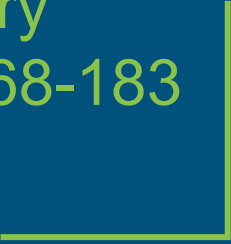




# Atomic Theory and Bonding

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Application of Grade 10 Chemistry  
BC SCI 10 Textbook Chapter 4.1 p168-183



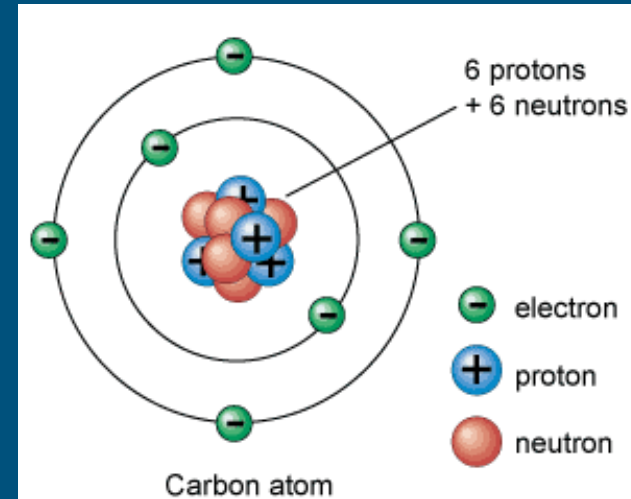
# Key terms (handout)

- atomic number
- Bohr diagram
- compound
- covalent compound
- covalent bond
- ionic compound
- ionic bond
- ions
- metals
- nonmetals
- chemical equation
- metalloids
- Lewis diagram
- molecule
- valence electron
- group/family
- chemical period
- chemical reaction
- law of conservation of Mass
- reactant
- product
- synthesis reaction
- decomposition reaction
- single replacement reaction
- double replacement reaction
- combustion reaction
- acid
- base
- acid base indicator
- ph scale
- neutralization reaction
- endothermic reaction
- exothermic reactions

# What are atoms?

Atom- the smallest particle of any element that retains the properties of the element.

- made up of subatomic particles: protons, neutrons and electrons.



# Complete the following table:

---

<u>Name</u>	<u>Symbol</u>	<u>Electric Charge</u>	<u>Location in the Atom</u>	<u>Relative Mass</u>
Proton				
Neutron				
Electron				

# Answer Key

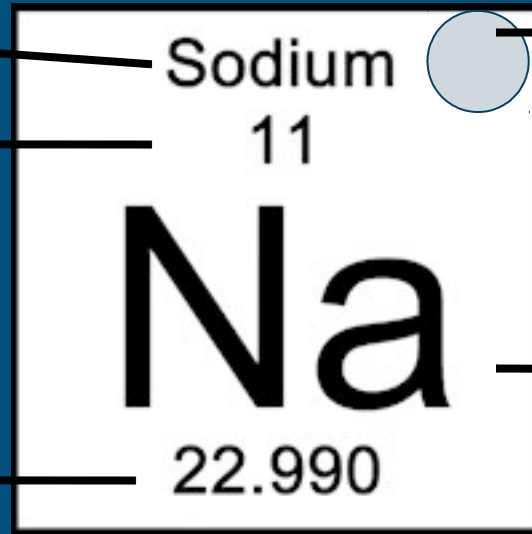
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<u>Name</u>	<u>Symbol</u>	<u>Electric Charge</u>	<u>Location in the Atom</u>	<u>Relative Mass</u>
Proton	p	1 +	nucleus	1
Neutron	n	0	nucleus	1.0001
Electron	e	1 -	Surrounding the nucleus	0.0001

Element Name

Atomic number

Atomic Mass



ion charge(s)

