

Chapter 9 "Chemical Names and Formulas"

Section 9.1 Naming lons

• **OBJECTIVES**:

–<u>Identify</u> the charges on monatomic ions by using the periodic table, and <u>name</u> the ions. Section 9.1 Naming lons

• **OBJECTIVES**:

 <u>Define</u> a polyatomic ion and <u>write</u> the names and formulas of the most common polyatomic ions. Section 9.1 Naming lons

• **OBJECTIVES**:

<u>Identify</u> the two common
 endings for the names of
 most polyatomic ions.

Atoms and lons

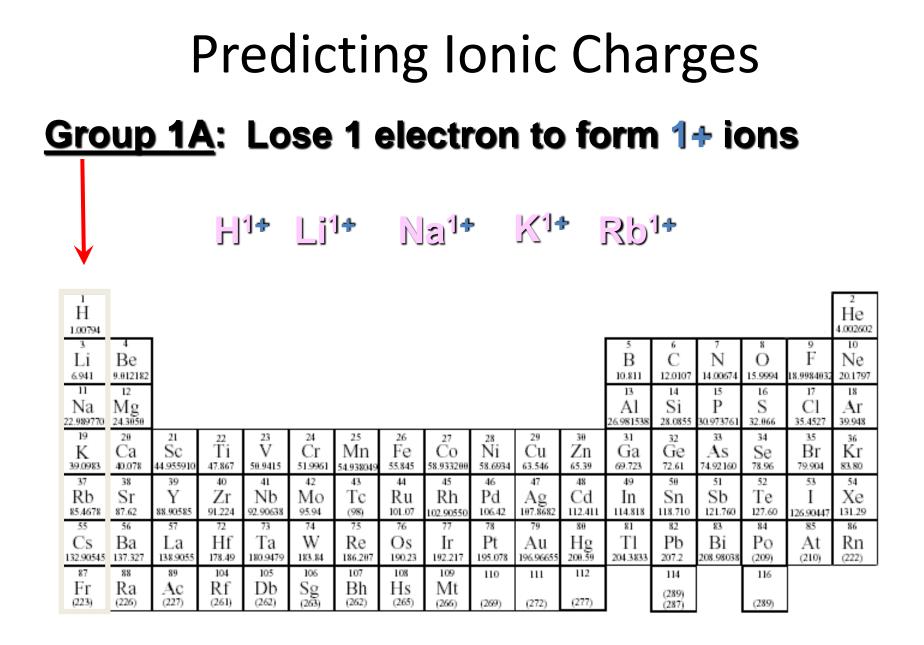
- <u>Atoms</u> are electrically neutral.
 - Because there is the same number of protons (+) and electrons (-).
- <u>lons</u> are atoms, or groups of atoms, with a charge (positive or negative)
 - They have *different* numbers of protons and electrons.
- Only *electrons* can move, and **ions** are made by <u>gaining or losing electrons</u>.

An Anion is...

- A negative ion.
- Has gained electrons.
- <u>Nonmetals can gain</u> electrons.
- Charge is written as a superscript on the right.
 - **F1-** Has gained one electron (-ide is new ending = fluoride)
 - O²⁻ Gained two electrons (oxide)

A Cation is...

- A positive ion.
- Formed by losing electrons.
- More protons than electrons.
- Metals can lose electrons
 - K¹⁺ Has lost one electron (no name change for positive ions)
 - Ca²⁺ Has lost two electrons



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1 H 1.00794	ł											í				He 4.002602
3 4 Li B 6.941 9.01											B 10.811	C 12.0107	N 14.00574	8 O 15.9994	9 F 18.9984032	10 Ne 20.1797
11 12 Na M 22.989770 24.3	g										13 Al 26.981538	14 Si 28.0855	15 P 30.973761	16 S 32.866	17 Cl 35.4527	18 Ar 39.948
19 20 K C 39.0983 40.0		²² Ti 47.867	23 V 50.9415	24 Cr 51.9961	25 Mn 54.938049	26 Fe 55.845	27 Co 58.933200	28 Ni 58.6934	29 Cu 63.546	30 Zn 65.39	31 Ga 69.723	32 Ge 72.61	33 As 74.92160	34 Se 78.96	35 Br 79.904	36 Kr 83.80
37 38 Rb S 85.4678 87./	r Y	40 Zr 5 91.224	41 Nb 92.90638	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.90550	46 Pd 106.42	47 Ag 107.8682	48 Cd 112.411	49 In 114.818	50 Sn 118.710	51 Sb 121.760	52 Te 127.60	53 I 126.90447	54 Xe 131.29
55 50 Cs B 132,90545 137	a La	72 Hf 55 178.49	73 Ta 180.9479	74 W 183.84	75 Re 186.207	76 Os 190.23	77 Ir 192.217	78 Pt 195.078	79 Au 196.96655	80 Hg 200.59	81 T1 204.3833	82 Pb 207.2	83 Bi 208.98038	84 Po (209)	85 At (210)	86 Rn (222)
87 89 Fr R (223) (22	a Ac	104 Rf (261)	105 Db (262)	106 Sg (263)	107 Bh (262)	108 Hs (265)	109 Mt (266)	110 (269)	111 (272)	112 (277)		114 (289) (287)		116 (289)		

