



Ionic Compound s

Cations and
anions

Ion reactivity

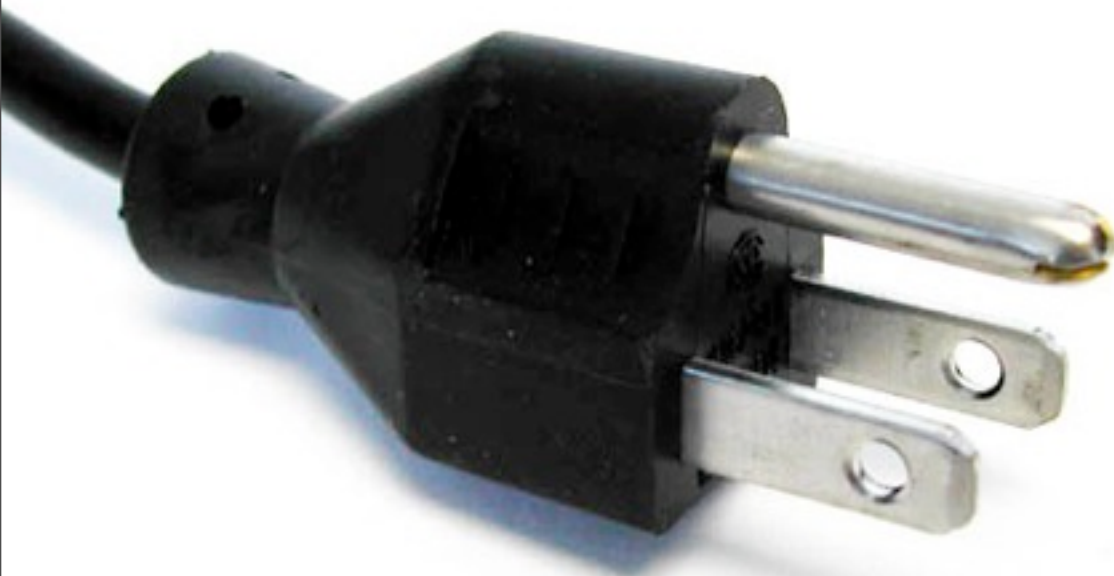
Ionic
nomenclature

Properties of ionic
compounds

Polyatomic
nomenclature

Ion

- An ion is an atom or group of atoms that has either a positive charge or a negative charge



Ion

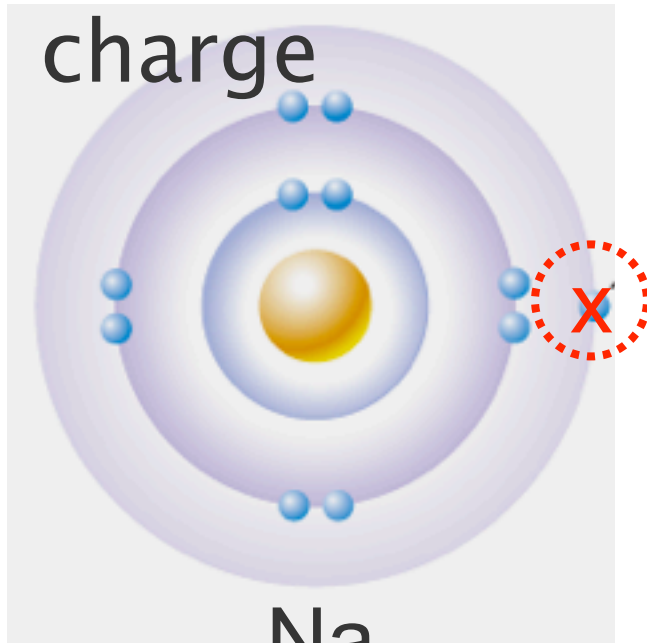
- Ions form when atoms gain or lose **electrons** to become **stable**
- An atom is stable when the **valence shell is full**



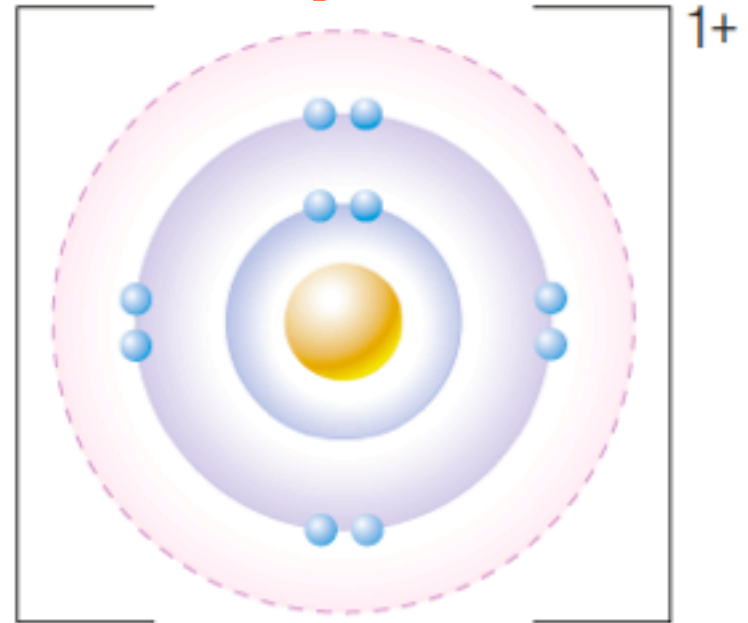
Positive Ion Example

- Sodium **loses** one electron to become stable
- Results in an ion that has a **positive**

charge

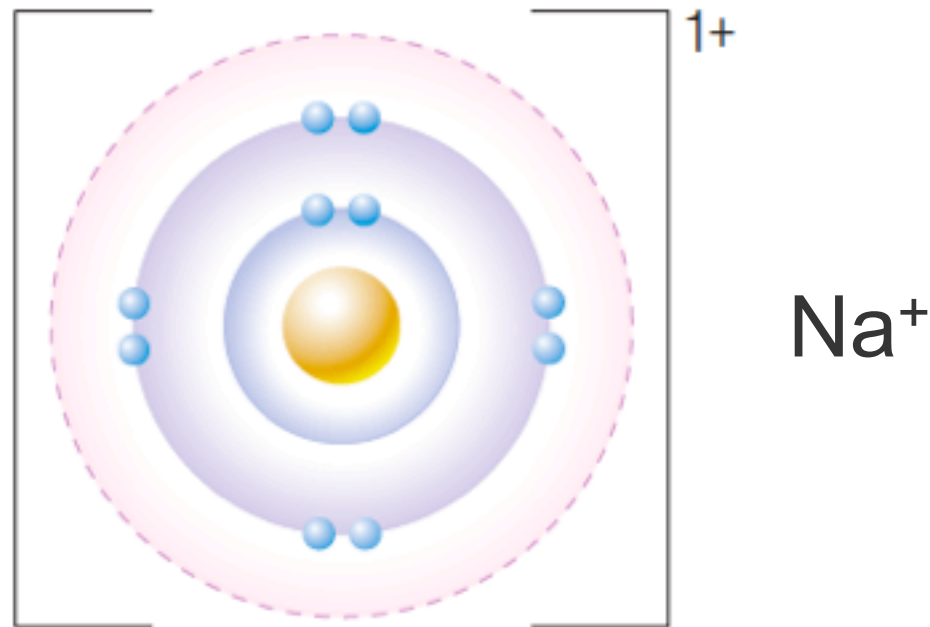


=



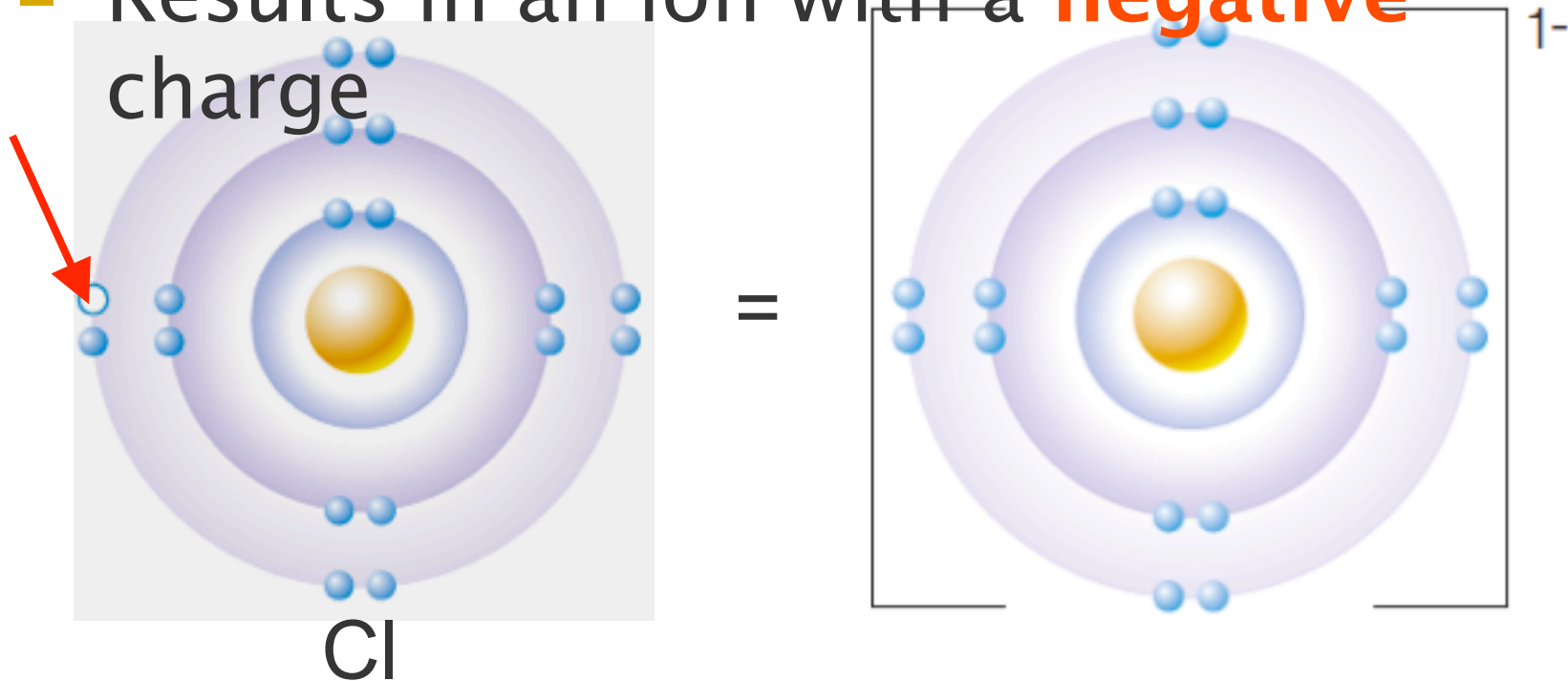
Positive Ion Example

- The symbol “+” is written as a superscript to indicate that the sodium has a charge of 1+