Symbol

- Assignment: the atom and the subatomic particles handout

## Assignments:

- **Build a model of two atoms (from the first 20 elements)**

**[in pairs]**

- **Choose 2 cards per group**
- **Create the models**
- **Walk and talk**

☰ Periodic Table 🔍

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	H Hydrogen 1.00794					110 Ds Darmstadtium (271) 2-8-18-32-32-17-1												He Helium 4.002602
2	Li Lithium 6.941	Be Beryllium 9.012182																Ne Neon 20.1797
3	Na Sodium 22.98976928	Mg Magnesium 24.3050																Ar Argon 39.948
4	K Potassium 39.0983	Ca Calcium 40.078	Sc Scandium 44.955912	Ti Titanium 47.867	V Vanadium 50.9415	Cr Chromium 51.9961	Mn Manganese 54.938045	Fe Iron 55.845	Co Cobalt 58.933195	Ni Nickel 58.6934	Cu Copper 63.546	Zn Zinc 65.38	Ga Gallium 69.723	Ge Germanium 72.64	As Arsenic 74.92160	Se Selenium 78.96	Br Bromine 79.904	Kr Krypton 83.798
5	Rb Rubidium 85.4678	Sr Strontium 87.62	Y Yttrium 88.90585	Zr Zirconium 91.224	Nb Niobium 92.90638	Mo Molybdenum 95.96	Tc Technetium (97.9072)	Ru Ruthenium 101.07	Rh Rhodium 102.90550	Pd Palladium 106.42	Ag Silver 107.8682	Cd Cadmium 112.411	In Indium 114.818	Sn Tin 118.710	Sb Antimony 121.760	Te Tellurium 127.60	I Iodine 126.90447	Xe Xenon 131.293
6	Cs Cesium 132.9054519	Ba Barium 137.327	La-Lu 57-71	Hf Hafnium 178.49	Ta Tantalum 180.94788	W Tungsten 183.84	Re Rhenium 186.207	Os Osmium 196.23	Ir Iridium 192.227	Pt Platinum 195.084	Au Gold 196.966569	Hg Mercury 200.59	Tl Thallium 204.3833	Pb Lead 207.2	Bi Bismuth 208.98040	Po Polonium (208.9824)	At Astatine (209.9871)	Rn Radon (222.0176)
7	Fr Francium (223)	Ra Radium (226)	Ac-Lr 89-103	Rf Rutherfordium (261)	Db Dubnium (262)	Sg Seaborgium (266)	Bh Bohrium (264)	Hs Hassium (277)	Mt Meitnerium (268)	Ds Darmstadtium (271)	Rg Roentgenium (273)	Cn Copernicium (285)	Uut Ununtrium (284)	Fl Flerovium (289)	Uup Ununpentium (288)	Lv Livermorium (292)	Uus Ununseptium (294)	Uuo Ununoctium (294)

■ Other nonmetals  
■ Alkali metals  
■ Alkaline earth metals  
■ Noble gases  
■ Metalloids  
■ Halogens  
■ Transition metals  
■ Post-transition metals  
■ Lanthanoids  
■ Actinoids

Label your periodic table with the following:

- group/family
- chemical period
- metals
- nonmetals
- metalloids

For elements with no stable isotopes, the mass number of the isotope with the longest half-life is in parentheses.

