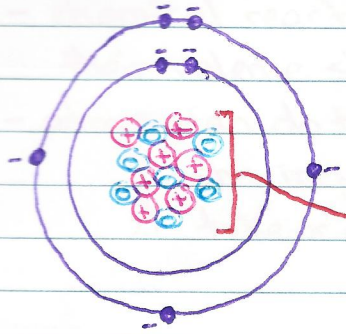
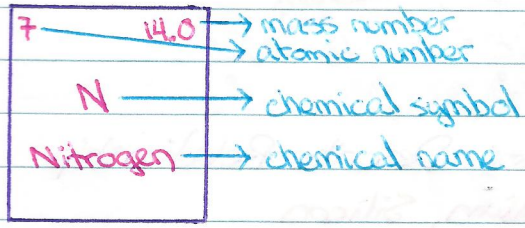
ATOMIC STRUCTURE



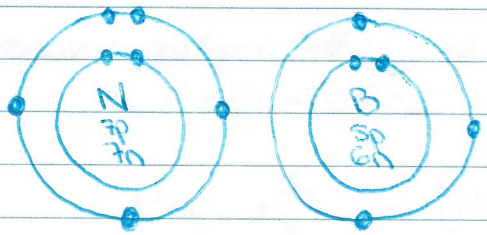
⊕ protons
◎ neutrons
-• electrons
nucleus
valence electrons
- the -• in the outer shell.

what element is this?
nitrogen - the # of protons is always the atomic number.



- in a neutral atom (charge is ∅) the # of electrons is the same as the # of protons.
- the number of neutrons is determined by subtracting the mass number from the atomic number.
- electrons are arranged in layers. First layer has a max. of 2, every other layer has a max. of 8.

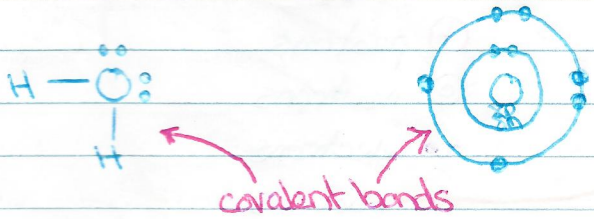
Bohr Diagram:



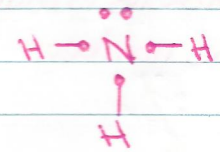
Lewis Diagram:

- atoms are happy (stable and unreactive) when valence shells are full.
- atoms can fill valence shells by:
  1) share electrons (covalent bonds between 2 non-metals)
  2) take or give away electrons (ionic bonds between a metal & non-metal)

H_2O ⟶ covalent



NH_3



Draw Lewis Diagrams for: Describe Relationship

Carbon, Lithium, Sodium, Silicon

Column 1 elements - have 1 valence electron
Column 2 elements - have 2 valence electrons
Column 3 elements - " 3 " "
Column 4 elements - " 4 " "
Column 8 elements - " 8 " "
(noble gases)

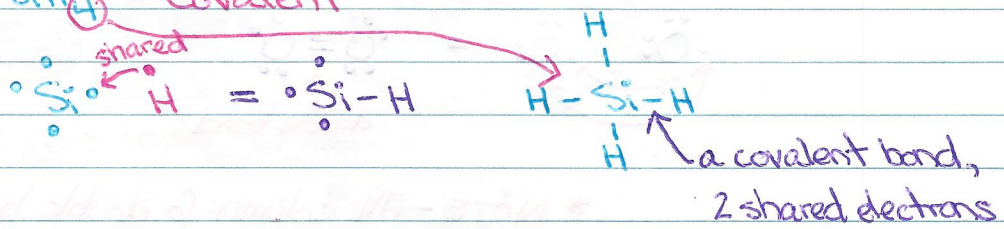
column 5, 6, 7 etc.

→ the family number tells you the number of valence electrons.

