# Salt Lake Community College, Chemistry Department

# Chem 1110 Workshop 3

# **Topic:** Ionic Compounds

#### **Objective:**

- Ions and Ionic compounds
- Ions of Some Common Elements
- Empirical Formula
- Lewis dot structure
- Formulas of Ionic Compounds

lons:

- **lons** atoms with an electrical charge
- In general: metal atoms tend to lose electrons to form cations, nonmetal atoms tend to gain electrons to form anions.

#### **Ionic Compounds:**

The behavior of the atoms in forming bonds or ions can be predicted by their position in the Periodic Table.

- 1. Is the element a metal or a nonmetal?
- 2. Of which group is the element a member?
- Ionic compounds usually combinations of metals and nonmetals, NaCI.

# Ions of Some Common Elements:

atom Na: 11 e<sup>-</sup>; the closest noble gas Ne: 10 e<sup>-</sup> atom Na – 1 e –  $\rightarrow$  Na<sup>+</sup> (metal)

atom CI: 17 e<sup>-</sup>; the closest noble gas Ar: 18 e<sup>-</sup> atom CI + 1 e<sup>-</sup>  $\rightarrow$  CI<sup>-</sup> (nonmetal)

82	Common-ion	ic-states-of-	the-element	ts.png 1,552	×912 pixels														9/25/19, 8-17 AM
	<b>+1</b>				C	omm	on lo	nic St	tates	of th	e Ele	ment	s					2	
	H <sup>+</sup>	+2	At	omic n	umber								+3		-3	-2	-1	Не	
	3	4		_	1	-	- CO	mmon	ionic st	ate			5	6	7	8	9	10	
I		Be <sup>2+</sup>				H <sup>+</sup>	- F	ement	name		T		B	C	N <sup>3-</sup>	O <sup>2-</sup>	F-	Ne	
	11	12				DIRACIA	-				тур	eI	13	14	15	16	17	18	2
2	Na <sup>+</sup>	Mg <sup>2+</sup>			]	Гуре	II N	letal	S		Met	tals	Al <sup>3+</sup>	Si	P <sup>3-</sup>	S <sup>2-</sup>	Cl-	Ar	
	19	20	21	22 T:3+	23	24	25 84m2+	26 Eo2+	27	28 NI124	29	30	31	32	33	34	35	36	
3	K+	Ca <sup>2+</sup>	Sc3+	Ti <sup>4+</sup>	V <sup>5+</sup>	Cr <sup>3+</sup>	Mn <sup>4+</sup>	Fe <sup>3+</sup>	Co <sup>3+</sup>	Ni <sup>34</sup>	Cu <sup>2+</sup>	Zn2+	Ga <sup>3+</sup>	Ge <sup>4+</sup>	As <sup>3-</sup>	Se <sup>2-</sup>	Br	Kr	
	37	38	39	40	41 <sub>NIb3+</sub>	42	43	44 D3+	45	46 pd2	47	48	49	50	51 Ch3+	52	53	54	8
4	Rb⁺	Sr <sup>2+</sup>	Y <sup>3+</sup>	Zr <sup>4+</sup>	Nb <sup>5+</sup>	Mo <sup>6+</sup>	Tc7+	Ru <sup>4+</sup>	Rh <sup>3+</sup>	Pd <sup>4+</sup>	Ag *	Cd <sup>2+</sup>	In <sup>3+</sup>	Sn <sup>4+</sup>	Sb <sup>5+</sup>	Te <sup>2-</sup>	Ľ	Xe	
	S5	56	71	72	NIOBIUM 73	74	75	76	77	78	SILVER	80	INDIUM 81	82	ANTIMONY 83	84	85	XENON 86	e.
5	Cs <sup>+</sup>	Ba <sup>2+</sup>	Lu <sup>3+</sup>	Hf <sup>4+</sup>	Ta <sup>5+</sup>	W6+	Re <sup>7+</sup>	Os4+	Ir4+	Pt <sup>2+</sup> Pt <sup>4+</sup>	Au <sup>+</sup> Au <sup>3+</sup>	Hg2+ Hg2+	TI *	Pb2+ Pb4+	Bi <sup>3+</sup> Bi <sup>5+</sup>	Po <sup>2+</sup> Po <sup>4+</sup>	At	Rn	
	CESIUM 87	BARIUM	LUTETIUM	HAFNIUM	TANTALUM	TUNGSTEN	RHENIUM	OSMIUM	MUDIUM	PLATINUM	GOLD	MERCURY	THALLIUM	LEAD	BISMUTH	POLONIUM	ASTATINE	KADON	
	Fr <sup>+</sup>	Ra <sup>2+</sup>	Lr <sup>3+</sup>	57	58	59	60	61	62 Sm	2+ 63	2+ 64	65	66	67	68	69	70 V	3+	
	FRANCIUM	RADIUM	LAWRENCIUM	La	<sup>s+</sup> Ce <sup>3</sup>	+ Pr	+ Nd	<sup>3+</sup> Pm	3+ Sm	3+ Eu	Gd	3+ Tb	3+ Dy	3+ Ho	3+ Er	<sup>s+</sup> Tm	3+		
	Tw	No I		LANTHA	ADW CERTON	M PRASECOW	NEODYN	IUM PROMETH	IUM SAMAR	UM EUROPH	UM GADOUN	UM TERBIO	M DYSPROS	TOW HOLM	UM ERBIU		JM YTTERS	UM	
	Tyl	Je I		89	90	91 Pa4	+ <sup>92</sup> U <sup>4</sup>	+ 93	94 Pu	4+ 95 Am	3+ 96	97	98	99	100	101	2+ NO	2+	
	Me	tals		ACTINI	Th4	Pas	+ U <sup>6</sup>	NPTUN		4+ Am	4+ Cm	Bk	3+ Cf3	+ Es	Fm	M	3+ NO	3+ UM	

