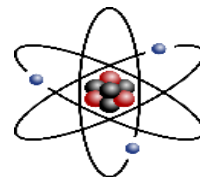


7. Introduction to Bonding

- Chemical Reactivity

- The reactivity of an element depends on the number of **valence electrons**
- If the outer shell of an atom already contains **8 valence electrons**, this means the atom has a **stable octet** and is **unreactive** (e.g. noble gases).
- If the outer shell has **less than 8** valence electrons, the atom is unstable and **reactive** (e.g. fluorine).
- In order to become stable atoms will link up with other atoms to form **compounds** by sharing or transferring electrons.



- What is Valence Anyway?

- **Valence:** refers to the outside **orbital** of an atom/element
: it is electrons in this energy level that are involved in **bonding**
- **Valence electrons:** are the electrons in the **outermost** shell of an atom
: the # of valence electrons an atom has is the same as the atom's Main Group number on the Periodic Table
- **Valence number:** is the number of electrons an atom needs to **get rid of** or **get** to make an atom's outermost shell **full**
- **Ie: Lithium**
 - Lithium is in **Group 1** and has **1** electrons in its outside shell
 - It would be too hard for a lithium atom to try find 7 more electrons to fill its valence shell SO.....
it 'ditches' or gives away that electron and now has a full outside shell



- Now it doesn't have the same amount of protons and electrons. It has **more** protons than electrons = it now has a **positive** charge
- We write Lithium's valence number as **1⁺**
- **Ie: Aluminum:**
 - Group **3** elements have **3** electrons in its outside shell
 - It would be easier to **lose 3** electrons than gain 5
 - It would end up with a **3⁺** charge

- Ie: Sulfur
 - Group has **6** electrons in its outside shell
 - It would be easier for a sulfur atom to **gain 2** electrons than give away 6
 - If it does this, it will have a **negative** charge
 - So we say that Sulfur has a **charge** or valence number of **2⁻**
- What about Carbon?!
 - It has **4** electrons in its outside shell. So it will **gain or lose** electrons.

Try these valences:

Cl: _____ B: _____ Br: _____ Mg: _____

Li: _____ S: _____ Si: _____ Ca: _____

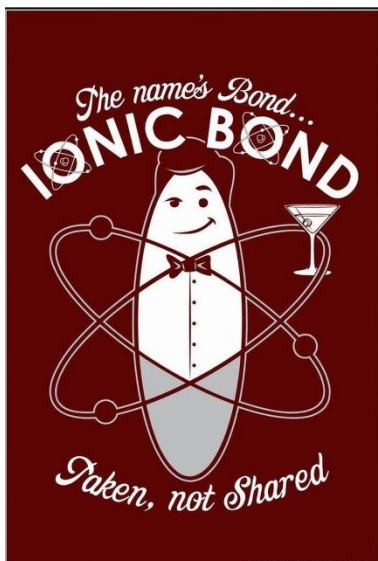
K: _____ P: _____ Al: _____ N: _____

DO ELEMENT/ LEWIS DOT / VALENCE NOW

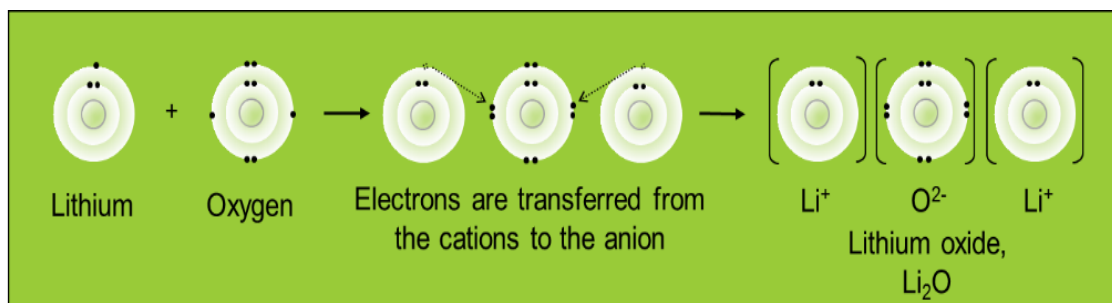
- Forming Compounds

- When atoms combine by transferring or sharing their electrons, they are said to have **bonded** and formed a **compound**
- Compounds are represented by a **Chemical Formula** (ie. H₂, H₂O)
- Compounds can be formed by either ionic bonding or covalent bonding.