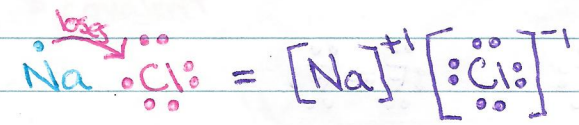
- atoms want a full valence shell
- chemical reactions happen when atoms try to fill their valence shells.
- atoms can do this by:
  1) sharing electrons (covalent bond between 2 non-metals)
  2) take or give away electrons (ionic bond between a metal and non-metal)

Draw Lewis Diagrams for Molecules

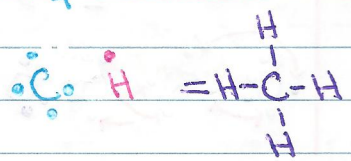
ex. SiH4 = covalent



ex. NaCl = ionic

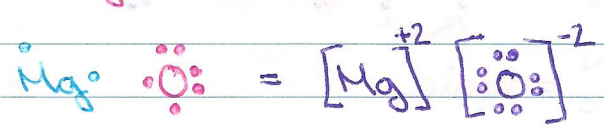


ex. CH_4 = covalent

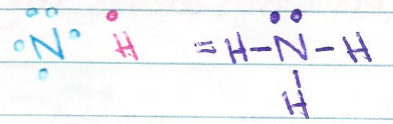


ex. Magnesium Oxide

MgO = ionic



ex. NH_3 = covalent

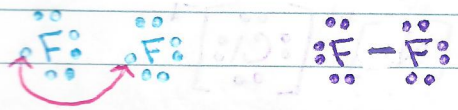


ex. K_2S = ionic

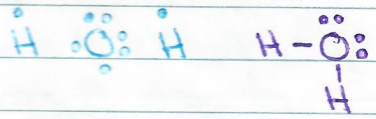
ex. O_2 = covalent

* NOTE - All column 6 double bonded.

ex. F_2 = covalent

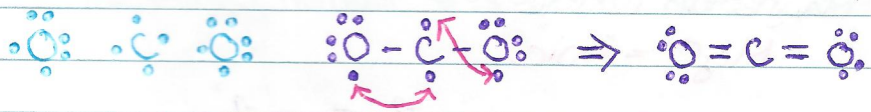


ex. H_2O = covalent

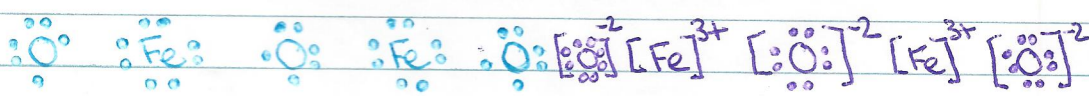


ex. SiO_2 = covalent

ex. CO_2 = covalent



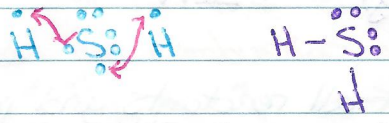
ex. $Fe_2^{+3}O_3^{-2}$ = ionic



NOTE: Do NOT have to draw valence electrons around ⊕ ion.

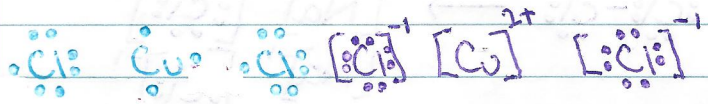
ex. carbon monoxide : CO = covalent

ex. H_2S = covalent

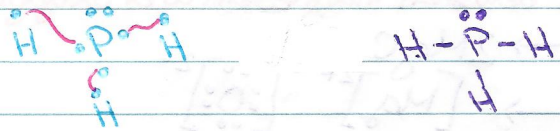


ex. SO = covalent

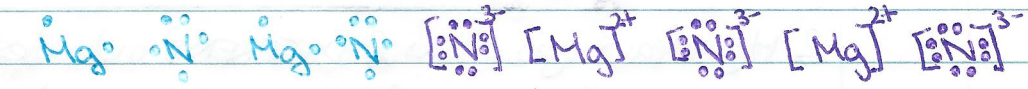
ex. $CuCl_2$ = ionic



ex. PH_3 = covalent



ex. $Mg_3^{2+}N_2^{3-}$ = ionic



Using Lewis Diagrams to Model Chemical Reactions

Model the reaction between lithium and fluorine.