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19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 K Ca Sc Ti V Cr Mn Fe Co Ni Cu Zn 65.39 Ga Ge As Se Br Kr 39.0983 40.078 44.955910 47.867 50.9415 51.9961 54.938049 55.845 58.933200 58.6934 63.546 65.39 Ga Ge As Se Br Kr 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 Rb Sr Y Zr Nb Mo Tc Ru Rh Pd Ag Cd In Sn Sb Te I Xe 85.4678 87.62 88.90585 91.224 92.90638 95.94 (98) 101.07 102.90550 106.42 <td< td=""><td>H 1.00794 3 Li 6.941 11 Na</td><td>4 Be 9.01218</td><td>2</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>10.811 13 Al</td><td>C 12.0107 14 Si</td><td>14.00674 15 P</td><td>15.9994 16 S</td><td>F 18.9984032 17 Cl</td><td>He 4.002602 10 Ne 20.1797 18 Ar</td></td<>	H 1.00794 3 Li 6.941 11 Na	4 Be 9.01218	2										10.811 13 Al	C 12.0107 14 Si	14.00674 15 P	15.9994 16 S	F 18.9984032 17 Cl	He 4.002602 10 Ne 20.1797 18 Ar
87 88 89 104 105 106 107 108 109 110 111 112 114 116	19 K 39,0983 37 Rb 85,4676 55 CS 132,9054	20 Ca 40.078 38 Sr 87.62 56 Ba 137.327	Sc 44.955910 39 Y 88.90585 57 La 138.9055	47.867 40 Zr 91.224 72 Hf 178.49	V 50.9415 41 Nb 92.90638 73 Ta 180.9479	Cr 51.9961 42 MO 95.94 74 W 183.84	Mn 54.938049 43 Tc (98) 75 Re 186.207	Fe 55,845 44 Ru 101.07 76 OS 190.23	Co 58.933200 45 Rh 102.90550 77 Ir 192.217	Ni 58.6934 46 Pd 106.42 78 Pt 195.078	Cu 63.546 47 Ag 107.8682 79 Au 196.96655	Zn 65.39 48 Cd 112.411 80 Hg 200.59	³¹ Ga ^{69.723} ⁴⁹ In ^{114.818} ⁸¹ Tl	³² Ge 72.61 50 Sn 118.710 82 Pb 207.2	³³ As ^{74,92160} ⁵¹ Sb ^{121,760} ⁸³ Bi	³⁴ Se ^{78.96} ⁵² Te ^{127.60} ⁸⁴ Po (209)	35 Br 79.904 53 I 126.90447 85 At	36 Kr 83.80 54 Xe 131.29 86 Rn

Predicting Ionic Charges

Neither! Group 4A elements rarely form ions (they tend to share)

<u>Group 4A</u>: Do they lose 4 electrons or gain 4 electrons?

1 H 1.00794																	He 4.002602
3 Li 6.941	4 Be 9.012182											5 B 10.811	C 12.0107	7 N 14.00674	8 O 15.9994	9 F 18.9984032	10 Ne 20.1797
11 Na 22.989770	12 Mg 24.3050											13 Al 26.981538	14 Si 28.0855	15 P 30.973761	16 S 32.066	17 Cl 35.4527	18 Ar 39.948
19 K 39.0983	20 Ca 40.078	21 Sc 44.955910	²² Ti 47.867	23 V 50.9415	24 Cr 51.9961	²⁵ Mn 54.938049	26 Fe 55.845	CO 58.933200	28 Ni 58.6934	²⁹ Cu _{63.546}	30 Zn 65.39	31 Ga 69.723	Ge 72.61	33 As 74.92160	34 Se 78.96	Br 79.904	83.80
37 Rb 85.4678	38 Sr 87.62	39 Y 88.90585	40 Zr 91.224	41 Nb 92.90638	42 Mo 95.94	43 Tc (98)		45 Rh 102.90550	46 Pd 106.42	47 Ag 107.8682	48 Cd 112.411	49 In 114.818	50 Sn 118.710	51 Sb 121.760	52 Te 127.60	53 I 126.90447	54 Xe 131.29
55 Cs 132.90545	56 Ba 137.327	57 La 138.9055	72 Hf 178.49	73 Ta 180.9479	74 W 183.84	75 Re 186.207	76 Os 190.23	77 Ir 192.217	78 Pt 195.078	79 Au 196.96655	80 Hg 200.59	81 T1 204.3833	82 Pb 207.2	83 Bi 208.98038	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	89 Ac (227)	104 Rf (261)	105 Db (262)	106 Sg (263)	107 Bh (262)	108 Hs (265)	109 Mt (266)	110 (269)	111 (272)	112 (277)		114 (289) (287)		116 (289)		