- Ionic Compounds



- Are formed when a **metal** joins with a **nonmetal**
- Atoms **transfer** valence electrons to become stable forming **ionic bonds**
- Atoms that lose or gain electrons to become stable are called **ions**
- The **ionic charge** is the charge the element will take on if it loses or gains electrons.
 - 1) **Cations** are metals that lose electrons and form **positive** ions (Na^+).
 - 2) **Anions** are non-metals that gain electrons & form **negative** ions (O^{2-}).
- Eg. Li_2O



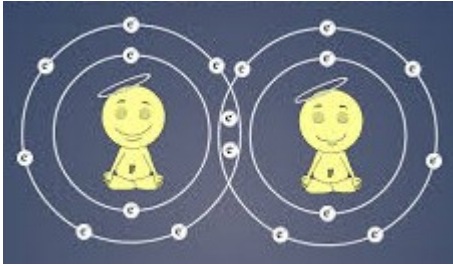
Cations

Element	Total e^-	Valence e^-	To bond...	Ion
Sodium	11	1	Lose 1 e^-	Na^{+1}
Magnesium	12	2	Loses 2 e^-	Mg^{+2}
Aluminum	13	3	Loses 3 e^-	Al^{+3}
Calcium				

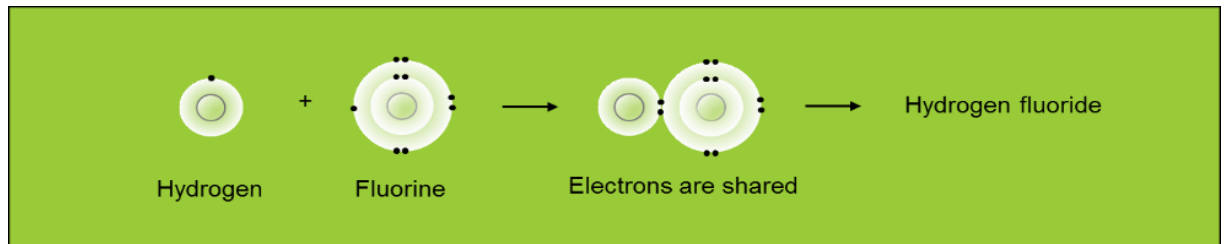
Anions

Element	Total e^-	Valence e^-	To bond...	Ion
Chlorine	17	7	Gain 1 e^-	Cl^{-1}
Oxygen	8	6	Gains 2 e^-	O^{-2}
Nitrogen	7	5	Gains 3 e^-	N^{-3}
Sulfur				

- Covalent Bonds

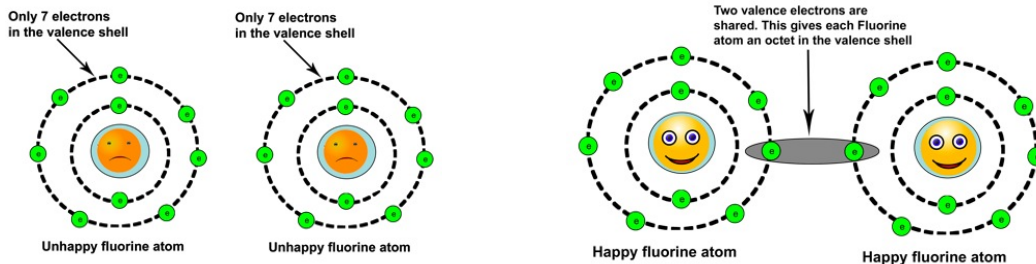


- Formed between two or more **nonmetals**
- Valence electrons are **shared** between atoms
- Compounds formed using covalent bonds are referred to as **molecules**
-
- Eg. HF



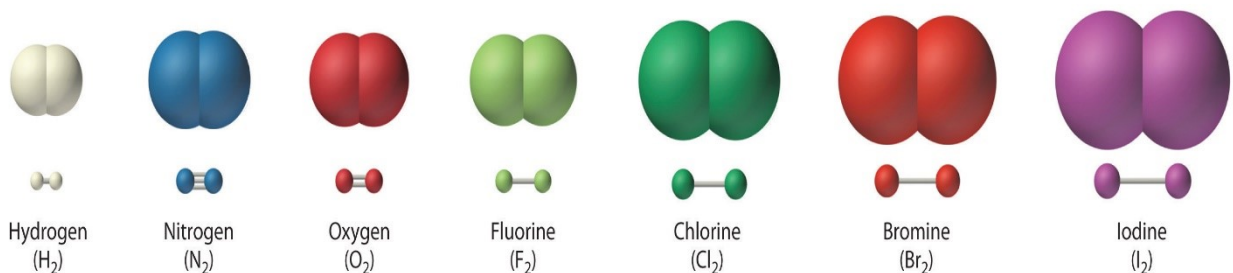
- Diatomic Molecules

- A special molecule is formed when 2 atoms of the **same element** share their valence electrons to become stable