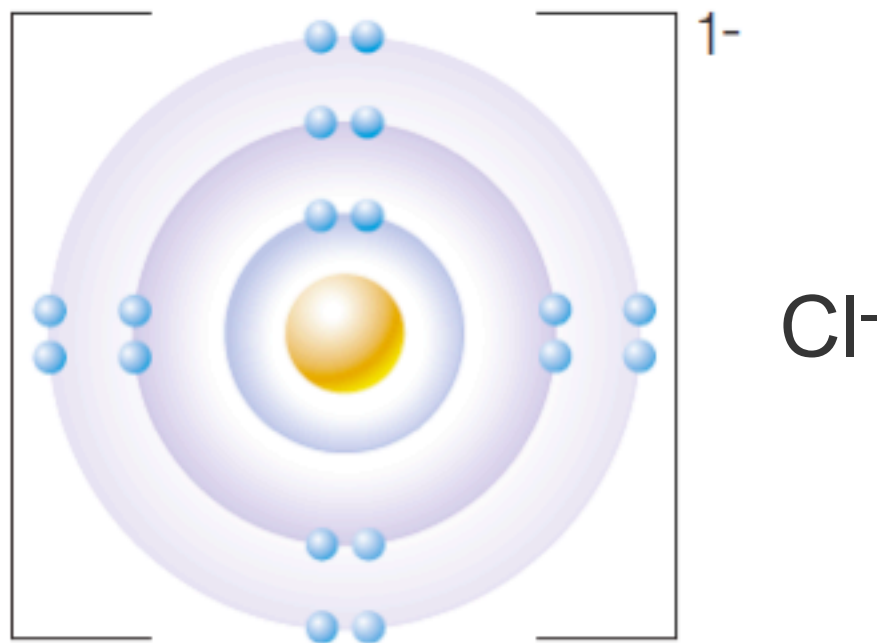
Negative Ion Example

- Chlorine **gains** one electron to become stable
- Results in an ion with a **negative charge**



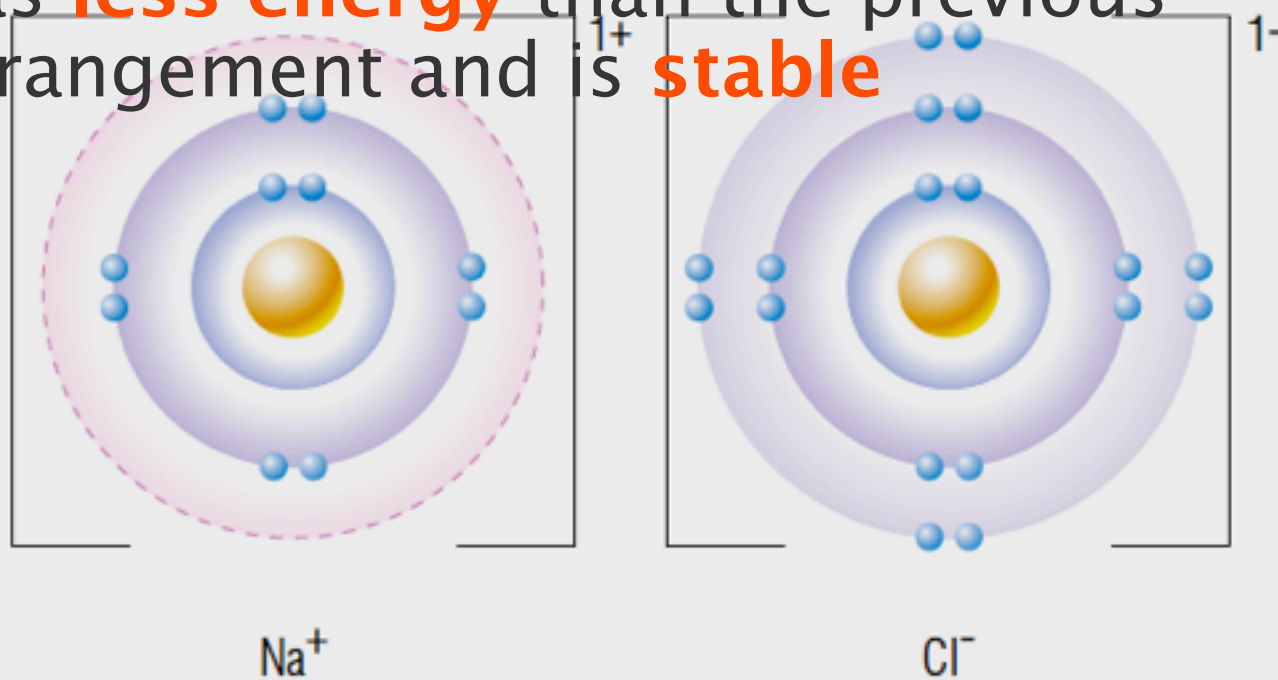
Negative Ion Example

- The symbol “-” is written as a superscript to indicate that the chlorine ion has a charge of 1-



Ion

- Both ions have a full valence shell containing the **maximum** number of electrons possible
- This new arrangement of valence electrons has **less energy** than the previous arrangement and is **stable**



Cation

- When an atom gives up one or more electrons it becomes **positive**
- Called a **cation** “cat-eye-on”



Anion

- When an atom **gains** one or more electron it become **negative**
- Called an **anion** (“an-eye-on”)



Ion

Ca⁺ ions
are posi
⁺ive



Anions are
negative



He

Ne

Ar

Kr

Xe



An atom that has lost electrons (cation) or has gained electrons (anion) will have the same number of electrons as its nearest **noble gas**.

Cations

- For example, **neon** is the closest noble gas in the periodic table to **sodium, magnesium and aluminum**

The periodic table shows the following elements highlighted with colored boxes:

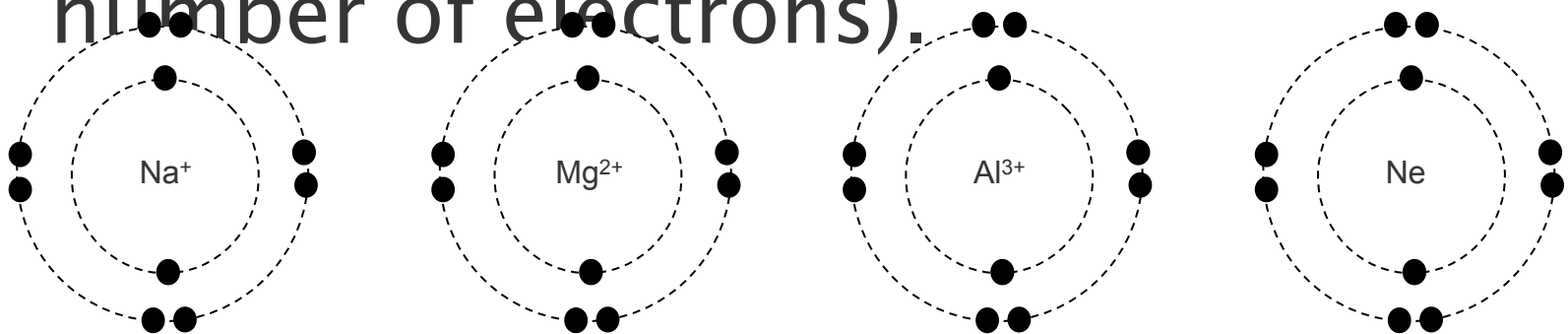
- Green boxes:** Sodium (Na, atomic number 11, atomic weight 22.99) and Magnesium (Mg, atomic number 12, atomic weight 24.31).
- Red box:** Neon (Ne, atomic number 10, atomic weight 20.18).
- Blue box:** Aluminum (Al, atomic number 13, atomic weight 26.98).

The periodic table also includes the following elements:

1	2											13	14	15	16	17	18	
1	H											B	C	N	O	F	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	57-71	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
7	Fr	Ra	89-103	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Uub	Uut	Uuq	Uup	Uuh	Uus	Uuo
6	La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu			
7	Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr			

Cations

- The cations Na^+ , Mg^{2+} , and Al^{3+} all have the same number of electrons as atoms of neon.
- This relationship is known as being **isoelectronic** (having the same number of electrons).



Anions

- Apply concept to anions
- For example, **neon** is the closest noble gas in the periodic table to **nitrogen, oxygen and fluorine**

The periodic table shows the following elements highlighted:

- Nitrogen (N)**: Atomic number 7, atomic weight 14.01
- Oxygen (O)**: Atomic number 8, atomic weight 16.00
- Fluorine (F)**: Atomic number 9, atomic weight 19.00
- Neon (Ne)**: Atomic number 10, atomic weight 20.18

The noble gas neon is highlighted in red, while nitrogen, oxygen, and fluorine are highlighted in green. The periodic table also includes the lanthanide and actinide series at the bottom.