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As	3-	Ar	sei	nid	е				3-	io	ns					
1 H 1.00794 3 4 Li Be 6.941 9.012182 11 12 Na Mg 22.989770 24.3050											5 B 10.811 13 Al 26.981538	6 C 12.0107 14 Si 28.0855	7 N 14.00674 15 P 30.973761	8 O 15.9994 16 S 32.866	9 F 18.9984032 17 Cl 35.4527	² He 4.002602 10 Ne 20.1797 18 Ar 39.948
19 28 K Ca 39.0983 40.078	21 Sc 44.955910	²² Ti 47.867	23 V 50.9415	24 Cr 51.9961	25 Mn 54.938049	26 Fe 55.845	27 Co 58.933200	28 Ni 58.6934	29 Cu 63.546	30 Zn 65.39	31 Ga @.723	32 Ge 72.61	33 As 74.92160	34 Se 78.96	35 Br 79.904	83.80
37 38 Rb Sr 85.4678 87.62	39 Y 88.90585	40 Zr 91.224	41 Nb 92.90638	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.90550	46 Pd 106.42	47 Ag 107.8682	48 Cd 112.411	49 In 114.818	50 Sn 118.710	51 Sb 121.760	52 Te 127.60	53 I 126.90447	54 Xe 131.29
55 56 Cs Ba 132.90545 137.327	57 La 138.9055	72 Hf 178.49	73 Ta 180.9479	74 W 183.84	75 Re 186.207	76 Os 190.23	77 Ir 192.217	78 Pt 195.078	79 Au 196.96655	80 Hg 200.59	81 Tl 204.3833	82 Pb 207.2	83 Bi 208.98038	84 Po (209)	85 At (210)	86 Rn (222)
87 88 Fr Ra (223) (226)	89 Ac (227)	104 Rf (261)	105 Db (262)	106 Sg (263)	107 Bh (262)	108 Hs (265)	109 Mt (266)	110 (269)	111 (272)	112 (277)		114 (289) (287)		(289)		

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1.00794 3 Li 6.941	4 Be 9.012182											5 B 10.811	6 C 12.9107	7 N 14.00674	8 O	9 F 18.9984032	4.002602 10 Ne 20.1797
11 Na 22.989770	12 Mg 24.3050											13 Al 26.981538	14 Si 28.0855	15 P 30.973761	16 S 32.066	17 Cl 35.4527	18 Ar 39.948
19 K 39.0983	20 Ca 40.078	21 Sc 44.955910	²² Ti 47.867	23 V 50.9415	24 Cr 51.9961	²⁵ Mn 54.938049	Fe 55.845	27 Co 58.933200	28 Ni 58.6934	29 Cu 63.546	30 Zn 65.39	31 Ga 69.723	Ge 72.61	33 As 74.92160	34 Se 78.96	35 Br 79.904	83.80
37 Rb 85.4678	38 Sr 87.62	39 Y 88.90585	40 Zr 91.224	41 Nb 92.90638	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.90550	46 Pd 106.42	47 Ag 107.8682	48 Cd 112.411	49 In 114.818	50 Sn 118.710	51 Sb 121.760	52 Te 127.60	53 I 126.90447	54 Xe 131.29
55 Cs 132.90545	56 Ba 137.327	57 La 138.9055	72 Hf 178.49	73 Ta 180.9479	74 W 183.84	75 Re 186.207	76 Os 190.23	77 Ir 192.217	78 Pt 195.078	79 Au 196.96655	80 Hg 200.59	81 Tl 204.3833	82 Pb 207.2	83 Bi 208.98038	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	89 Ac (227)	104 Rf (261)	105 Db (262)	106 Sg (263)	107 Bh (262)	108 Hs (265)	109 Mt (266)	110 (269)	(272)	112 (277)		114 (289) (287)		(289)		

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1 H 1.00794 3 Li 6.941 11 Na 22.989770	4 Be 9.012182 12 Mg 24.3050											5 B 10.811 13 Al 26.981538	6 C 12.0107 14 Si 28.0855	7 N 14.00674 15 P 30.973761	8 O 15.9994 16 S 32.866	9 F 18.998403 17 Cl 35.4527	² He 4.002602 ¹⁰ Ne 20.1797 ¹⁸ Ar 39.948
19 K 39.0983 37 Rb 85.4678	Ca	21 Sc 44.955910 39 Y 88.90585 57	22 Ti 47.867 40 Zr 91.224 72	23 V 50.9415 41 Nb 92.90638	42 Mo 95.94	25 Mn 54.938049 43 Tc (98) 75	26 Fe 55.845 44 Ru 101.07 76	27 Co 58.933200 45 Rh 102.90550	28 Ni 58.6934 46 Pd 106.42	29 Cu 63.546 47 Ag 107.8682 79	30 Zn 65.39 48 Cd 112.411	³¹ Ga ^{69.723} ⁴⁹ In ^{114.818}	32 Ge 72.61 50 Sn 118.710	33 As 74.92160 51 Sb 121.760	34 Se 78.96 52 Te 127.60 84	35 Br 79.904 53 I 126.90447	³⁶ Kr ^{83,80} ⁵⁴ Xe ^{131,29} ⁸⁶
55 Cs 132.9054 87 Fr (223)	Ba 5 137.327 88 Ra (226)	La 138.9055 89 Ac (227)	12 Hf 178.49 104 Rf (261)	73 Ta 180.9479 105 Db (262)	74 W 183.84 106 Sg (263)	75 Re 186.207 107 Bh (262)	76 Os 190.23 108 Hs (265)	77 Ir 192.217 109 Mt (266)	78 Pt 195.078 110 (269)	Au 196.96655 111 (272)	89 Hg 200.59 112 (277)	81 T] 204.3833	82 Pb 207.2 114 (289) (287)	83 Bi 208.98038	84 Po (209) 116 (289)	85 At (210)	86 Rn (222)