1) write the balanced chemical equation.

$$2Li(s) + F_2(g) \longrightarrow 2LiF$$

2) draw diagrams for all reactants and products.

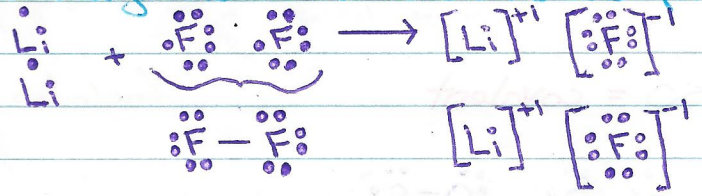


Diagram the reaction between sodium and chlorine.

$$2Na + Cl_2 \longrightarrow 2NaCl$$

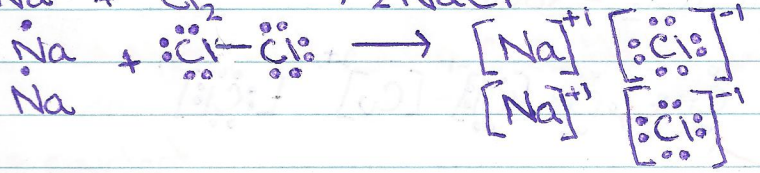
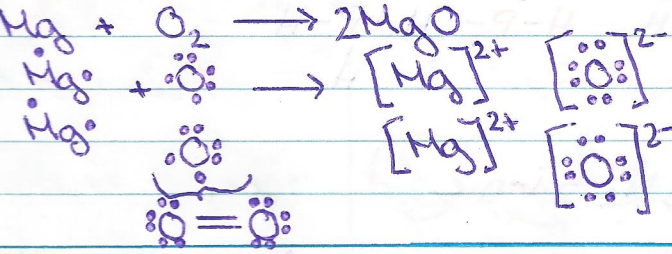


Diagram the reaction between magnesium and oxygen.

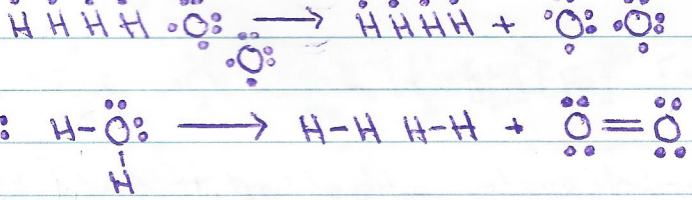
$$2Mg + O_2 \longrightarrow 2MgO$$



2 Mg means you draw 2 DIFFERENT molecules.
O_2 means there are 2 oxygens BONDED together.

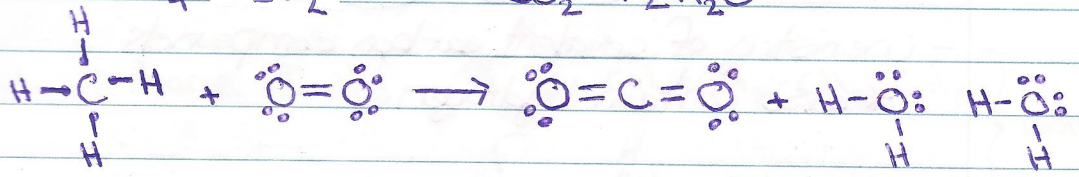
Model the decomposition of water.

$$2H_2O \longrightarrow 2H_2 + O_2$$



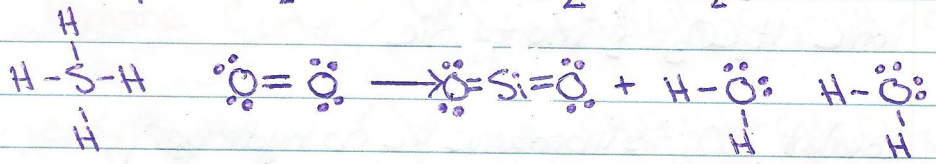
Model the combustion of methane.

$$CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$$



Model the combustion of silicon hydride

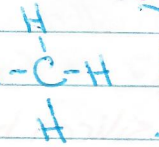
$$SiH_4 + 2O_2 \longrightarrow SiO_2 + 2H_2O$$



Model the reaction between calcium and potassium sulfide.