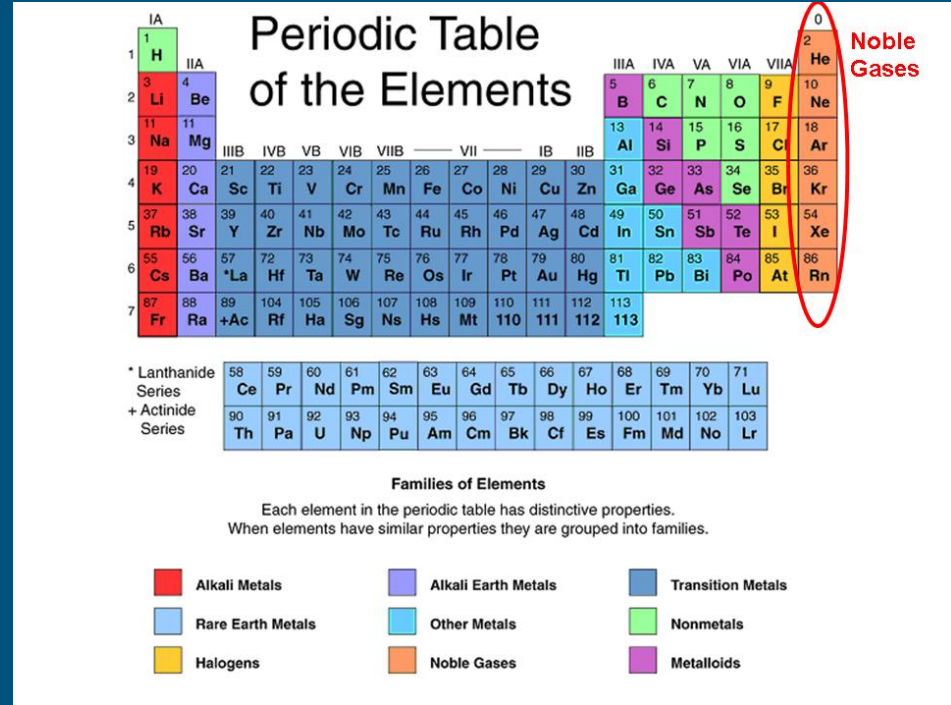
57 La Lanthanum 138.90547	58 Ce Cerium 140.116	59 Pr Praseodymium 140.90765	60 Nd Neodymium 144.242	61 Pm Promethium (145)	62 Sm Samarium 150.36	63 Eu Europium 151.964	64 Gd Gadolinium 157.25	65 Tb Terbium 158.92535	66 Dy Dysprosium 162.5	67 Ho Holmium 164.93032	68 Er Erbium 167.259	69 Tm Thulium 168.93421	70 Yb Ytterbium 173.054	71 Lu Lutetium 174.9668
89 Ac Actinium (227)	90 Th Thorium 232.03806	91 Pa Protactinium 231.03588	92 U Uranium 238.02891	93 Np Neptunium (237)	94 Pu Plutonium (244)	95 Am Americium (243)	96 Cm Curium (247)	97 Bk Berkelium (247)	98 Cf Californium (251)	99 Es Einsteinium (252)	100 Fm Fermium (257)	101 Md Mendelevium (258)	102 No Nobelium (259)	103 Lr Lawrencium (262)



# Family characteristics (use different colours to show the different families)

## Noble Gases:

- Not reactive because they have a full outer electron shell
- Outer electron shell is known as a valence shell



# Alkali Metals

## ALKALI METALS

1 H																			2 He
3 Li	4 Be									5 B	6 C	7 N	8 O	9 F	10 Ne				
11 Na	12 Mg									13 Al	14 Si	15 P	16 S	17 Cl	18 Ar				
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr		
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe		
55 Cs	56 Ba	* 71 Lu	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn		
87 Fr	88 Ra	** 103 Lr	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Uut	114 Uuq	115 Uup	116 Uuh	117 Uus	118 Uuo		
lanthanoids		* 57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb				
actinoids		** 89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No				

- Most reactive metal because outer electron shell only contains one electron

DO NOT TRY THIS AT HOME!!!

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# Alkaline Earth Metals

Reactivity increases down the group

Alkaline earth metals

1	2																18	
1	H																He	
2	Li	Be											B	C	N	O	F	Ne
3	Na	Mg											Al	Si	P	S	Cl	Ar
4	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
5	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
6	Cs	Ba		Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
7	Fr	Ra		Rf	Db	Sg	Bh	Hs	Mt									

La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr

- Reactive, has two electrons in outer electron shell

# Halogens

- Most reactive group of non-metals
- Have one empty space in outer electron shell, so they want to gain one.

Halogen family ←

1	H	2																	18
1	Li	Be										B	C	N	O	F	He		
2	Na	Mg										Al	Si	P	S	Cl	Ar		
3	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr	
4	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe	
5	Cs	Ba		Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn	
6	Fr	Ra		Rf	Db	Sg	Bh	Hs	Mt										
7																			

La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr

# Special case: Hydrogen

- Can act like a metal or non-metal
- Can lose or gain an electron (unique, as it is the only atom that can do this)

# Other special cases

Special 7: N, O, F, Cl, Br, I, H

- Always occur in pairs:  $N_2$ ,  $O_2$ ,  $F_2$ ,  $Cl_2$ ,  $Br_2$ ,  $I_2$ ,  $H_2$

Phosphorus:

- Occurs alone in groups of 4:  $P_4$

Sulfur

- Occurs in groups of 8 when alone:  $S_8$

# Isotopes

---

- Are variations of the same element
- They have the same number of protons but vary in their number of neutrons

→ Example: Carbon- 12 vs. Carbon- 11

- ◆ Carbon- 12 has 6 protons and 6 neutrons, while
- ◆ Carbon-11 has 6 protons and 5 neutrons

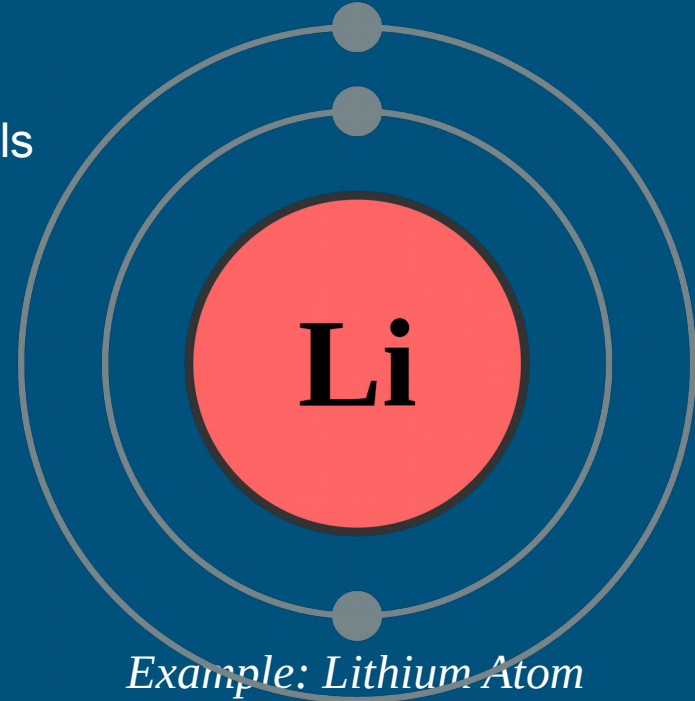
- Assignment: The atom and subatomic particles handout



# Bohr Diagrams

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- Used to show electron arrangement in the shells
  - 1st shell- can hold 2 electrons
  - 2nd shell can hold 8 electrons
  - 3rd shell can hold 8 electrons
  - 4th shell- can hold 16 electrons



- Desk activity [chalk/white boards]- quick practice
- Bohr diagram activity

# Full valence shell

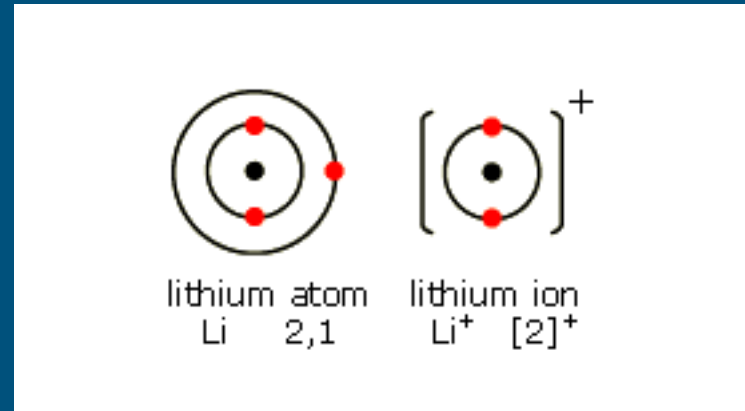
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- Called a stable octet
- Unreactive
- Metals may lose electrons to gain a full outer shell (become cations)
- Non-metals may gain electrons to gain a full outer shell (become anions)

# Difference between Atom and Ion

- Ions have a charge, which means they differ in number of protons and electrons
- A lithium ion has a charge of plus one, which means that it has one more proton than electron
- If in an atom of lithium there are three electrons, in an ion there would be two electrons