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1 H 1.007																	2 He 4.002602
3 Li 6.941	Be	2										5 B 10.811	6 C 12.0107	7 N 14.00674	8 O 15.9994	9 F 18.998403 17	10 Ne 20.1797
Na 22.9897	Mg											13 Al 26.981538	14 Si 28.0855	15 P 30.973761	16 S 32.066	Cl 35.4527	18 Ar 39.948
19 K 39.09	20 Ca 83 40.078	21 Sc 44.955910	22 Ti 47.867	23 V 50.9415	24 Cr 51.9961	25 Mn 54.938049	26 Fe 55.845	27 Co 58.933200	28 Ni 58.6934	29 Cu 63.546	30 Zn 65.39	31 Ga 69.723	32 Ge 72.61	33 As 74.92160	34 Se 78.96	35 Br 79.904	36 Kr 83.80
37 Rb 85.46		39 Y 88,90585	40 Zr 91.224	41 Nb 92,90638	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	Rh	46 Pd 106.42	47 Ag 197.8682	48 Cd 112.411	49 In 114.818	50 Sn 118.710	51 Sb 121.760	52 Te 127.60	53 I	54 Xe 131.29
Cs	56 Ba	57 La	72 Hf	73 Ta	74 W	75 Re	76 Os	102.90550 77 Ir	78 Pt	79 Au	80 Hg 200.59	81 Tl	⁸² Pb	83 Bi	84 Po	126.90447 85 At	86 Rn
132.909 87 Fr (223)	Ra 88	138.9055 89 AC (227)	178.49 104 Rf (261)	180.9479 105 Db (262)	183.84 106 Sg (263)	186.207 107 Bh (262)	190.23 108 HS (265)	192.217 109 Mt (266)	195.078 110 (299)	196.96655	208.59	204.3833	207.2 114 (289) (287)	208.98038	(209) 116 (289)	(210)	(222)

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3 Li 6.941	4 Be 9.012182											5 B 10.811	6 C 12.0107	7 N 14.00674	8 O 15.9994	9 F 18.9984832	10 Ne 20.1797	
11 Na 22.989770	12 Mg 24.3050											13 Al 26.981538	14 Si 28.0855	15 P 30.973761	16 S 32.066	17 Cl 35.4527	18 Ar 39.948	
19 K 39.0983	20 Ca 40.078	21 Sc 44.955910	22 Ti 47.867	23 V 50.9415	24 Cr 51.9961	25 M11 54.9380'9	26 Fe 55.845	27 Co (8.933200	28 Ni 58.6934	29 Cu 63.546	30 Zn 65.39	31 Ga 69.723	32 Ge 72.61	33 As 74.92160	34 Se 78.96	Br 79.904	83.80	
37 Rb 85.4678	38 Sr 87.62	39 Y 88.90585	40 Zr 91.224	41 Nb 92.90638	42 Mo 95.94	43 Tc (98)	Ru 101.07	45 Rh 102.90550	46 Pd 106.42	47 Ag 187.8682	48 Cd 112.411	49 In 114.818	50 Sn 118.710	51 Sb 121.760	52 Te 127.60	53 I 126.90447	54 Xe 131.29	
55 Cs 132,90545	56 Ba	57 La 138,9055	72 Hf 178.49	73 Ta 180.9479	74 W 183.84	75 Re 186,207	76 Os 190.23	77 Ir 192,217	78 Pt 195.078	79 Au 196.96655	80 Hg 200.59	81 T1 204,3833	82 Pb 207.2	83 Bi 208,98038	84 Po (209)	85 At (210)	86 Rn (222)	
87 Fr (223)	88 Ra (226)	89 AC (227)	104 Rf (261)	105 Db (262)	106 Sg (263)	107 Bh (262)	108 Hs (265)	109 Mt (266)	(269)	(272)	(277)		114 (289) (287)		(289)	()	(eee)	

Naming cations

- <u>Two methods</u> can clarify when more than one charge is possible:
 - Stock system uses roman numerals in parenthesis to indicate the numerical value
 - 2) <u>Classical method</u> uses root word with *suffixes* (-ous, -ic)
 - Does not give true value

Naming cations

- We will use the **<u>Stock system</u>**.
- Cation if the charge is always the same (like in the Group A metals) just write the name of the metal.
- Transition metals can have more than one type of charge.
 - Indicate their charge as a *roman numeral* in parenthesis after the name of the metal (Table 9.2, p.255)

