

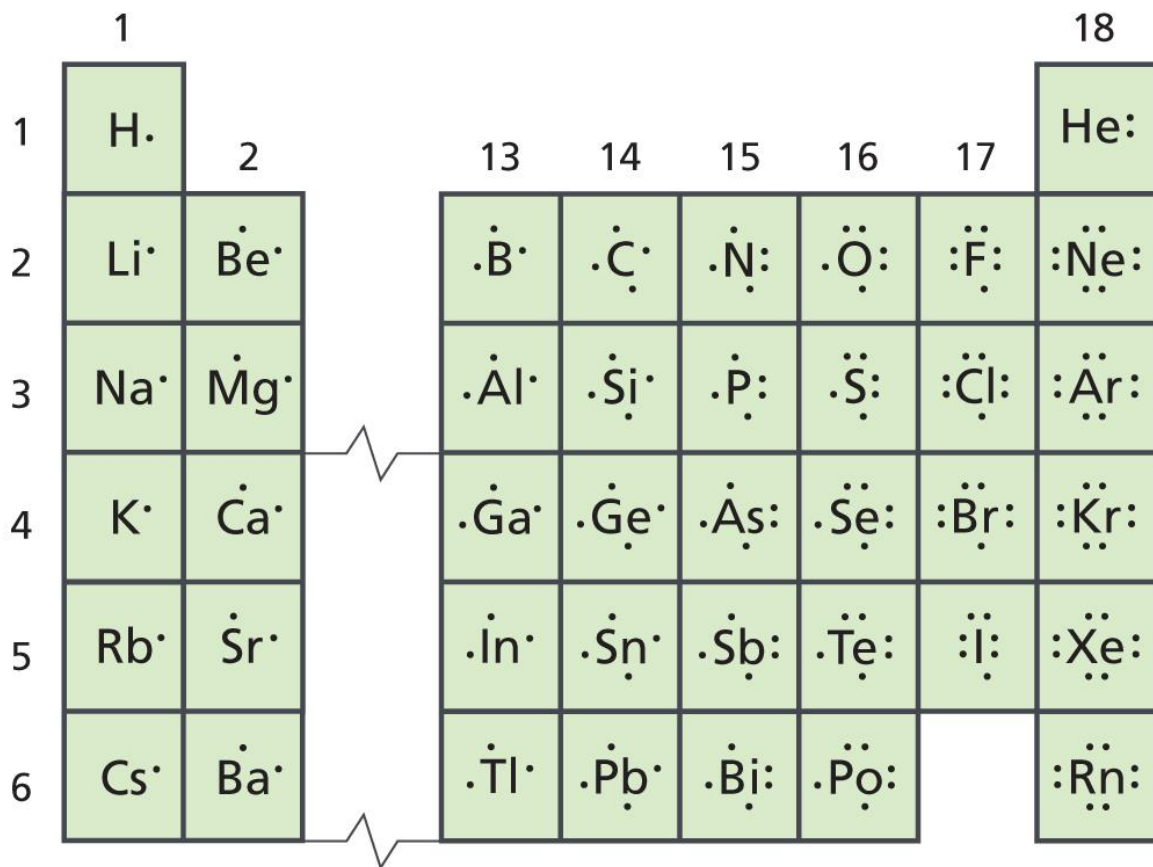
Quick review

- All types of **chemical bonds** involve **electrons**
- **Valence electrons**, the electrons in the outermost occupied energy level of an atom, are usually the electrons involved in bonding

- The representative elements have the same number of valence electrons as their family number in the American system
 - Example: Mg, column IIA, 2 valence electrons
- The transition metals all have two valence electrons
 - $\Rightarrow ns^2(n-1)d^x$

- Lewis dot structures are used to represent the valence electrons
 - each dot represents a valence electron
 - no more than 8 dots total
 - no more than 2 dots on a side
 - example = Mg: Na·