[Desk/white board] activity for more practice

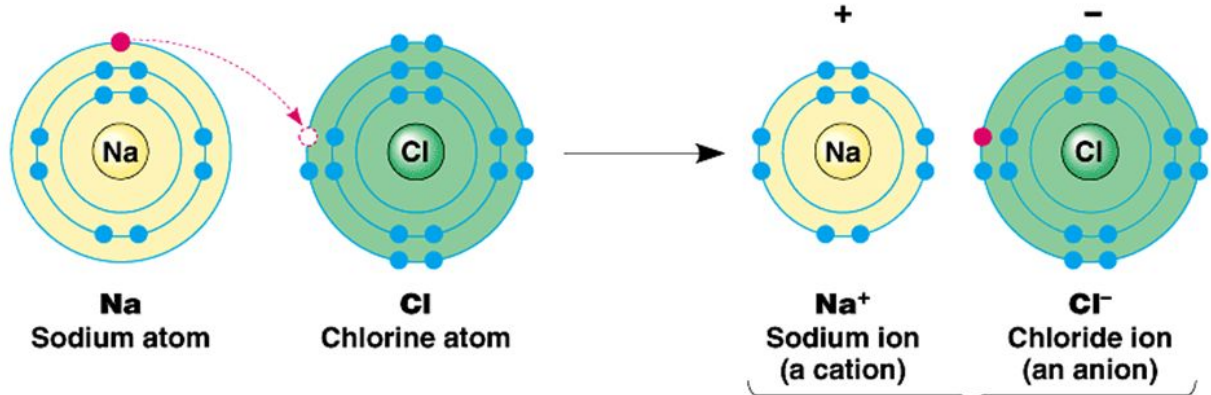




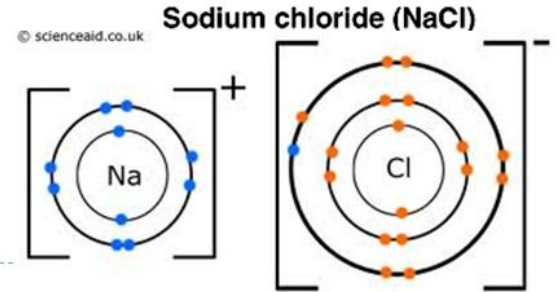
# Ionic Bonding

- Occurs between a metal and a non-metal
- Involves the transfer of Electrons
- Example: NaCl

## Ionic Bonding – Bohr Diagrams



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- Tennis ball/'bucket' activity to model ionic bonding
- practice drawing ionic bonding activity

# Covalent Bonding

- Occurs between 2 non-metals
- Electrons are shared, not transferred

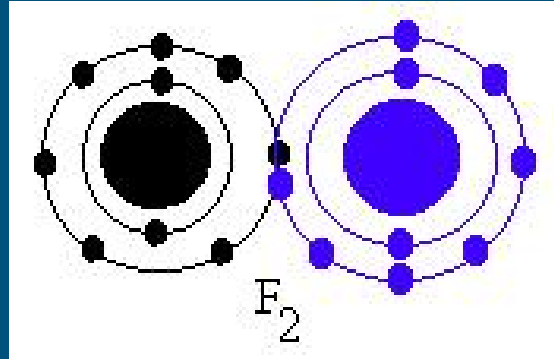
Periodic Table

										18 VIII A								
										13 III A	14 IV A	15 V A	16 VI A	17 VII A	18 VIII A			
1 H 1.008	2 II A												5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
3 Li 6.94	4 Be 9.01	3		4	5	6	7	8	9	10	11	12	13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 39.95
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.88	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.39	31 Ga 69.72	32 Ge 72.61	33 As 74.92	34 Se 76.96	35 Br 79.90	36 Kr 83.80	
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (98)	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.71	51 Sb 121.75	52 Te 127.60	53 I 126.90	54 Xe 131.29	
55 Cs 132.91	56 Ba 137.33	57 La 138.9	72 Hf 178.5	73 Ta 180.9	74 W 183.9	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 208.98	84 Po (209)	85 At (210)	86 Rn (222)	
87	88	89	104	105	106	107	108	109										

- Example F<sub>2</sub>

\*\*\*\* Diatomic Molecules (special 7)- will always occur in pairs.

