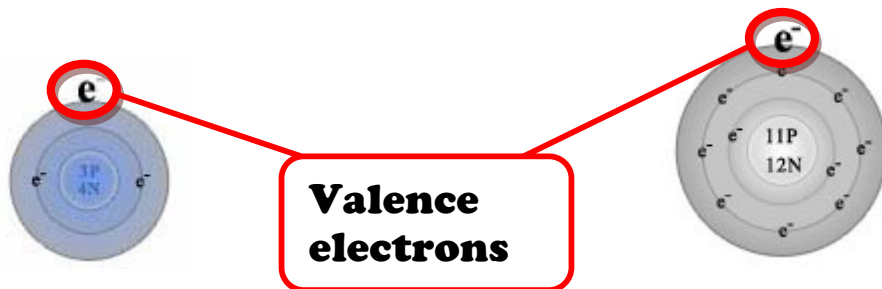


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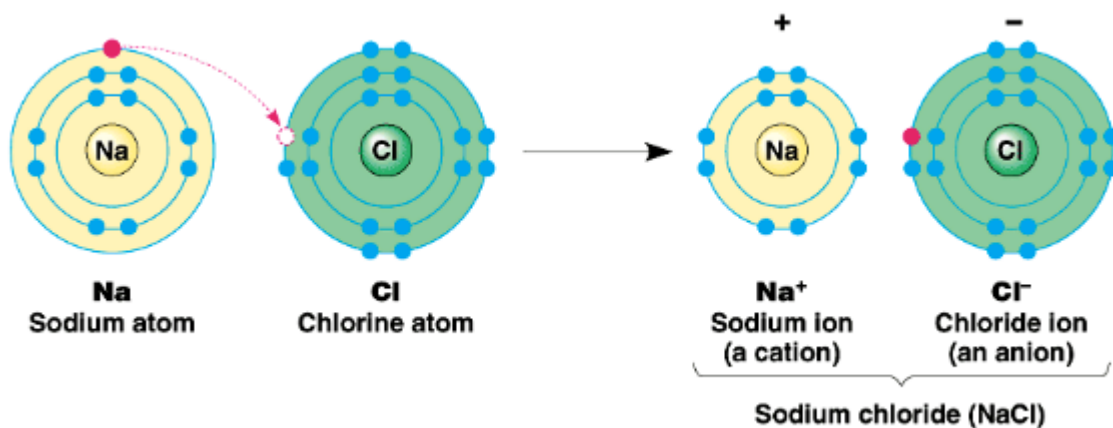
WORKSHEET ON CHEMICAL BONDING

Valence electrons: When an atom undergoes a chemical reaction, only the outermost electrons are involved. These electrons are of the highest energy and are furthest away from the nucleus. These are the **valence electrons**. For the main group elements, the valence electrons are in the orbitals **s** (this orbital holds up to 2 electrons) and **p** (this orbital holds up to 8 electrons).



IONIC BONDING

Ions are formed where electrons are transferred from the valence shell of one atom (usually a metal) to the valence shell of another atom (non-metal) so that both end up with Noble Gas configurations. Assume, in the first instance, that compounds between reactive metals and reactive non-metals will be ionic.



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1) Draw diagrams (outer electrons only) to show the bonding in the following covalent molecules. Draw a before and after bond picture for each on another sheet of paper (your drawings should be similar to the example above):