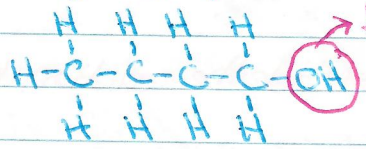
ORGANIC CHEMISTRY

- Chemistry of <u>covalent</u> carbon compounds
  * also contain hydrogen

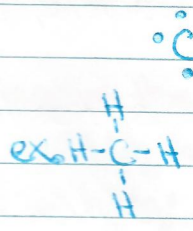
covalent CH_4  } organic

ionic H_2CO_3 } inorganic

covalent CO_2 } inorganic b/c no hydrogen

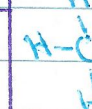
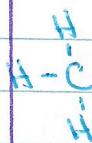
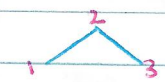
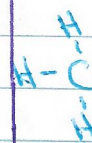
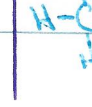
covalent C_4H_9OH } organic 

→ Carbon can form the greatest variety of compounds.



* able to form 4 covalent bonds.
* able to form double or triple bonds.

→ Carbon forms long chains by covalently bonding to itself.

Line Diagram		Chemical Formula	Structural Diagram (completed)	Structural Diagram (condensed)
N/A	Methane	CH_4		CH_4
	Ethane	C_2H_6		CH_3-CH_3
	Propane	C_3H_8		$CH_3-CH_2-CH_3$
	Butane	C_4H_{10}		$CH_3-CH_2-CH_2-CH_3$
	Pentane	C_5H_{12}		$CH_3-CH_2-CH_2-CH_2-CH_3$

Isomer → molecules that have the same chemical formula but different chemical structure.

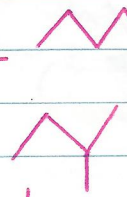
ex. Butane C_4H_{10}

$CH_3-CH_2-CH_2-CH_3$

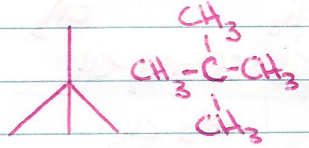
$CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_3$

} isomers

Pentane C_5H_{12}



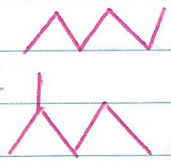
$CH_3-CH_2-CH_2-CH_2-CH_3$



$CH_3-CH_2-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_3$

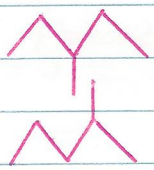
$CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_2-CH_3$

Hexane C_6H_{14}



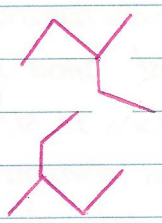
$CH_3-CH_2-CH_2-CH_2-CH_2-CH_3$

$CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_2-CH_2-CH_3$



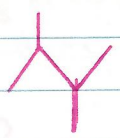
$CH_3-CH_2-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_2-CH_3$

$CH_3-CH_2-CH_2-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_3$

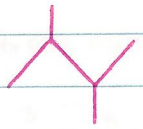


$CH_3-CH_2-\underset{\displaystyle CH_2}{\underset{|}{CH}}-CH_3$

$CH_3-\underset{\displaystyle CH_2}{\underset{|}{CH}}-CH_2-CH_3$



$CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_3$

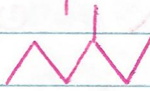


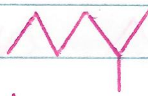
$CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_3$

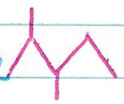
Heptane C_7H_{16}  $CH_3-CH_2-CH_2-CH_2-CH_2-CH_2-CH_3$

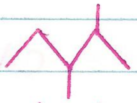
2-methyl hexane 
CH_3
$CH_3-CH-CH_2-CH_2-CH_2-CH_3$

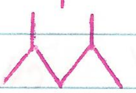
3-methyl hexane 
$CH_3-CH_2-CH-CH_2-CH_2-CH_3$
CH_3

