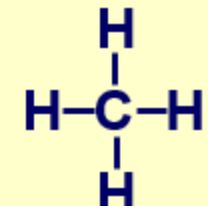
element	N	H
electron configuration	(2.5)	(1)
electrons needed	3	1
ratio of atoms	1	3



NH_3 or H–N–H
|
H

element	C	H
electron configuration	(2.4)	(1)
electrons needed	4	1
ratio of atoms	1	4



CH_4 or 

1.47

Molecules with simple structure have a low boiling and melting point because the electrostatic attraction is low, making it easier to break with less energy.

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Melting and boiling point of substances with simple molecular structure increase, in general, with increasing relative molecular mass because there are more bonds to break in larger compounds

1.49

Substances with giant covalent structures are solids with high melting and boiling points because they have a strong bond, making it difficult to be a liquid.

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Graphite is strong in one direction but the layers could slide due to weak attraction between the layers. It conducts electricity with free electrons delocalized. It has three covalent bonds.

C60 fullerene (Buckministerfullerene)has a space inside and extremely strong

Diamonds are extremely hard, very high boiling point, and cannot conduct electricity. Each carbon shares electrons with four other carbon atoms

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Covalent bonds do not usually conduct electricity

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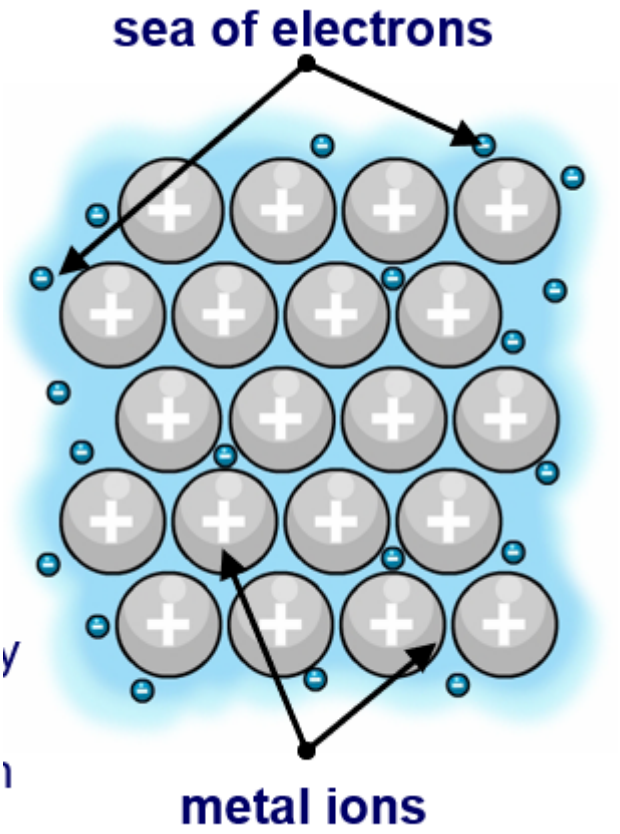
Metallic lattice is represented by a 2-D diagram with circles with multiple plus symbols surrounded by sea of small electrons.



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Metallic bonding is electrostatic attraction between the positive ions and negative sea of delocalized electrons.

1.54

Metals are shiny, ductile, conduct electricity and malleable.

Bonding	Type of structure	Particles in structure	State at room temperature
ionic	giant ionic lattice	millions of metal and non-metal ions	solid
covalent	simple molecular	few non-metal atoms	usually liquid or solid
	giant covalent lattice	millions of non-metal atoms	solid
metallic	giant metallic lattice	millions of metal ions	solid (except mercury – liquid)