a) Lithium fluoride – LiF

b) Magnesium sulphide – MgS

c) Calcium chloride – CaCl₂

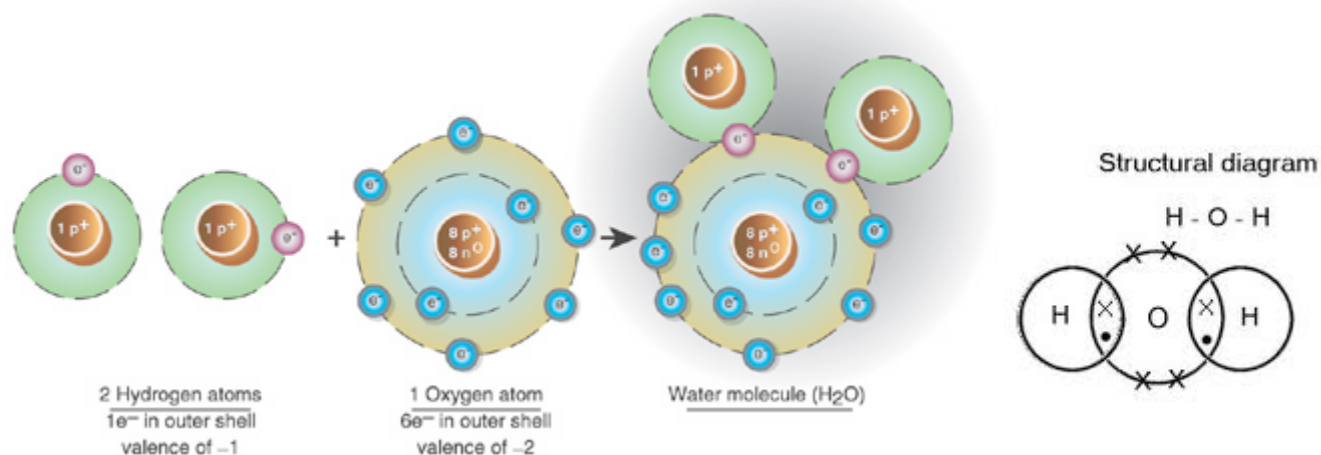
d) Sodium oxide – Na₂O

e) Aluminium oxide – Al₂O₃

f) Magnesium nitride – Mg₃N₂

COVALENT BONDING

Covalent bonding involves the sharing of electron pairs between two atoms. This is most often between non-metal atoms (but there are a number of compounds between metals and non-metals that are covalent). A single covalent bond involves one shared pair of electrons. In many compounds, atoms will share electrons to enable their valence shell to become like the nearest Noble Gas. This is normally 8 electrons (the “Octet Rule”), apart from Hydrogen. There are exceptions (see next section).



2) Draw diagrams (outer electrons only) to show the bonding in the following covalent molecules. Draw a before and after bond picture for each on another sheet of paper (your drawings should be similar to the example above)::

a) Hydrogen fluoride – HF

b) Chlorine – Cl₂

c) Oxygen – O₂

d) Nitrogen – N₂

e) Silicon tetrachloride – SiCl₄

f) Ammonia – NH₃

g) Carbon dioxide – CO₂

h) Hydrogen cyanide – HCN

i) Ethane – C₂H₆

j) Ethene – C₂H₄

Chemical Bonding

Ionic Bond	between a Metal and Non-Metal	(M + NM)
Covalent Bond	between a Non-Metal and Non-Metal	(NM + NM)
Metallic Bond	between a Metal and Metal	(M+ M)

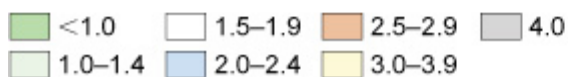
Determine if the elements in the following compounds are metals or non-metals. Describe the type of bonding that occurs in the compound.

Compound	Element 1 (metal or non-metal?)	Element 2 (metal or non-metal?)	Bond Type
NO ₂	N = non-metal	O = non-metal	covalent
NaCl			
SO ₂			
PO ₄ ³⁻			
MgBr ₂			
CaO			
H ₂ O			
K ₂ O			
Cu-Zn alloy			
O ₂			
CuCl ₂			
NO ₂ ⁻			
TiO ₂			
HF			
Rb ₂ S			
Au-Ag mixture			
Fe ₂ O ₃			
C ₆ H ₁₂ O ₂₂			

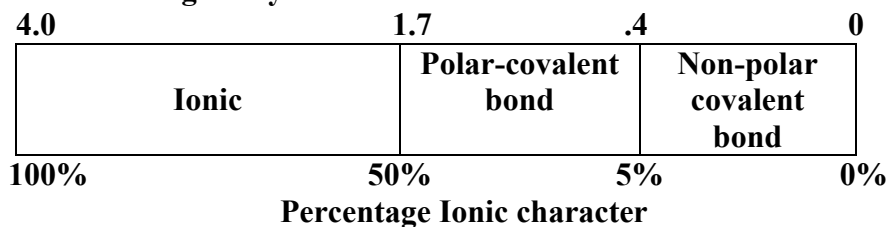
Electronegativity: A property of an atom which increases with its tendency to attract the electrons of a bond.

Examples: The chlorine atom has a higher electronegativity than the hydrogen atom, so the bonding electrons will be closer to the Cl than to the H in the HCl molecule.

Electronegativity																	
1A	2A											3A	4A	5A	6A	7A	
Li 1.0	Be 1.5											B 2.0	C 2.5	N 3.0	O 3.5	F 4.0	
Na 1.0	Mg 1.2	3B	4B	5B	6B	7B	8B				1B	2B	Al 1.5	Si 1.8	P 2.1	S 2.5	Cl 3.0
K 0.9	Ca 1.0	Sc 1.3	Ti 1.4	V 1.5	Cr 1.6	Mn 1.6	Fe 1.7	Co 1.7	Ni 1.8	Cu 1.8	Zn 1.6	Ga 1.7	Ge 1.9	As 2.1	Se 2.4	Br 2.8	
Rb 0.9	Sr 1.0	Y 1.2	Zr 1.3	Nb 1.6	Mo 1.6	Tc 1.7	Ru 1.8	Rh 1.8	Pd 1.8	Ag 1.6	Cd 1.6	In 1.6	Sn 1.8	Sb 1.9	Te 2.1	I 2.5	
Cs 0.8	Ba 1.0	La 1.1	Hf 1.3	Ta 1.4	W 1.5	Re 1.7	Os 1.9	Ir 1.9	Pt 1.8	Au 1.9	Hg 1.7	Tl 1.6	Pb 1.7	Bi 1.8	Po 1.9	At 2.1	



Difference in electronegativity



Bonding between	More electronegative element and value	Less electronegative element and value	Difference in electronegativity	Bond Type
Sulfur and Hydrogen				
Sulfur and cesium				
Chlorine and bromine				
Calcium and chlorine				
Oxygen and hydrogen				
Nitrogen and hydrogen				
Iodine and iodine				
Copper and sulfur				
Hydrogen and fluorine				
Carbon and oxygen				