3-methyl hexane 
CH_3
$CH_3-CH_2-CH_2-CH-CH_2-CH_3$

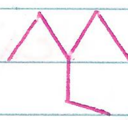
2-methyl hexane 
$CH_3-CH_2-CH_2-CH_2-CH-CH_3$
CH_3

2,3 dimethyl pentane 
CH_3
$CH_3-CH-CH-CH_2-CH_3$
CH_3

2,3 dimethyl pentane 
CH_3
$CH_3-CH_2-CH-CH-CH_3$
CH_3

2,4 dimethyl pentane 
CH_3 CH_3
$CH_3-CH-CH_2-CH-CH_3$

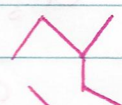
2-ethyl pentane 
CH_3
CH_2
$CH_3-CH-CH_2-CH_2-CH_3$

3-ethyl pentane 
$CH_3-CH_2-CH-CH_2-CH_3$
CH_2
CH_3

2-ethyl pentane 
CH_3
CH_2
$CH_3-CH_2-CH_2-CH-CH_3$

2-ethyl-3methyl butane 
CH_3
CH_2
$CH_3-CH-CH-CH_3$
CH_3

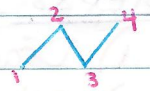
2-ethyl-3methyl butane 
CH_3 CH_3
$CH_3-CH-CH-CH_3$
CH_2
CH_3

2 propyl butane 
$CH_3-CH_2-CH-CH_3$
CH_2
CH_2
CH_3

2 propyl butane 
CH_3
CH_2
CH_2
$CH_3-CH-CH_2-CH_3$

Naming Branched Isomers

→ Isomers have the same chemical formula but different chemical names.

ex. C_4H_{10} $CH_3-CH_2-CH_2-CH_3$ butane 

branch → CH_3

parent chain → $CH_3-\underset{\underset{CH_3}{|}}{CH}-CH_3$ 

2-methylpropane

{ location number - branch - parent chain

Branch	Name
$-CH_3$	methyl
$-CH_2-CH_3$	ethyl
$-CH_2-CH_2-CH_3$	propyl
$-CH_2-CH_2-CH_2-CH_3$	butyl

ex. $\overset{1}{CH_3}-\overset{2}{CH_2}-\underset{\underset{CH_2-CH_3}{|}}{\overset{3}{CH}}-\overset{4}{CH_2}-\overset{5}{CH_3}$  3-ethyl pentane

{ branch = ethyl

STEPS:

1) Identify the parent chain (longest)
2) Number the carbons starting with the carbon closest to the branch. (unless more than 1 branch then order doesn't matter).
3) Identify the branch and location.
4) Name branches in alphabetical order.

ex. $\overset{1}{CH_3}-\underset{\underset{CH_3}{|}}{\overset{2}{CH}}-\overset{3}{CH_2}-\underset{\underset{CH_3}{|}}{\overset{4}{CH}}-\overset{5}{CH_3}$ 2,4 dimethyl pentane

methyl ↑ ↑ methyl

* similar branches are named using a prefix (di, tri, tetra)

ex. $\overset{1}{CH_3}-\underset{\underset{CH_3}{|}}{\overset{2}{CH}}-\overset{3}{CH_2}-\overset{4}{CH_2}-\underset{\underset{CH_3}{|}}{\overset{5}{CH}}-\overset{6}{CH_3}$ 2,5 dimethyl hexane

ex. $\overset{1}{CH_3}-\underset{\underset{CH_2-CH_3}{|}}{\overset{2}{CH}}-\overset{3}{CH_2}-\underset{\underset{CH_3}{|}}{\overset{4}{CH}}-\overset{5}{CH_2}-\overset{6}{CH_3}$ 2-ethyl-4-methyl hexane

Drawing Structures when given Chemical names

STEPS:

1) Draw out parent chain with only the carbons.
2) Attach branches to proper locations.
3) Fill in hydrogens so all carbons have 4 bonds.

ex. 2-methyl propane $CH_3-\underset{\displaystyle CH_3}{\overset{\displaystyle |}{CH}}-CH_3$