1	H											13	14	15	16	17	18	
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	57-71	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
7	Fr	Ra	89-103	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Uub	Uut	Uuq	Uup	Uuh	Uus	Uuo
6	La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu			
7	Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr			

Isoelectronic

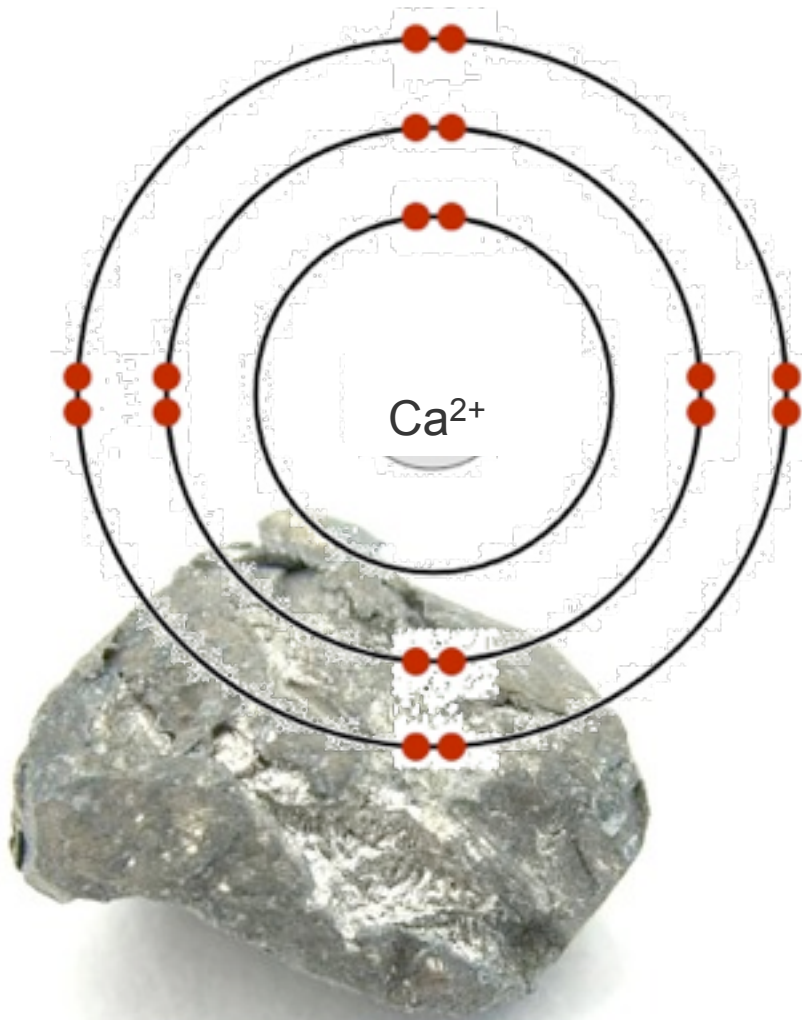
- Prove that these atoms are isoelectronic by drawing the Bohr diagrams.

Ne	N^{3-}	O^{2-}	F^{-}

How to write symbols for ions

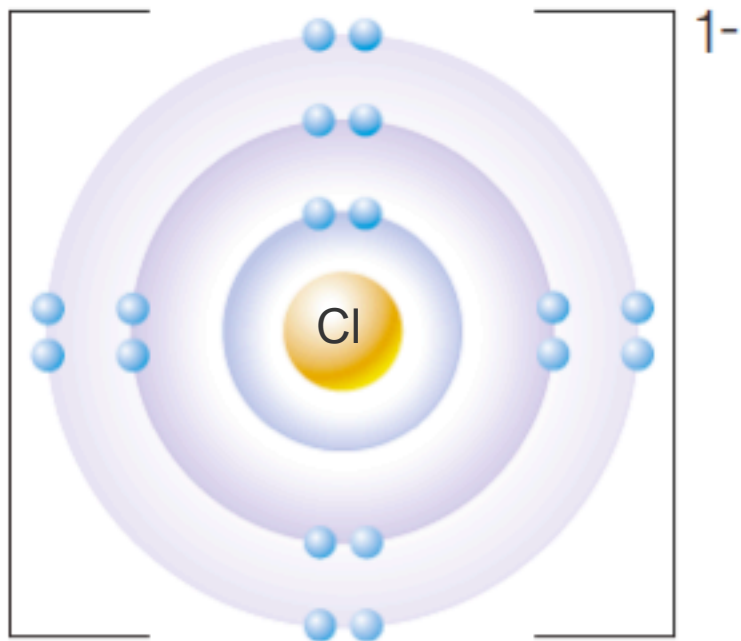
- Write the symbol of the element and show the ion charge as a superscript to the right of the element symbol
 - Example: the symbol of a calcium ion is Ca^{2+}
- When an ion has a charge of $1+$ or $1-$ the symbol has no number in the superscript
 - Example: sodium ion is Na^+ and not Na^{1+}

Naming Cations



- A metal that has lost electrons to become an ion has the same name as the element
- Eg: Ca^{2+} = calcium ion

Naming Anions



- A nonmetal that has gained electrons to become an ion has the the same name as the element but with the ending changed to **-ide**
- Eg: Cl⁻ = chloride ion

Naming Anions

nitrogen → nitride

oxygen → oxide

fluorine → fluoride

phosphorous → phosphide

sulfur → sulfide

chlorine → chloride

selenium → selenide

bromine → bromide

iodine → iodide

Ion Reactivity

- **Metal** atoms tend to **lose** electrons
- **Non-metal** atoms tend to **gain** electrons

The periodic table is shown with two regions highlighted by ovals. A red oval on the left side encloses the alkali and alkaline earth metals (groups 1 and 2). A blue oval on the right side encloses the halogens and noble gases (groups 17 and 18). The rest of the periodic table, including the transition metals, metalloids, and lanthanide/actinide series, is not highlighted.

1																	17	18								
1	H hydrogen 1.01																	He helium 4.00								
2	3	4											5	6	7	8	9	10	11	12	13	14	15	16	17	18
	Li lithium 6.94	Be beryllium 9.01											B boron 10.81	C carbon 12.01	N nitrogen 14.01	O oxygen 16.00	F fluorine 19.00	Ne neon 20.18								
3	11	12											13	14	15	16	17	18								
	Na sodium 22.99	Mg magnesium 24.31											Al aluminum 26.98	Si silicon 28.09	P phosphorus 30.97	S sulfur 32.07	Cl chlorine 35.45	Ar argon 36.95								
4	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36								
	K potassium 39.10	Ca calcium 40.08	Sc scandium 44.96	Ti titanium 47.87	V vanadium 50.94	Cr chromium 52.00	Mn manganese 54.94	Fe iron 55.85	Co cobalt 58.93	Ni nickel 58.69	Cu copper 63.55	Zn zinc 65.41	Ga gallium 69.72	Ge germanium 72.64	As arsenic 74.92	Se selenium 78.96	Br bromine 79.90	Kr krypton 83.80								
5	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54								
	Rb rubidium 85.47	Sr strontium 87.62	Y yttrium 88.91	Zr zirconium 91.22	Nb niobium 92.91	Mo molybdenum 95.94	Tc technetium (98)	Ru ruthenium 101.07	Rh rhodium 102.91	Pd palladium 106.42	Ag silver 107.87	Cd cadmium 112.41	In indium 114.82	Sn tin 118.71	Sb antimony 121.76	Te tellurium 127.60	I iodine 126.90	Xe xenon 131.29								
6	55	56	57-71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86								
	Cs cesium 132.91	Ba barium 137.33	Lanthanide series	Hf hafnium 178.49	Ta tantalum 180.95	W tungsten 183.84	Re rhenium 186.21	Os osmium 190.23	Ir iridium 192.22	Pt platinum 195.08	Au gold 196.97	Hg mercury 200.59	Tl thallium 204.38	Pb lead 207.21	Bi bismuth 208.98	Po polonium (209)	At astatine (210)	Rn radon (222)								
7	87	88	89-103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118								
	Fr francium (223)	Ra radium (226)	Actinide series	Rf rutherfordium (261)	Db dubnium (262)	Sg seaborgium (266)	Bh bohrium (264)	Hs hassium (277)	Mt meitnerium (268)	Ds darmstadtium (271)	Rg roentgenium (272)	Uub ununbium (285)	Uut ununtrium (284)	Uuq ununquadium (289)	Uup ununpentium (288)	Uuh ununhexium (293)	Uus ununseptium (?)	Uuo ununoctium (294)								
6	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71											
	La lanthanum 138.91	Ce cerium 140.12	Pr praseodymium 140.91	Nd neodymium 144.24	Pm promethium (145)	Sm samarium 150.36	Eu europium 151.96	Gd gadolinium 157.25	Tb terbium 158.93	Dy dysprosium 162.50	Ho holmium 164.93	Er erbium 167.26	Tm thulium 168.93	Yb ytterbium 173.04	Lu lutetium 174.97											
7	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103											
	Ac actinium (227)	Th thorium 232.04	Pa protactinium 231.04	U uranium 238.03	Np neptunium (237)	Pu plutonium (244)	Am americium (243)	Cm curium (247)	Bk berkelium (247)	Cf californium (251)	Es einsteinium (252)	Fm fermium (257)	Md mendelevium (258)	No nobelium (259)	Lr lawrencium (262)											

Ion Reactivity



- The farther the valence electron is from its positive nucleus, the more easily it is removed and the more

Cation Reactivity

- Reactivity generally increases for cations as you move down the periodic table
- Example: potassium is more reactive than sodium