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1 H 1.00794		- 0									LCC		(1 V	, –		2 He 4.002602
³ Li E 6.941 9.0	4 3e 112182 12 12										5 B 10.811 13 Al	6 C 12.0107 14 Si	7 N 14.00674 15 P	8 O 15.9994 16 S	9 F 18.9984032 17 Cl	10 Ne 20.1797 18 Ar
22.989770 24 19 2 K C 39.0983 40	3050 20 21 Ca Sc 0.078 44.95591	_	23 V 50.9415	24 Cr 51.9961	25 Mn 54.938049	26 Fe 55.845	27 Co 58.933200	28 Ni 58.6934	29 Cu 63.546	30 Zn 65.39	6.981538 31 ().72 (9.72)	28.0855 32 Ge (2.61	30.973761 33 AS 74.92160	32.066 34 Se 78.96	35.4527 35 Br 79.904	39.948 36 Kr 83.80
Rb 85,4678 87	88 39 Sr Y 2.62 88.90585 56 57 Ba La	40 Zr 91.224 72 Hf	41 Nb 92.90638 73 Ta	42 Mo 95.94 74 W	43 Tc (98) 75 Re	44 Ru 101.07 76 Os	45 Rh 102.90550 77 Ir	46 Pd 106.42 78 Pt	47 Ag 197.8682 79 Au	48 Cd 112.411 89 Ho	49 In 114.815 81 Tl	50 Sn 118.710 82 Pb	51 Sb 121.760 83 Bi	52 Te 127.60 84 Po	53 I 126.90447 85 At	54 Xe 131.29 86 Rn
132.90545 13 87 8 Fr R	7.327 138.9053 88 89 Ra Ac 26) (227)		180.9479 105 Db (262)	183.84 106 Sg (263)	186.207 107 Bh (262)	190.23 108 HS (265)	192.217 109 Mt (266)	195.078 110 (269)	196.96655 111 (272)	Hg 200.59 112 (277)	204.3833		208.98038	(209) 116 (289)	(210)	(222)

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1 H 1.00794 3 4 Li Be 6.941 9.012182 11 12 Na Mg 22.989770 24.3059										5 B 10.811 13 Al 26.981538	6 C 12.0107 14 Si 28.0855	7 N 14.00674 15 P 30.973761	8 O 15.9994 16 S 32.866	9 F 18.9984032 17 Cl 35.4527	² He 4.002602 ¹⁰ Ne 20.1797 ¹⁸ Ar 39.948	
37 38	²¹ Sc Ti 4.955910 47.867 ³⁹ Y Zr	23 V 50.9415 41 Nb	42	25 Mn 54.938049 43 Tc	26 Fe 55.845 44	27 CO 58.933200 45 Db	28 Ni 58.6934 46 Pd	29 Cu 47	Zn	31 Ga 69.723 49	32 Ge 72.61 50	33 As 74.92160 51	34 Se 78.96	35 Br 79.904 53 I	36 Kr 83.80 54	
85.4678 87.62 8 55 56 Cs Ba	Y ZI 188.90585 91.224 57 72 La Hf 138.9055 178.49 89 104 Ac Rf (227) (261)	IND 92.90638 73 Ta 180.9479 105 Db (262)	Mo 95.94 74 W 183.84 106 Sg (263)	1 C (98) 75 Re 186.207 107 Bh (262)	Ru 101.07 76 0s 190.23 108 Hs (265)	Rh 102.90550 77 Ir 192.217 109 Mt (266)	Pd 106.42 78 Pt 195.078 110 (269)	Ag 107.8682 78 Au 196.96655 111 (272)	Cd 112.411 en Hg 200.59 112 (277)	In 114.818 81 Tl 204.3833	Sn 118.710 82 Pb 207.2 114 (289) (287)	Sb 121.760 83 Bi 208.98038	Te 127.60 84 PO (209) 116 (289)	1 126.90447 85 At (210)	Xe 131.29 86 Rn (222)	

Exceptions:

- Some of the transition metals have <u>only one</u> ionic charge:
 - -**Do not** need to use roman numerals for these:
 - -<u>Silver</u> is always 1+ (Ag¹⁺)
 - –<u>Cadmium</u> and <u>Zinc</u> are always 2+ (Cd²⁺ and Zn²⁺)

Practice by naming these:

- Na¹⁺
- Ca²⁺
- Al³⁺
- Fe³⁺
- Fe²⁺
- Pb²⁺
- Li¹⁺

Write symbols for these:

- Potassium ion
- Magnesium ion
- Copper (II) ion
- Chromium (VI) ion
- Barium ion
- Mercury (II) ion

Naming Anions

- Anions are <u>always</u> the same charge
- Change the monatomic element ending to – ide
- **F**¹⁻ a Fluor<u>ine</u> atom will become a Fluor<u>ide</u> ion.

Practice by naming these:

- Cl¹⁻
- N³⁻
- Br¹⁻
- O²⁻
- Ga³⁺

Write symbols for these:

- Sulfide ion
- Iodide ion
- Phosphide ion
- Strontium ion

Polyatomic ions are...

- Groups of atoms that stay together and have an overall charge, and one name.
- Usually end in <u>–ate or -ite</u>
- Acet<u>ate</u>: **C**₂**H**₃**O**₂¹⁻
- Nitr<u>ate</u>: NO₃¹⁻
- Nitr<u>ite</u>: NO₂¹⁻
- Permangan<u>ate</u>: MnO₄¹⁻
- Hydroxide: OH¹⁻ and Cyanide: CN¹⁻?