Unit 4 Review Assignment

(1) a) $\cdot\dot{\underset{\cdot}{\overset{\cdot}{Al}}}\cdot$ b) $:\ddot{Br}-\ddot{Br}:$ c) $[Na]^{+}\left[:\ddot{\underset{\cdot\cdot}{I}}:\right]^{-}$

d) $[Ca]^{2+}\left[:\ddot{\underset{\cdot\cdot}{N}}:\right]^{3-}$ e) $:\ddot{Cl}-\underset{|}{\ddot{P}}-\ddot{Cl}:$ with $:\ddot{Cl}:$ below P

(2) a) $2H_2O \longrightarrow 2H_2 + O_2$

$H-\ddot{O}:$ (H below O) $\longrightarrow$ $H-H$ (H-H) $+$ $:\ddot{O}=\ddot{O}:$

$H-\ddot{O}:$ (H below O)

b) $2Na + Cl_2 \longrightarrow 2NaCl$

Na, Na $+$ $:\ddot{Cl}-\ddot{Cl}:$ $\longrightarrow$ $[Na]^{+}\left[:\ddot{\underset{\cdot\cdot}{Cl}}:\right]^{-}$

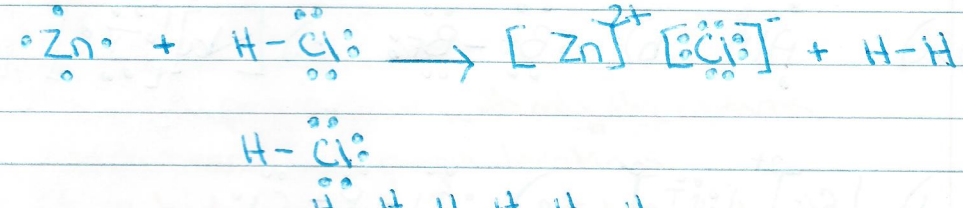
$[Na]^{+}\left[:\ddot{\underset{\cdot\cdot}{Cl}}:\right]^{-}$

c) $2Mg + O_2 \longrightarrow 2MgO$

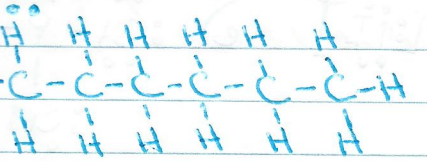
Mg, Mg $+$ $:\ddot{O}=\ddot{O}:$ $\longrightarrow$ $[Mg]^{2+}\left[:\ddot{\underset{\cdot\cdot}{O}}:\right]^{2-}$

$[Mg]^{2+}\left[:\ddot{\underset{\cdot\cdot}{O}}:\right]^{2-}$

d) $Zn + 2HCl \longrightarrow ZnCl_2 + H_2$



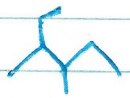
③ a) C_6H_{14} b)



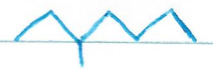
c) $CH_3-CH_2-CH_2-CH_2-CH_2-CH_3$ d)

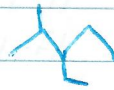
④

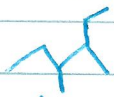

octane

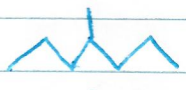

2-ethyl-3methyl pentane

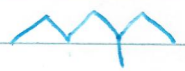

2-methyl heptane


3-methyl heptane


3-ethyl-2-ethyl pentane


2-ethyl-3-ethyl pentane

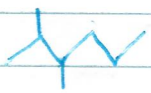

4-methyl heptane


3-methyl heptane

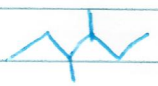

2-propyl pentane

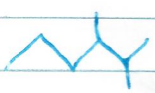

2-methyl heptane

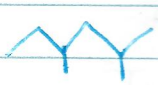

3-propyl pentane

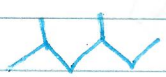

2,3-dimethyl hexane


2-propyl pentane


3,4-dimethyl hexane


2,3-dimethyl hexane


2,4-dimethyl hexane


2,4-dimethyl hexane