Lithium



Sodium



Potassium



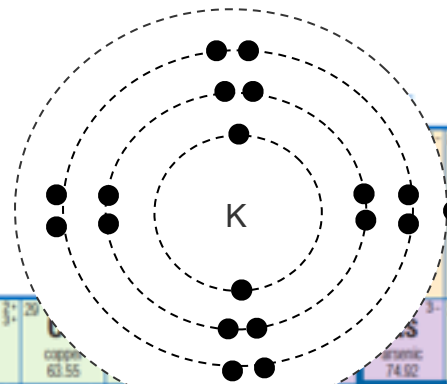
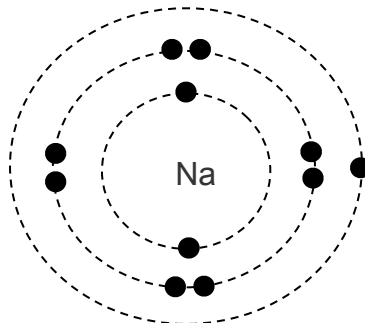
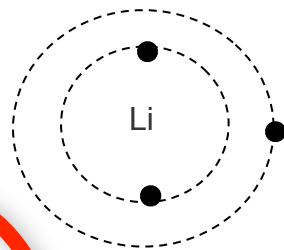
Rubidium



Cesium

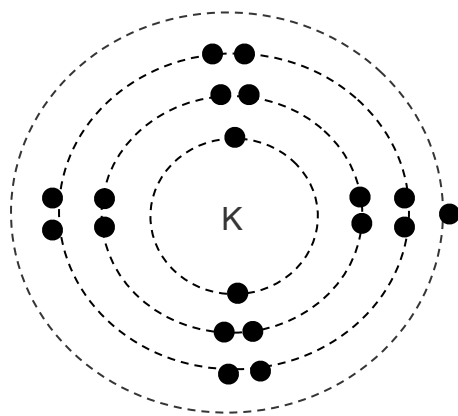
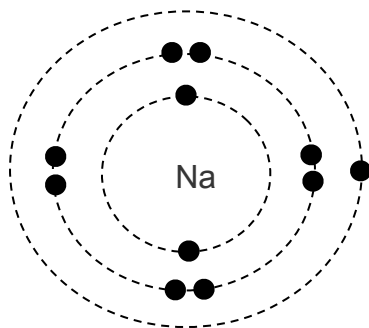
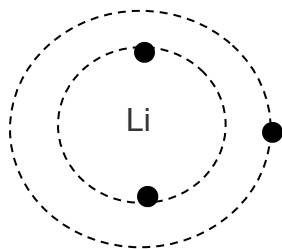
Cation Reactivity

reactivity increases



1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18																			
1	H hydrogen 1.01	2	He helium 4.00																																	
2	3	Li lithium 6.94	4	Be beryllium 9.01																																
3	11	Na sodium 22.99	12	Mg magnesium 24.31																																
4	19	K potassium 39.10	20	Ca calcium 40.08	21	Sc scandium 44.96	22	Ti titanium 47.87	23	V vanadium 50.94	24	Cr chromium 52.00	25	Mn manganese 54.94	26	Fe iron 55.85	27	Co cobalt 58.93	28	Ni nickel 58.69	29	Cu copper 63.55	30	Zn zinc 65.38	31	Ga gallium 69.72	32	Ge germanium 72.64	33	As arsenic 74.92	34	Se selenium 78.96	35	Br bromine 79.90	36	Kr krypton 83.80
5	37	Rb rubidium 85.47	38	Sr strontium 87.62	39	Y yttrium 88.91	40	Zr zirconium 91.22	41	Nb niobium 92.91	42	Mo molybdenum 95.94	43	Tc technetium (98)	44	Ru ruthenium 101.07	45	Rh rhodium 102.91	46	Pd palladium 106.42	47	Ag silver 107.87	48	Cd cadmium 112.41	49	In indium 114.82	50	Sn tin 118.71	51	Sb antimony 121.76	52	Te tellurium 127.60	53	I iodine 126.90	54	Xe xenon 131.29
6	55	Cs cesium 132.91	56	Ba barium 137.33	57	La lanthanum 138.91	72	Hf hafnium 178.49	73	Ta tantalum 180.95	74	W tungsten 183.84	75	Re rhenium 186.21	76	Os osmium 190.23	77	Ir iridium 192.22	78	Pt platinum 195.08	79	Au gold 196.97	80	Hg mercury 200.59	81	Tl thallium 204.38	82	Pb lead 207.21	83	Bi bismuth 208.98	84	Po polonium (209)	85	At astatine (210)	86	Rn radon (222)
7	87	Fr francium (223)	88	Ra radium (226)	103	Rf rutherfordium (261)	105	Db dubnium (262)	106	Sg seaborgium (266)	107	Bh bohrium (264)	108	Hs hassium (277)	109	Mt meitnerium (268)	110	Ds darmstadtium (271)	111	Rg roentgenium (272)	112	Uub ununbium (285)	113	Uut ununium (284)	114	Uuq ununquadium (289)	115	Uup ununpentium (288)	116	Uuh ununhexium (289)	117	Uus ununseptium (?)	118	Uuo ununoctium (284)		
6	57	La lanthanum 138.91	58	Ce cerium 140.12	59	Pr praseodymium 140.91	60	Nd neodymium 144.24	61	Pm promethium (145)	62	Sm samarium 150.36	63	Eu europium 151.96	64	Gd gadolinium 157.25	65	Tb terbium 158.93	66	Dy dysprosium 162.50	67	Ho holmium 164.93	68	Er erbium 167.26	69	Tm thulium 168.93	70	Yb ytterbium 173.04	71	Lu lutetium 174.97						
7	89	Ac actinium (227)	90	Th thorium 232.04	91	Pa protactinium 231.04	92	U uranium 238.03	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)						

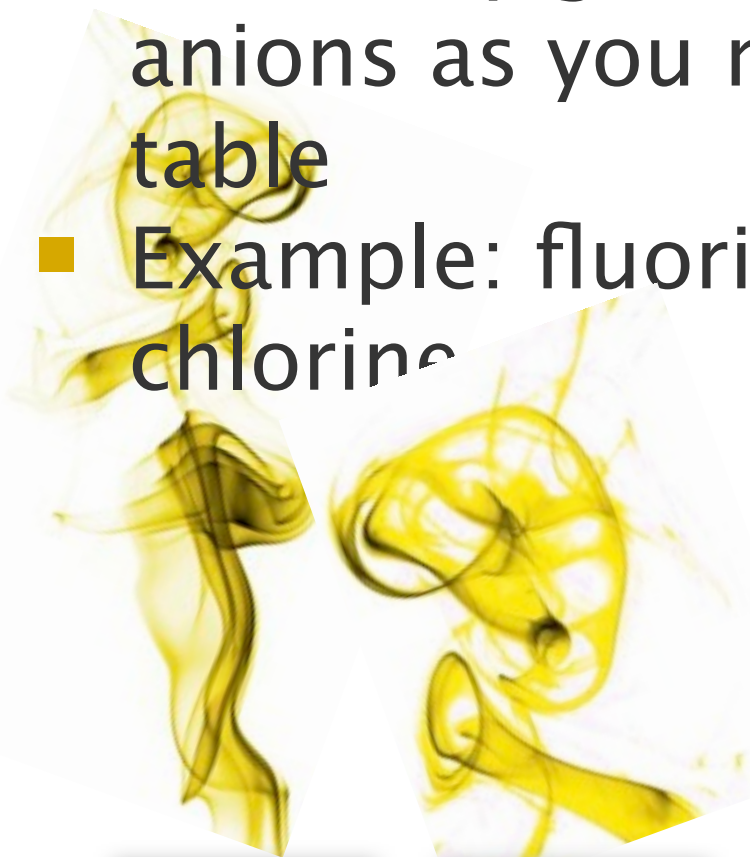
Cation Reactivity



- Why does cation reactivity increase as you move down the periodic table?
- Answer:
 - Electrons that are further away from the nucleus are more easily lost.
 - Thus atoms with more orbitals will be more reactive.

Anion Reactivity

- Reactivity generally decreases for anions as you move down the periodic table
- Example: fluorine is more reactive than chlorine

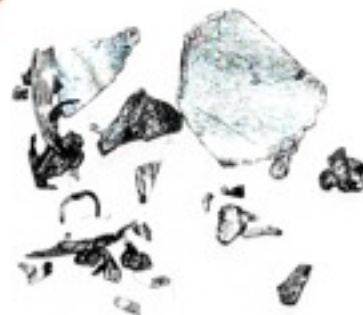


Fluorine

Chlorine



Bromine

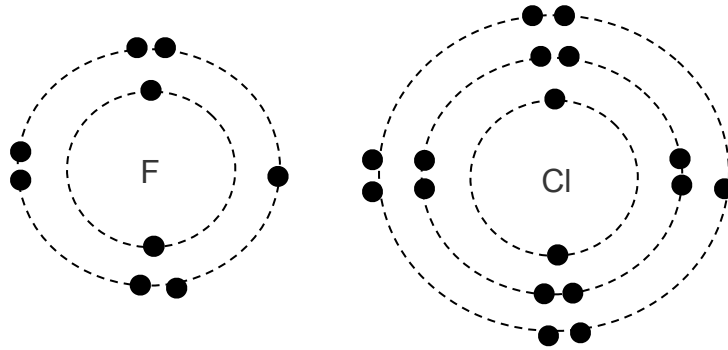


Iodine



Astatine

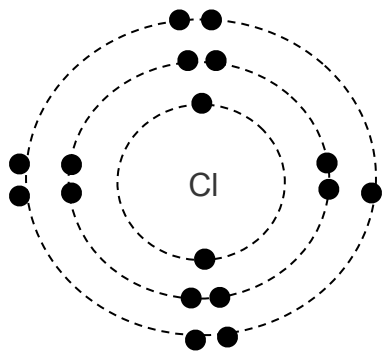
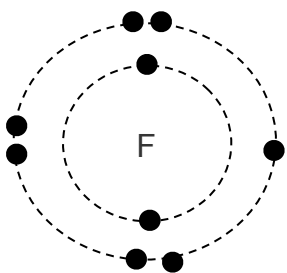
Anion Reactivity