1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100

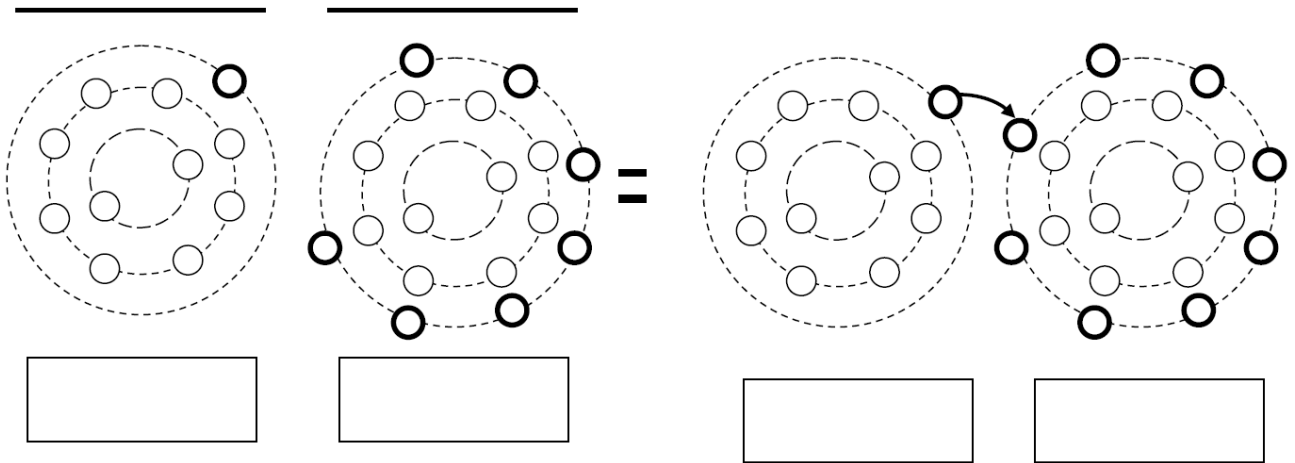
There are 7 diatomic molecules.
 Nitrogen is atomic number 7.
 The 6 atoms N, O, F, Cl, Br, & I
 form a "seven" on the table.
 That leaves 1 more -
 Hydrogen is atomic number 1.



(a) Elements that exist as diatomic molecules

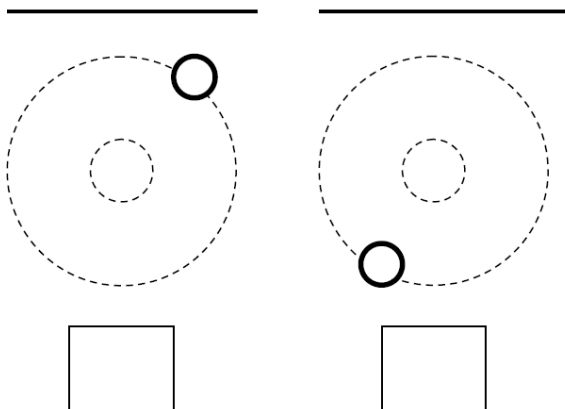
BONDING

Ionic Bonding (lending and borrowing.... giving and taking...etc!)

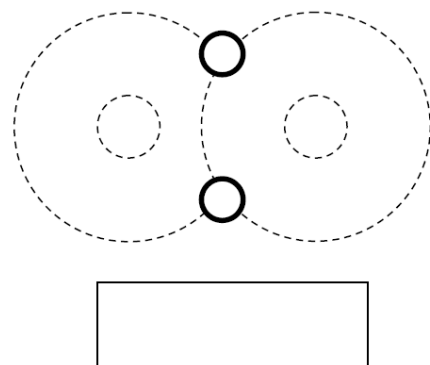


Covalent Bonding (sharing!)

Hydrogen Atoms



Hydrogen Molecules



Ionic vs Covalent Properties

	Ionic	Covalent
Examples	Sodium Chloride (NaCl - salt)	Carbon Dioxide (CO ₂)
Physical State	Solid at room temp	Liquids & gases at room temp
Melting & Boiling Points	High	Low
Solubility in Water	High (meaning soluble)	Low (meaning insoluble)
Electrical Conductivity	High (means conducts electricity)	Low (doesn't normally conduct electricity)