Know Table 9.3 on page 257

- Sulf<u>ate</u>: **SO₄²⁻**
- Sulf<u>ite</u>: **SO₃²⁻**
- Carbon<u>ate</u>: CO₃²⁻
- Chrom<u>ate</u>: CrO₄²⁻
- Dichrom<u>ate</u>: Cr₂O₇²⁻

- Phosph<u>ate</u>: PO₄³⁻
- Phosphite: **PO₃³⁻**
- Ammonium: NH₄¹⁺ (One of the few positive polyatomic ions)

If the polyatomic ion begins with H, then combine the word hydrogen with the other polyatomic ion present: $H^{1+} + CO_3^{2-} \rightarrow HCO_3^{1-}$ hydrogen + carbonate \rightarrow hydrogen carbonate ion

Section 9.2 Naming and Writing Formulas for Ionic Compounds

• **OBJECTIVES**:

—<u>Apply the rules for naming</u> and writing formulas for binary ionic compounds.

Section 9.2 Naming and Writing Formulas for Ionic Compounds

• **OBJECTIVES**:

–<u>Apply the rules for naming</u> and writing formulas for compounds containing polyatomic ions.

Example: Barium nitrate (note the 2 word name)

1. Write the formulas for the cation and anion, including <u>CHARGES</u>!

2. Check to see if charges are balanced.

3. Balance charges , if necessary, using subscripts. Use parentheses if you need more than one of a <u>polyatomic ion</u>. Use the *criss-cross* method to balance subscripts.

Example: Ammonium sulfate (note the 2 word name)

1. Write the formulas for the cation and anion, including <u>CHARGES</u>!

2. Check to see if charges are balanced.

3. Balance charges , if necessary, using subscripts. Use parentheses if you need more than one of a <u>polyatomic ion</u>. Use the *criss-cross* method to balance the subscripts.

 $(NH_4)_2SO_4^2$ -Now balanced. Not balanced! = $(NH_4)_2SO_4$

Example: Iron (III) chloride (note the 2 word name)

1. Write the formulas for the cation and anion, including <u>CHARGES</u>!

2. Check to see if charges are balanced.

Now balanced. Not_balanced! Not_balanced! 3

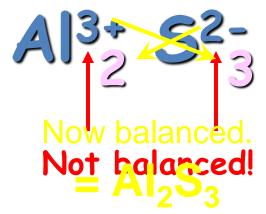
3. Balance charges , if necessary, using subscripts. Use parentheses if you need more than one of a polyatomic ion. Use the *criss-cross* method to balance the subscripts.

Example: Aluminum sulfide (note the 2 word name)

1. Write the formulas for the cation and anion, including <u>CHARGES</u>!

2. Check to see if charges are balanced.

3. Balance charges , if necessary, using subscripts. Use parentheses if you need more than one of a <u>polyatomic ion</u>. Use the *criss-cross* method to balance the subscripts.



Example: Magnesium carbonate (note the 2 word name)

1. Write the formulas for the cation and anion, including <u>CHARGES</u>!

2. Check to see if charges are balanced.

 $Mg^{2+}CO_3^{2-}$

They <u>are</u> balanced!

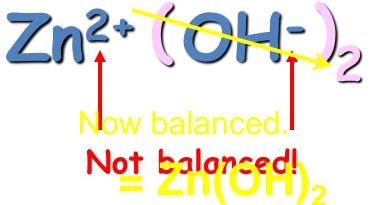
= MgCO₃

Example: Zinc hydroxide (note the 2 word name)

1. Write the formulas for the cation and anion, including <u>CHARGES</u>!

2. Check to see if charges are balanced.

3. Balance charges , if necessary, using subscripts. Use parentheses if you need more than one of a <u>polyatomic ion</u>. Use the *criss-cross* method to balance the subscripts.

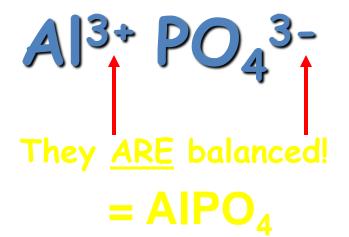


Writing Ionic Compound Formulas

Example: Aluminum phosphate (note the 2 word name)

1. Write the formulas for the cation and anion, including <u>CHARGES</u>!

2. Check to see if charges are balanced.



Naming Ionic Compounds

- 1. Name the cation first, then anion
- 2. Monatomic cation = name of the element

Ca²⁺ = calcium ion

3. Monatomic anion = root + -ide
 Cl⁻ = chloride
 CaCl₂ = calcium chloride

Naming Ionic Compounds (Metals with multiple oxidation states)

- some metals can form more than one charge (usually the transition metals)
- use a <u>Roman numeral</u> in their name:

PbCl₂ – use the <u>anion</u> to find the charge on the cation (chloride is always 1-)

Pb²⁺ is the lead (II) cation

PbCl₂ = lead (II) chloride

Things to look for:

- 1) If cations have (), the number in parenthesis is their charge.
- 2) If anions end in -ide they are probably off the periodic table (Monoatomic)
- If anion ends in -ate or -ite, then it is polyatomic

Practice by writing the formula or name as required...

- Iron (II) Phosphate
- Stannous Fluoride
- Potassium Sulfide
- Ammonium Chromate
- MgSO₄
- FeCl₃

Section 9.3 Naming and Writing Formulas for Molecular Compounds

• **OBJECTIVES**:

<u>Interpret</u> the *prefixes* in the names of **molecular compounds** in terms of their chemical formulas.