1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
1 H hydrogen 1.01	2 He helium 4.00																	
3 Li lithium 6.94	4 Be beryllium 9.01											5 B boron 10.81	6 C carbon 12.01	7 N nitrogen 14.01	8 O oxygen 16.00	9 F fluorine 19.00	10 Ne neon 20.18	
11 Na sodium 22.99	12 Mg magnesium 24.31											13 Al aluminum 26.98	14 Si silicon 28.09	15 P phosphorus 30.97	16 S sulphur 32.07	17 Cl chlorine 35.45	18 Ar argon 39.95	
19 K potassium 39.10	20 Ca calcium 40.08	21 Sc scandium 44.96	22 Ti titanium 47.87	23 V vanadium 50.94	24 Cr chromium 52.00	25 Mn manganese 54.94	26 Fe iron 55.85	27 Co cobalt 58.93	28 Ni nickel 58.69	29 Cu copper 63.55	30 Zn zinc 65.41	31 Ga gallium 69.72	32 Ge germanium 72.64	33 As arsenic 74.92	34 Se selenium 78.96	35 Br bromine 79.90	36 Kr krypton 83.80	
37 Rb rubidium 85.47	38 Sr strontium 87.62	39 Y yttrium 88.91	40 Zr zirconium 91.22	41 Nb niobium 92.91	42 Mo molybdenum 95.94	43 Tc technetium (98)	44 Ru ruthenium 101.07	45 Rh rhodium 102.91	46 Pd palladium 106.42	47 Ag silver 107.87	48 Cd cadmium 112.41	49 In indium 114.82	50 Sn tin 118.71	51 Sb antimony 121.76	52 Te tellurium 127.60	53 I iodine 126.90	54 Xe xenon 131.29	
55 Cs cesium 132.91	56 Ba barium 137.33	57-71	72 Hf hafnium 178.49	73 Ta tantalum 180.95	74 W tungsten 183.84	75 Re rhenium 186.21	76 Os osmium 190.23	77 Ir iridium 192.22	78 Pt platinum 195.08	79 Au gold 196.97	80 Hg mercury 200.59	81 Tl thallium 204.38	82 Pb lead 207.21	83 Bi bismuth 208.98	84 Po polonium (209)	85 At astatine (210)	86 Rn radon 222	
87 Fr francium (223)	88 Ra radium (226)	89-103	104 Rf rutherfordium (261)	105 Db dubnium (262)	106 Sg seaborgium (266)	107 Bh bohrium (264)	108 Hs hassium (277)	109 Mt meitnerium (268)	110 Ds darmstadtium (271)	111 Rg roentgenium (272)	112 Uub ununbium (285)	113 Uut ununtrium (284)	114 Uuq ununquadium (289)	115 Uup ununpentium (288)	116 Uuh ununhexium (288)	117 Uus ununseptium (?)	118 Uuo ununoctium (294)	
6	7																	
57 La lanthanum 138.91	58 Ce cerium 140.12	59 Pr praseodymium 140.91	60 Nd neodymium 144.24	61 Pm promethium (145)	62 Sm samarium 150.36	63 Eu europium 151.96	64 Gd gadolinium 157.25	65 Tb terbium 158.93	66 Dy dysprosium 162.50	67 Ho holmium 164.93	68 Er erbium 167.26	69 Tm thulium 168.93	70 Yb ytterbium 173.04	71 Lu lutetium 174.97				
89 Ac actinium (227)	90 Th thorium 232.04	91 Pa protactinium 231.04	92 U uranium 238.03	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)				

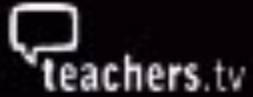
↑
reactivity increases

Anion Reactivity



- Why does anion reactivity decrease as you move down the periodic table?
- Answer:
 - Elements whose valence shell is closer to the nucleus will gain electrons more readily because they are closer to the nucleus.
 - Negative electrons have a stronger attraction for the positive nucleus when the valence shell is closer to the

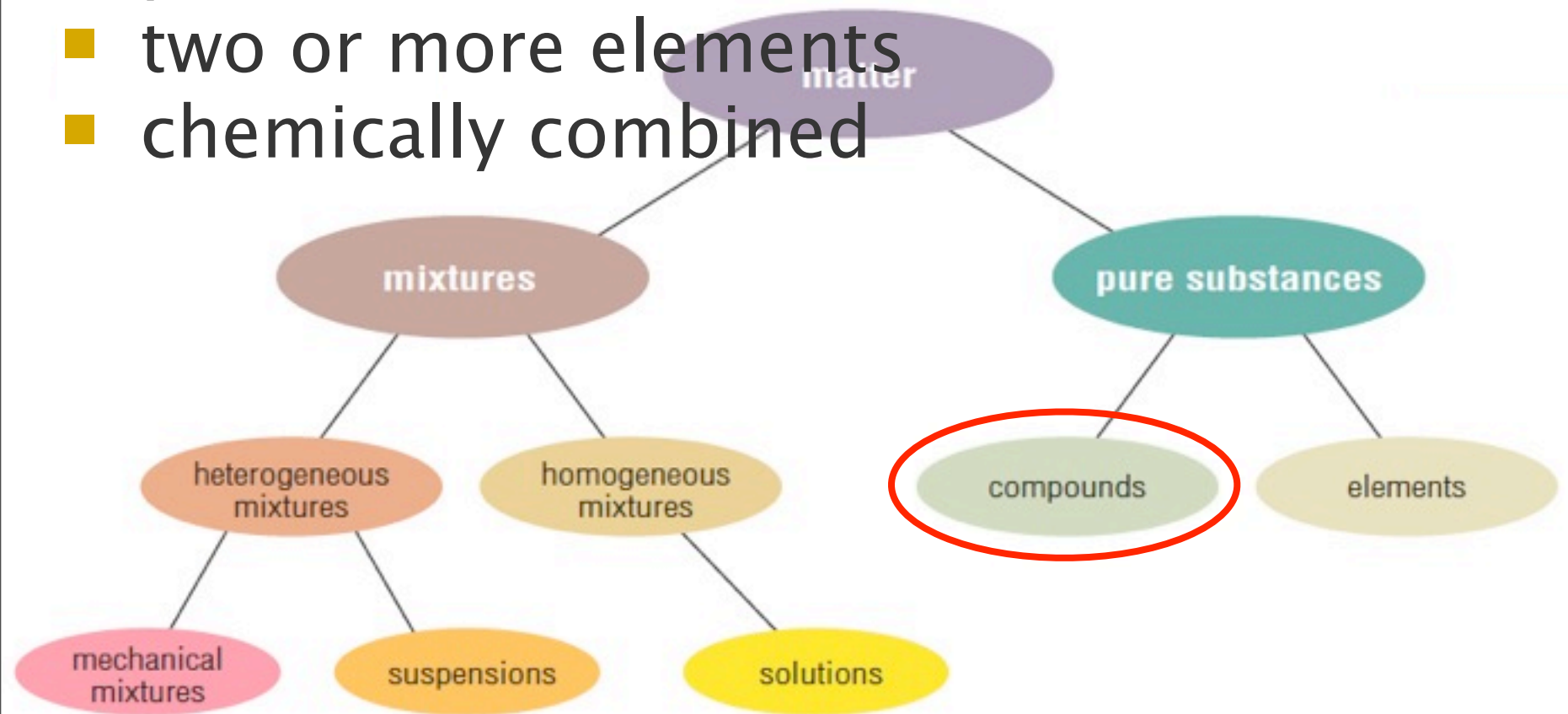
Video: Ferocious Elements (14:00)



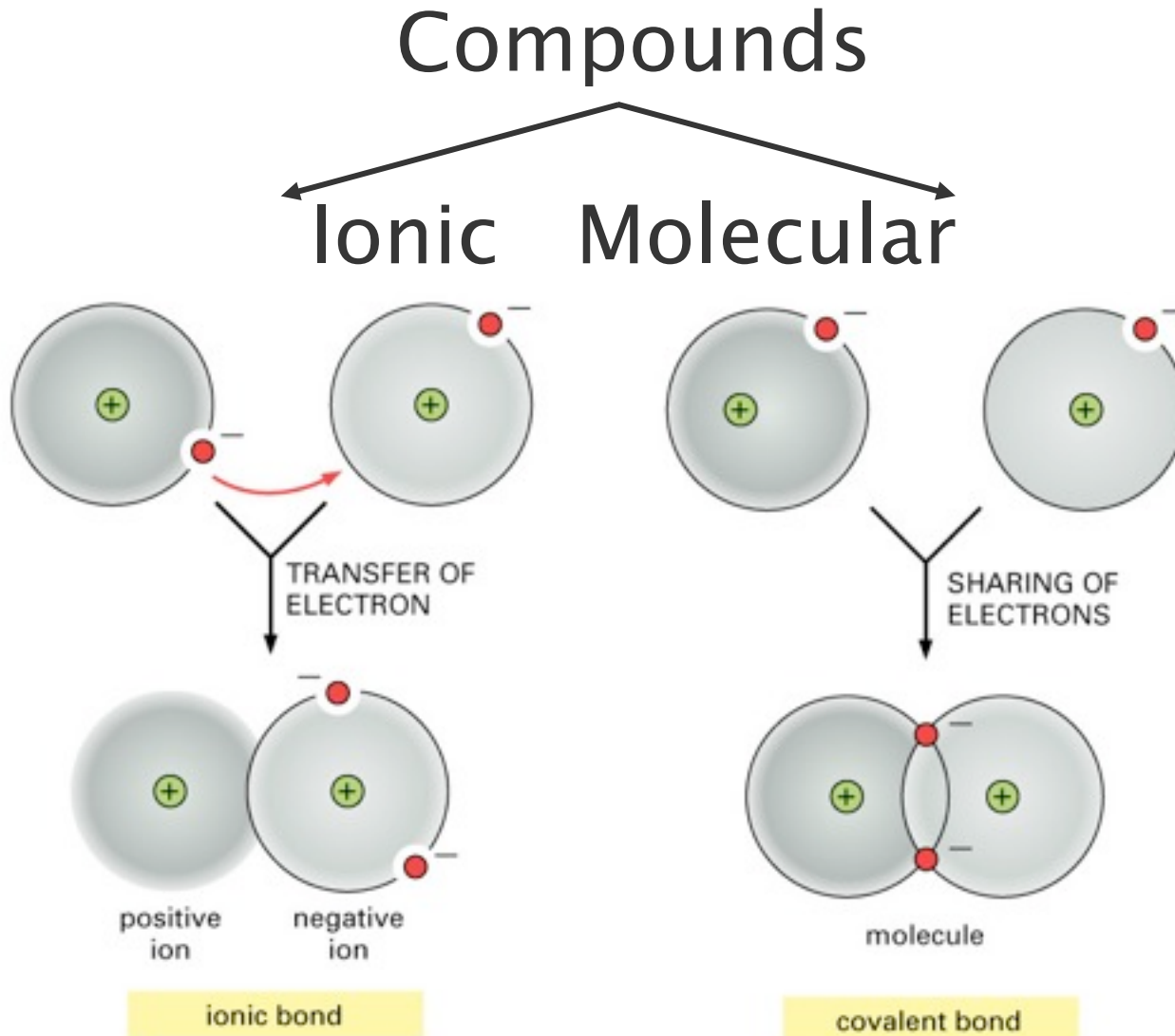
Review: Classification of Matter

Definition of compound:

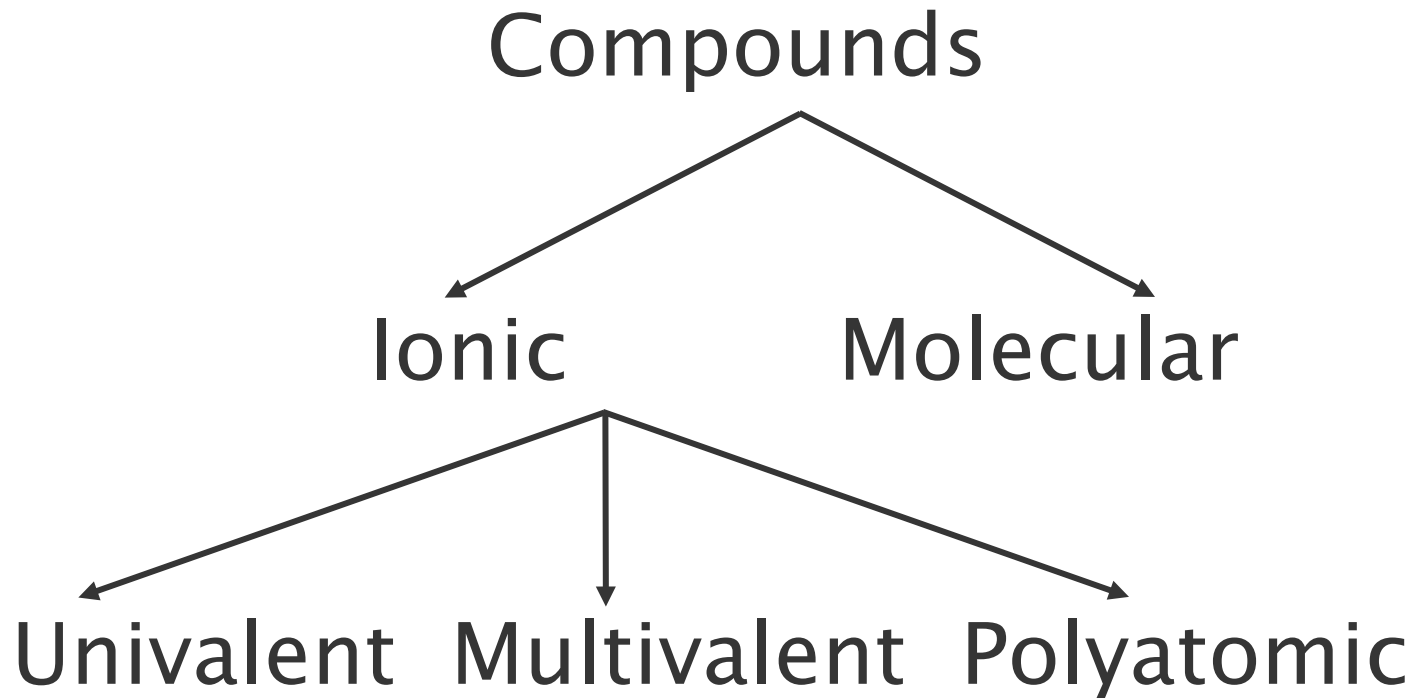
- pure substance
- two or more elements
- chemically combined



Types of Compounds



Types of Compounds



Ionic Compounds

- Ionic compounds form when atoms transfer electrons
- Ionic compounds consists of:
 - ions of opposite charges
 - cation and anion
 - an electron donor and acceptor



Example of Ionic Compound

- Formation of NaCl, or table salt



Na

+



Cl

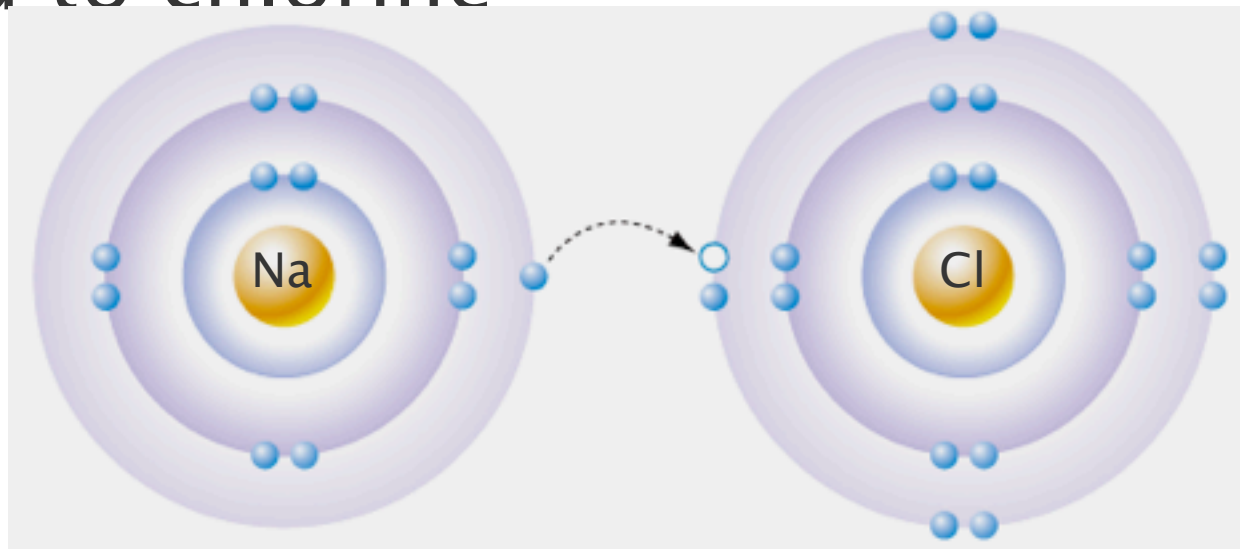
=



NaCl

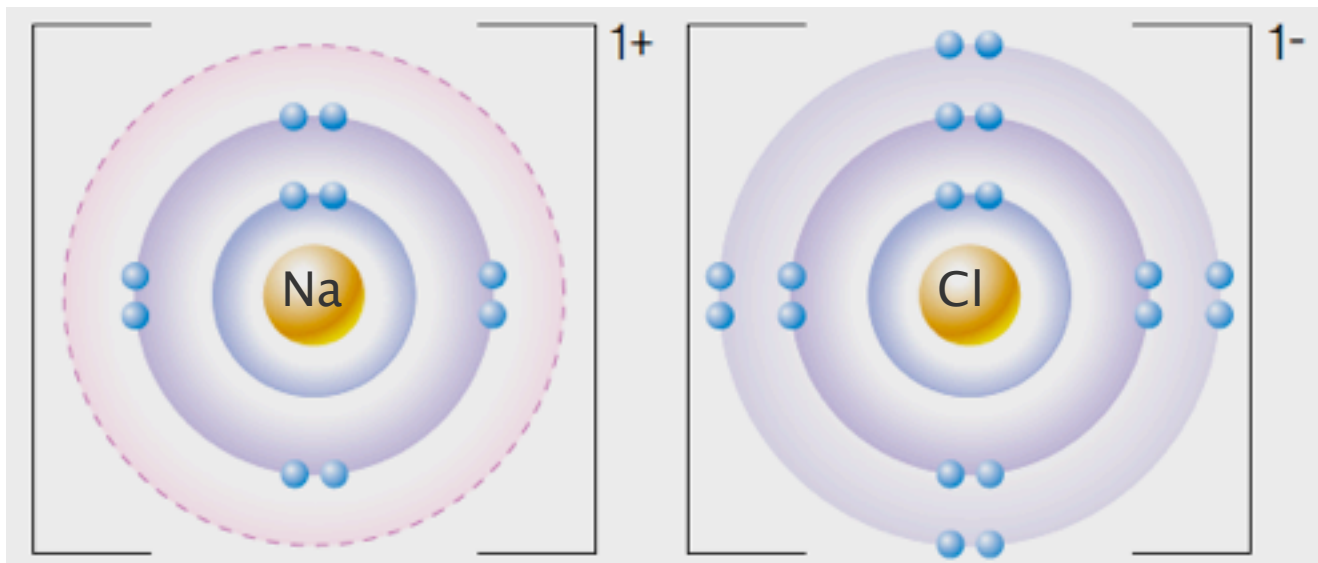
Example of Ionic Compound

- Sodium has 1 valence electron and wants to remove it to be stable
- Chlorine has 7 valence electrons and wants to gain one to be stable
- Thus, one electron from sodium is transferred to chlorine



Ionic Bond

- A cation will react with an anion to acquire a **full valence shell**
- The attraction between the cation and the anion is known as an **ionic bond**