- Chalk/white boards and talk activity



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## **Assignment:**

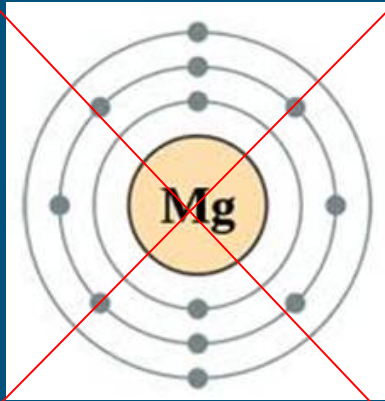
- **The Atom and subatomic particles handout, Bohr models**

# Lewis Diagram

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- Only show valence electrons

Ex. Mg



Lewis Dot Structure  
for Magnesium

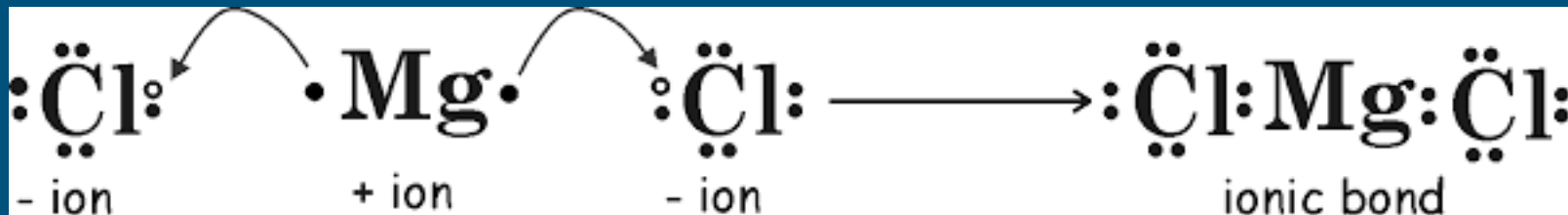


- **practice**

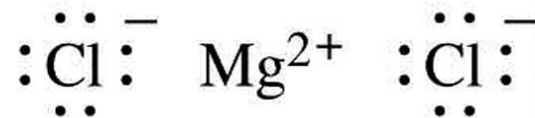


# Lewis Diagrams for Ionic Compounds

Ex.  $\text{MgCl}_2$

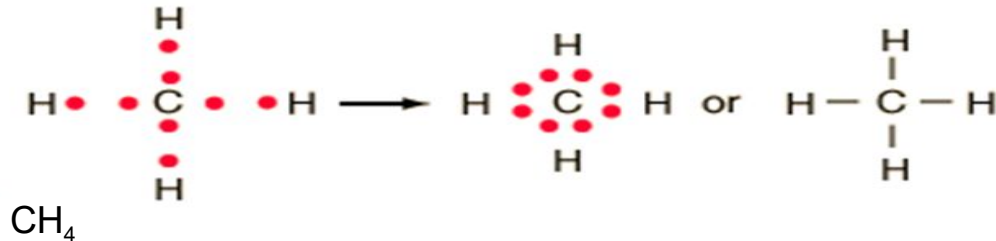
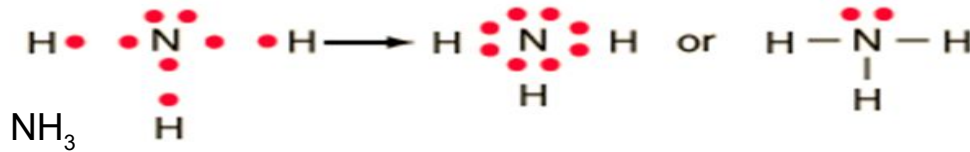
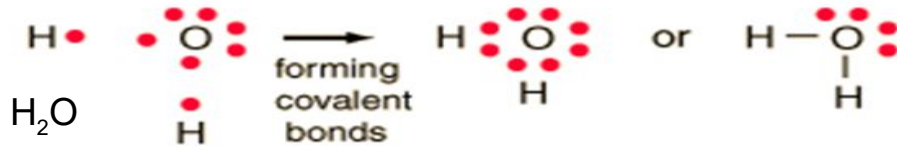


- **practice**



# Lewis diagram for a covalent compound

## Lewis Dot Diagrams – Covalent Bonds



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## Assignment:

- Lewis Diagrams handout