Section 9.3 Naming and Writing Formulas for Molecular Compounds

• **OBJECTIVES**:

 <u>Apply the rules</u> for naming and writing formulas for binary molecular compounds.

Molecular compounds are...

- made of just *nonmetals*
- smallest piece is a <u>molecule</u>
- can't be held together by opposite charge attraction
- can't use charges to figure out how many of each atom (there are no charges present)

Molecular compounds are easier!

- <u>lonic compounds</u> use *charges* to determine how many of each.
 - -You have to figure out charges.
 - -May need to criss-cross numbers.
- Molecular compounds: the <u>name tells</u>
 you the number of atoms.
 - -Uses prefixes to tell you the exact number of each element present!

Prefixes (Table 9.4, p.269)

- 1 = mono-
- 2 = di-
- 3 = tri-
- 4 = tetra-
- 5 = penta-
- 6 = hexa-
- 7 = hepta-
- 8 = octa-

Prefixes

- 9 = nona-
- 10 = deca-
- To write the name, write two words:

Prefix & name Prefix & name -ide

Prefixes

- 9 = nona-
- 10 = deca-
- To write the name, write two words:

Prefix name Prefix name -ide

• One exception is we don't write **mono** if there is only one of the first element.

Prefixes

- 9 = nona-
- 10 = deca-
- To write the name, write two words:

Prefix name Prefix name -ide

- One exception is we don't write mono if there is only one of the first element.
- Normally, we do not have double vowels when writing names (oa oo)

Practice by naming these:

- N₂O
- NO₂
- Cl₂O₇
- CBr₄
- CO₂
- BaCl₂

- = dinitrogen monoxide (also called nitrous oxide or laughing gas)
- = nitrogen dioxide
- = dichlorine heptoxide
- = carbon tetrabromide
- = carbon dioxide

(This one will not use prefixes, since it is an ionic compound!)

Write formulas for these:

- diphosphorus pentoxide
- tetraiodine nonoxide
- sulfur hexafluoride
- nitrogen trioxide
- carbon tetrahydride
- phosphorus trifluoride
- aluminum chloride (Ionic compound)

Section 9.4 Naming and Writing Formulas for Acids and Bases

• **OBJECTIVES**:

—<u>Apply three rules</u> for naming acids.

Section 9.4 Naming and Writing Formulas for Acids and Bases

• **OBJECTIVES**:

<u>Apply the rules</u> in reverse to write formulas of acids.

Section 9.4 Naming and Writing Formulas for Acids and Bases

• **OBJECTIVES**:

—<u>Apply the rules</u> for naming bases.

Acids are...

- Compounds that give off <u>hydrogen</u> ions (H¹⁺) when dissolved in water (the Arrhenius definition)
- Will start the formula with H.
- There will always be some Hydrogen next to an anion.
- The <u>anion</u> determines the name.

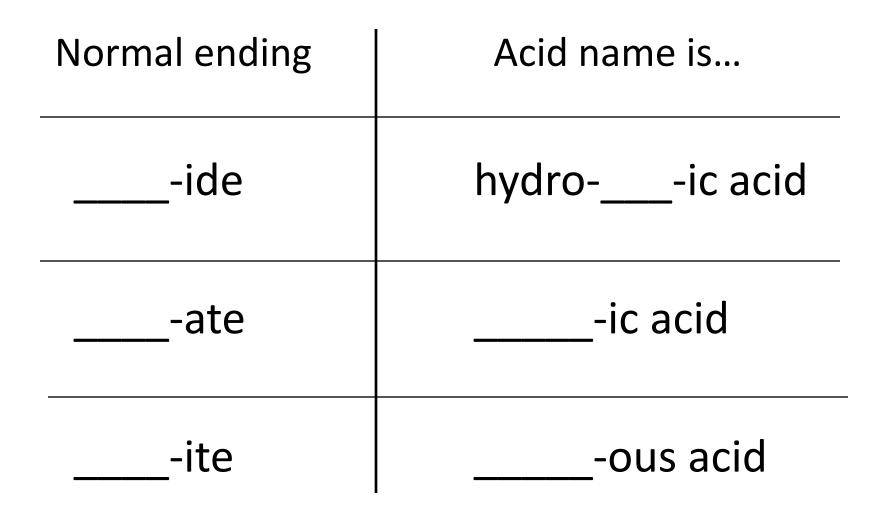
<u>Rules for Naming acids</u>: Name it as a normal compound first

- 1) If the anion attached to hydrogen ends in -ide, put the prefix hydroand change -ide to -ic acid
 - HCl hydrogen ion and chloride ion = hydrochloric acid
 - H₂S hydrogen ion and sulfide ion = hydrosulfuric acid

Naming Acids

- If the anion has oxygen in it, then it ends in -ate or -ite
- 2) change the suffix -ate to -ic acid (use no prefix)
 - Example: HNO₃ Hydrogen and nitrate ions = Nitric acid
- change the suffix -ite to -ous acid (use no prefix)
 - Example: HNO₂ Hydrogen and nitrite ions = Nitrous acid