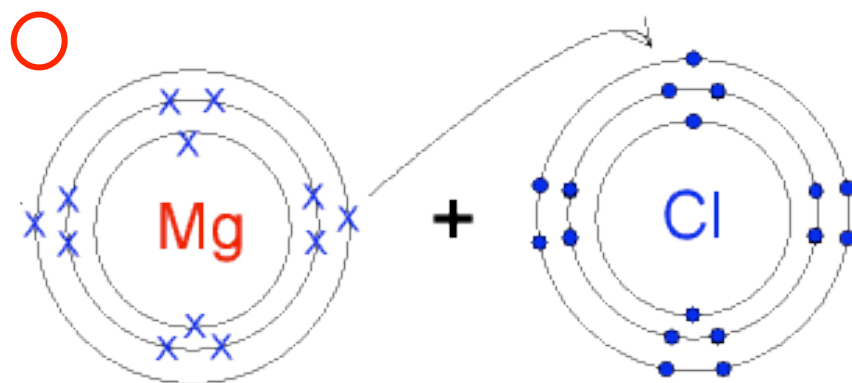


Forming Ionic Compounds

- Transfer of electrons until both elements in the compound have a full valence shell
- If the number of electrons that an atom wants to give away does not equal the number of electrons that the receiving atom wants, then more atoms of either element can be added until both elements are full

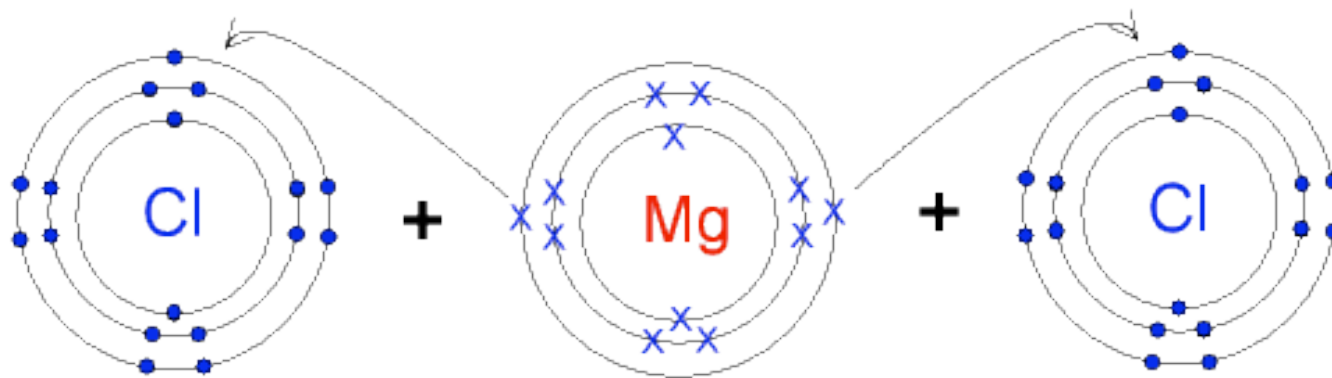
Forming Ionic Compounds

- Example: Form an ionic compound between magnesium and oxygen
 - Draw Bohr (or Lewis) diagram for each element
 - Use arrows to move electrons to fill valence shell



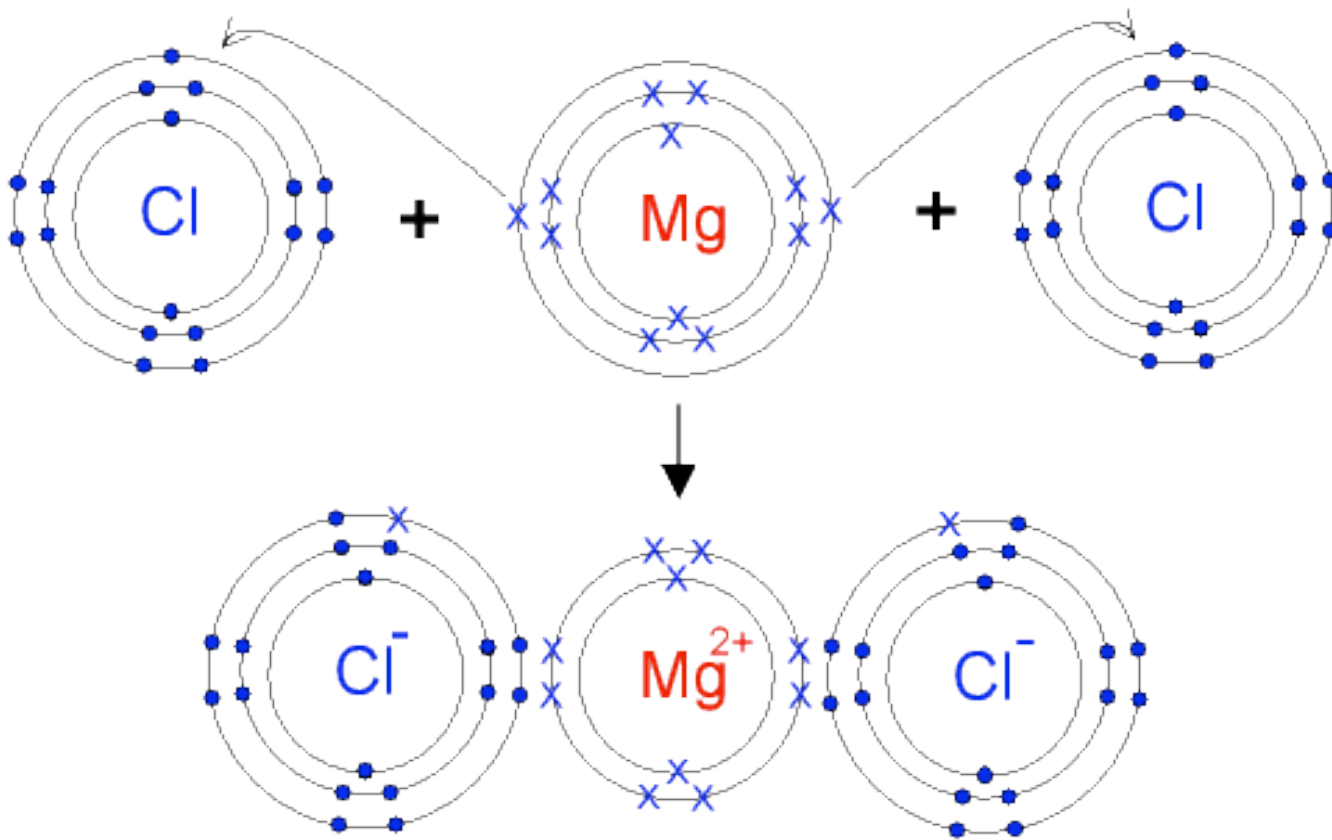
Forming Ionic Compounds

- Example: Form an ionic compound between magnesium and oxygen
 - If the valence shells are not full after moving as many of the electrons as possible, add more atoms as needed



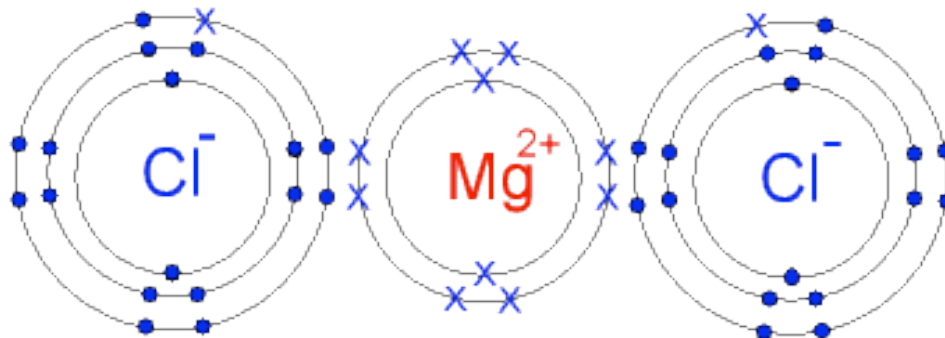
Forming Ionic Compounds

- Example: Form an ionic compound between magnesium and oxygen



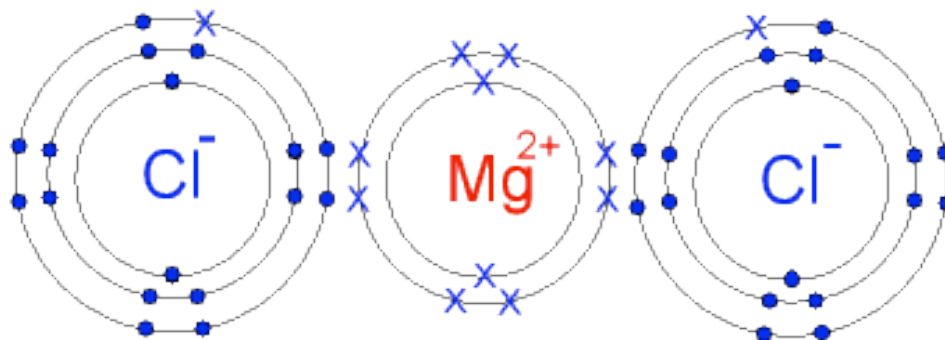
Forming Ionic Compounds

- Example: Form an ionic compound between magnesium and oxygen
- Final composition this ionic compound is:
 - 1 magnesium atom
 - 2 chlorine atoms
 - Chemical formula: MgCl_2



Ionic Compound Chemical Formula

- The cation is always written first
- The anion is always written second
- If there is more than 1 atom, it is indicated by a subscript following the element symbol (bottom-right)
- Example: MgCl_2



Is there a faster way?

- Drawing the Bohr/Lewis diagram every time you want to determine the chemical formula of an ionic compound is tedious and takes a long time
- There is a faster way that requires knowing stable form of elements

No net charge rule

- All ionic compounds must have a net charge of zero
- Example: MgCl_2

Atom	# valence electron	Movement of electrons	Charge of ion	Number of atoms in the compound	Total charge
Mg	2	Lose 2	2+	1	+2
Cl	7	Gain 1	1-	2	-2
Net charge					ZERO!