Lewis dot structures of representative elements

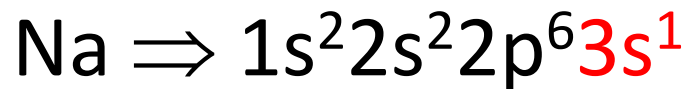


- Atoms that lose electrons easily have little attraction for additional electrons (and *vice versa*)
 - metals have low IE, low EA
 - Nonmetals have high IE, high EA

The Octet Rule

- Atoms of representative elements tend to gain, lose, or share electrons until they achieve an ns^2np^6 valence configuration
- **Losing or gaining more than that would require too much energy**
- “Isoelectronic” with noble gas
- “pseudonoble gas”

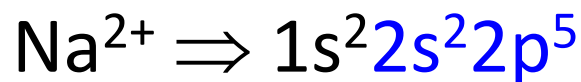
Electron Configuration of Ions



- Lose one electron...

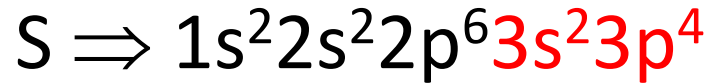


- Lose two?



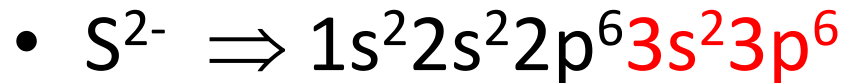
- NOT LIKELY!!
- Why not?
- The 2p electrons are **held more tightly!**
 - Closer to nucleus
 - Larger effective nuclear charge

Electron Configuration of Ions



- Large effective nuclear charge ($\sim +4$)
- Attracts electrons strongly

gain 2 e-



gain 3?

- **NOT LIKELY!**
- Third e- would go on an entirely new E level ($4s^1$)

Most likely ionic charge

- 1A = 1+
- 2A = 2+
- 3A = 3+
- 4A = +/- 4
 - Covalent bonding more likely for $\downarrow Z$
- 5A = 3-
- 6A = 2-
- 7A = 1-
- Note: H can form 1+ ions or 1- ions (H^{1-} = hydride ion)

Basic idea...

- All chemical bonds form because they result in lower energy for the atoms involved
- lower energy = greater stability

Ionic Bonding

- Metals lose electrons easily, nonmetals have a strong attraction for more electrons
- metal atoms will lose electrons to nonmetal atoms, causing both to become ions

Periodic Table

1A																	8A	
1 H 1.008																		2 He 4.003
3 Li 6.941	4 Be 9.012											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18	
11 Na 23.00	12 Mg 24.31	3B	4B	5B	6B	7B	8B				1B	2B	13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.06	17 Cl 35.45	18 Ar 39.95
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.90	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.70	29 Cu 63.55	30 Zn 65.38	31 Ga 69.72	32 Ge 72.59	33 As 74.92	34 Se 78.96	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 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3	
55 Cs 132.9	56 Ba 137.3	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 209.0	84 Po (209)	85 At (210)	86 Rn (222)	
87 Fr (223)	88 Ra 226.0	89 Ac 227.0	104 Rf (261)	105 Ha (262)	106 Unh (263)	107 Uns (262)											109 Une (267)	
Lanthanides		58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (145)	62 Sm 150.4	63 Eu 152.0	64 Gd 157.3	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0			
Actinides		90 Th 232.0	91 Pa 231.0	92 U 238.0	93 Np 237.0	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (260)			

- Blue = metals
- Pink = semi-metallics (metalloids)
- Yellow = nonmetals

1. Metals, having lost one or more electrons, become cations (+)
2. Nonmetals, having gained one or more electrons, become anions (-)
3. Opposites attract: the cations and anions are held together electrostaticly

– called “ionic bonds”

In summary...

- Ionic bonds are electrostatic attractions between cations and anions formed when electron(s) are transferred from the low IE, EA metal to the high IE, EA nonmetal