Type I Metals form only one cation species

Type II Metals form two or more cation species

http://www.wou.edu/chemistry/files/2017/04/Common-ionic-states-of-the-elements.png

# **Empirical Formula:**

The empirical formula of a compound is the simplest whole number ratio of atoms in the compound. Remember: the total charge of a compound is zero.

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# Lewis electron dot structures (Lewis structures) for atoms

- A. Lewis structures generally consist of the elemental symbol surrounded by one dot
- for each valence electron of the substance
- B. Valence electrons are the outer shell s and p electrons

# **Practice problems:**

1.Write the Empirical Formula of the following ionic compounds formed by:

(a) Al<sup>3+</sup> and O<sup>2-</sup>

- (b) Mg<sup>2+</sup> and NO<sub>3<sup>-</sup></sub>
- (c) Cr<sup>3+</sup> and Cl<sup>-</sup>
- (d) Fe<sup>3+</sup> and Br<sup>-</sup>
- (e)  $Ca^{2+}$  and  $O^{2-}$
- 2. Identify the valence electrons in the following elements and draw Lewis Dot structure:

Elements	Valence Electrons	Lewis Dot Structure
К		
Са		
Al		
Ba		
Na		

3. Determine the charge on each atom for the following ionic compounds:

Ionic Compounds	Metal (Cation)	Nonmetal (Anion)
CrCl <sub>3</sub>		
Fe <sub>2</sub> O		
TiO <sub>2</sub>		
PbBr <sub>2</sub>		
Al <sub>2</sub> O <sub>3</sub>		
NiO		
LiBr		

4. Using Lewis symbols, write the reaction formation of the following:

	Lewis dot Structu	re + Lewis dot Structure	Reaction Formation
	(Metal)	(Non-Metal)	(Ionic Compound)
NaCl from Na and Cl			

CaS from	
Ca and S.	