Rule for all compounds

- Although ionic compounds are made of charged particles, the compound itself has **no net charge**
- All ion charges must be equal and add up to **zero**



Writing Chemical Formula for Ionic

1. Identify the charge of the ions in the compound
 - Example: Calcium chloride
 - Ca^{2+} and Cl^-
2. Determine the number of positive and negative ions needed to make the compound neutral
 - Need 2 Cl^- to equal 1 Ca^{2+}
3. Write the cation first. Use subscript to indicate the number of ions if it is more than 1. Make sure to use on the lowest common multiple.
 - Calcium chloride = CaCl_2
 - Wrong: Ca_2Cl_4

	C	Cl
Charge		
Number of		
Total charge		

Writing Chemical Formula for Ionic Compounds

- Example Problem 1: Write the chemical formula for Aluminum oxide.
- Write the element symbol and their charges.
- How many of each do we need to make the compound neutral?
- Write the chemical formula using subscripts as needed.

	Al	O
Charge		
Number of		
Total charge		

Nomenclature

- A system used to name things
- In this case, we will be naming a variety of different types of ionic compounds:
 - Univalent
 - Polyatomic

Univalent Ionic Compounds

- Compounds where the cation only has one possible charge.

Naming Univalent Ionic Compounds

1. Name the cation first
 - The name of the metal ion is the same as the element name
 - Example: in KBr , the name of the K^+ ion is potassium
2. Name the anion second
 - When a non-metal becomes a negative ion, the ending of its name changes to “ide”
 - Example: a bromine atom become bromide ion (Br^-)
3. Combine the names. The formulas of ionic compounds often contain numbers called subscripts which can be ignored when determining the name.
 - Example: Na_3P is sodium phosphide

Naming Univalent Ionic Compounds

Example Problem 2: Write the name of the ionic compound ZnF_2

1. Name the metal ion:

- Zn forms only one type of ion (Zn^{2+}), so the name is zinc

2. Name the non-metal ion:

- The atom is fluorine so the ion is fluoride

3. Combine the names:

- ZnF_2 = zinc fluoride

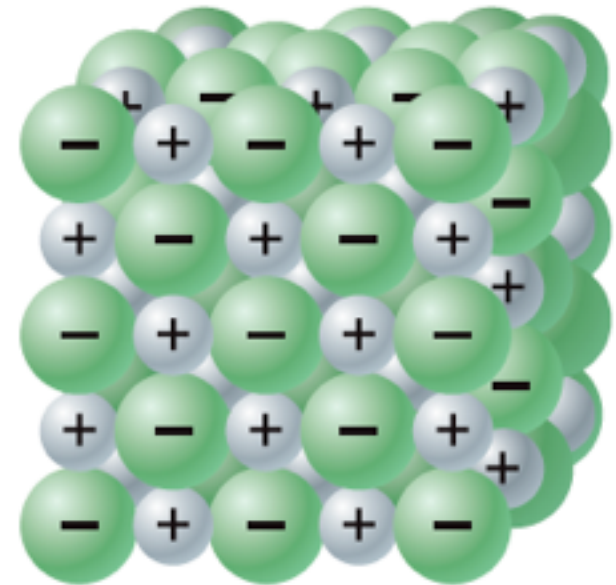
Properties of Ionic Compounds

- At room temperature, most are hard, brittle solids that can be crushed



Properties of Ionic Compounds

- Ionic compounds form crystals that have an alternating arrangement of positively charged ions and negatively charged ions
- When they break their edges are well-defined



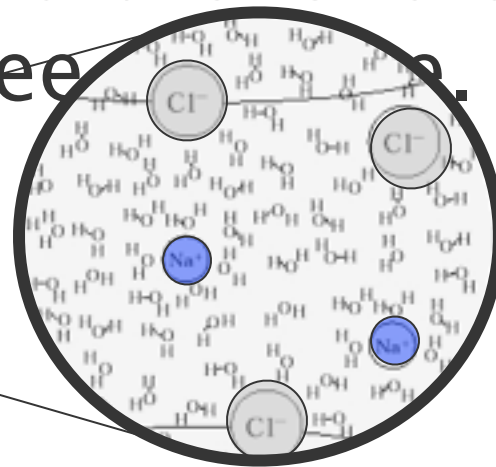
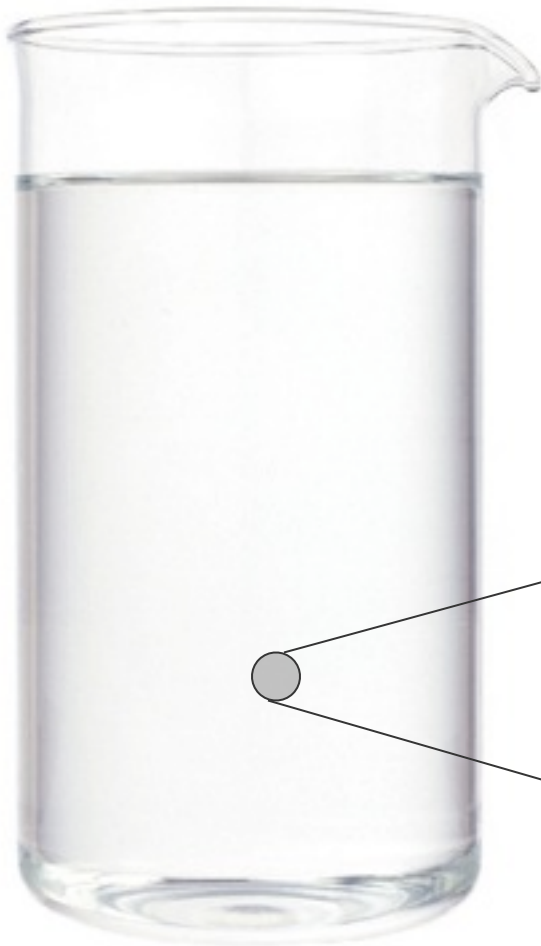
Properties of Ionic Compounds



- In an ionic crystal, every ion is attracted to every other ion
- Thus, ionic crystals have very high **melting points**
- Eg. NaCl melts at 800°C

Properties of Ionic Compounds

- When an ionic compound dissolves in water, the crystal structure breaks down and the ions become free.



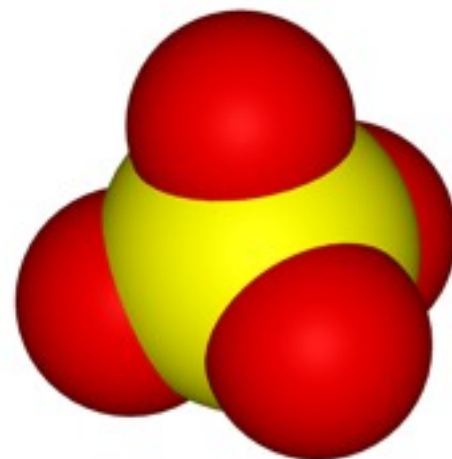
Properties of Ionic Compounds



- Solutions of ionic compounds can conduct electricity

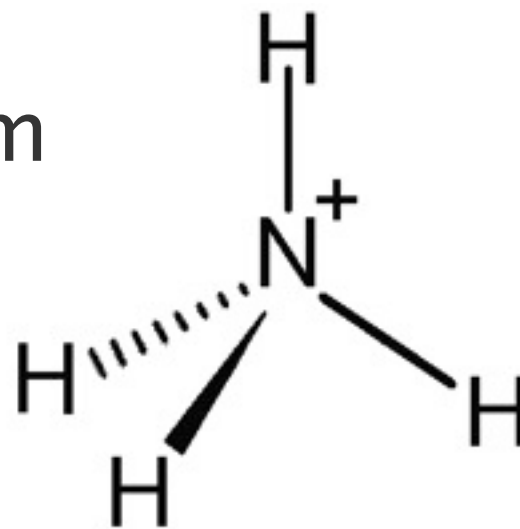
Polyatomic Ions

- Poly = 2 or more
- Atomic = atoms
- A polyatomic ion is a group of atoms, usually of different elements, that act as a single ion
- Example: one atom of sulphur and four atoms of oxygen form the polyatomic ion called sulphate, or SO_4^{2-}



Polyatomic Ions

- Similar polyatomic ions are named using the suffixes “-ate” or “-ite”
- Example: NO_3^- is nitrate; NO_2^- is nitrite
- Most common polyatomic ions have a negative charge
- However, the ammonium ion NH_4^+ has a positive charge



Examples of Polyatomic Ions

Name	Formul
ammonium	NH_4^+
carbonate	CO_3^{2-}
bicarbonate	HCO_3^-
hydroxide	OH^-
nitrate	NO_3^-
nitrite	NO_2^-
permanganate	MnO_4^-
phosphate	PO_4^{3-}
phosphite	PO_3^{3-}
sulphate	SO_4^{2-}
sulphite	SO_3^{2-}

Naming Polyatomic Ionic Compounds

Example Problem 3: Write the name of the ionic compound LiHCO_3

1. Name the cation:

- Example: Li^+ = lithium

2. Identify the polyatomic ion (use table):

- Example: HCO_3^- = bicarbonate

3. Combine the names. Do not change the polyatomic ending.

- LiHCO_3 = lithium bicarbonate

Writing Chemical Formula for Polyatomic Ionic Compounds

1. Identify the charge of the ions in the compound
 - Example: Calcium chlorate
 - Ca^{2+} and ClO_4^-
2. Determine the number of positive and negative ions needed to make the compound neutral
 - Need 2 ClO_4^- to equal 1 Ca^{2+}
3. Write the cation first. If subscripts are needed for the polyatomic ion, place a bracket around it first.
 - Calcium chlorate = $\text{Ca}(\text{ClO}_4)_2$

	C	ClO
Charge		
Number of		
Total charge		

Writing Chemical Formula for Polyatomic Ionic Compounds

- Example Problem 4: Write the chemical formula for calcium phosphate.
- Write the symbols of the cations and include their charges.
- How many of each do we need to make the compound neutral?
- Write the chemical formula using subscripts and brackets as needed.