Naming Acids



2 additional rules (not mentioned in the book)

- 4) If the acid has <u>1 more oxygen</u> than the –ic acid, add the prefix per
 - a. HClO₃ (Hydrogen Chlorate) is chloric acid
 - b. HClO₄ would be <u>per</u>chloric acid
- 5) If there is <u>1 less oxygen</u> than the -ous acid, add the prefix hypo-
 - HClO₂ (Hydrogen Chlorite) is chlorous acid, then HClO would be <u>hypo</u>chlorous acid

Practice by naming these:

- HF
- H₃P
- H_2SO_4
- H_2SO_3
- HCN
- H_2CrO_4

Writing Acid Formulas – <u>in reverse</u>! Hydrogen will be listed first

- The name will tell you the anion
- Be sure the charges cancel out.
- Starts with prefix hydro?- there is no oxygen, -ide ending for anion
- no prefix hydro?
 - 1) -ate anion comes from –ic ending
 - 2) -ite anion comes from -ous ending

Write formulas for these:

- hydroiodic acid
- acetic acid
- carbonic acid
- phosphorous acid
- hydrobromic acid

Names and Formulas for Bases

- A base is an ionic compound that produces hydroxide ions (OH¹⁻) when dissolved in water (the Arrhenius definition)
- Bases are named the same way as other ionic compounds:
 - -The name of the cation (which is a metal) is followed by the name of the anion (which will be hydroxide).

Names and Formulas for Bases

- NaOH is sodium hydroxide
- Ca(OH)₂ is calcium hydroxide
- To write the formula:
 - 1) Write the symbol for the metal cation
 - 2) followed by the formula for the hydroxide ion (OH¹⁻)
 - 3) then use the criss-cross method to balance the charges.

Practice by writing the formula for the following:

- Magnesium hydroxide
- Iron (III) hydroxide
- Zinc hydroxide

Section 9.5 The Laws Governing Formulas and Names

• **OBJECTIVES**:

<u>Define</u> the laws of definite proportions and multiple proportions.

Section 9.5 The Laws Governing Formulas and Names

• **OBJECTIVES**:

 <u>Apply the rules</u> for naming chemical compounds by using a flowchart.

Section 9.5 The Laws Governing Formulas and Names

• **OBJECTIVES**:

<u>Apply the rules</u> for writing the formulas of chemial compounds by using a flowchart.

Some Laws:

- 1. Law of Definite Proportions- in a sample of a chemical compound, the masses of the elements are always in the same proportions.
- H₂O (water) and H₂O₂ (hydrogen peroxide)

Some Laws:

• 2. Law of Multiple Proportions-Dalton stated that whenever two elements form more than one compound, the *different masses of* one element that combine with the same mass of the other element are in the ratio of small whole numbers.

SAMPLE PROBLEM 9.1

Calculating Mass Ratios - Page 275

Carbon reacts with oxygen to form two compounds. Compound A contains 2.41 g of carbon for each 3.22 g of oxygen. Compound B contains 6.71 g of carbon for each 17.9 g of oxygen. What is the lowest whole number mass ratio of carbon that combines with a given mass of oxygen?

Analyze List the knowns and the unknown.

Knowns

- Compound A = 2.41 g C and 3.22 g O
- Compound B = 6.71 g C and 17.9 g O

Unknown

 Lowest whole number ratio of carbon per gram of oxygen in the two compounds = ?

Apply the law of multiple proportions to the two compounds. For each compound, find the grams of carbon that combine with 1.00 g of oxygen by dividing the mass of carbon by the mass of oxygen. Then find the ratio of the masses of carbon in the two compounds by dividing the larger value by the smaller. Confirm that the ratio is the lowest whole number ratio.

Calculate Solve for the unknown.

• Compound A	$\frac{2.41 \text{ g C}}{3.22 \text{ g O}} = \frac{0.748 \text{ g C}}{1.00 \text{ g O}}$	
•Compound B	$\frac{6.71 \text{ gC}}{17.9 \text{ gO}} = \frac{0.375 \text{ gC}}{1.00 \text{ gO}} < \qquad \qquad$	
Compare the masses of carbon per gram of overen in the compounds		

Compare the masses of carbon per gram of oxygen in the compounds.

$$\frac{0.748 \text{ g C (in compound A)}}{0.375 \text{ g C (in compound B)}} = \frac{1.99}{1} = \text{roughly } \frac{2}{1} = 2:1$$

The mass ratio of carbon per gram of oxygen in the two compounds is 2:1.

Summary of Naming and Formula Writing

- For naming, follow the flowchart-Figure 9.20, page 277
- For writing formulas, follow the flowchart from Figure 9.22, page 278

Helpful to remember...

- 1. In an ionic compound, the net ionic charge is <u>zero</u> (criss-cross method)
- 2. An <u>-ide</u> ending generally indicates a binary compound
- 3. An <u>-ite</u> or <u>-ate</u> ending means there is a polyatomic ion that has oxygen
- 4. <u>Prefixes</u> generally mean molecular; they show the number of each atom

Helpful to remember...

- 5. A <u>Roman numeral</u> after the name of a cation is the <u>ionic charge</u> of the cation
- Use the handout sheets provided by your teacher!

