

Valence Electron and Ion Structure

The following chart displays the basic atomic structure including the valence electrons and charges for atoms and ions of representative (1A – 8A) elements

Group Number	1A 1	2A 2	1B – 10B 3 - 12	3A 13	4A 14	5A 15	6A 16	7A 17	8A 18
Valance Electrons (e ⁻)	1	2	2	3	4	5	6	7	8
Atom Type	Alkali Metals	Alkali Earth Metals	Trans. Metals	Earth Metals	Carbon Group	Picogens	Chalcogen	Halogens	Noble Gases
Ion Charge	+1	+2	Var.	+3	+4	-3	-2	-1	0
Lose e ⁻ Gain e ⁻	Lose 1	Lose 2	Var.	Lose 3	Lose 4	Gain 3	Gain 2	Gain 1	Gain 0
Ion Valence Electrons (e ⁻)	0	0	0	0	0	8	8	8	8

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Ionic Bonding Atomic Ratios

The following chart shows atomic ratios based on +X and -Y ion Charges

+X	-Y	a	b		+X	-Y	a	b
+1	-1	1	1		+2	-2	1	1
+2	-1	1	2		+4	-2	1	2
+3	-1	1	3		+6	-2	1	3
+4	-1	1	4		+6	-3	1	2
+6	-1	1	6		+3	-2	2	3
+1	-2	2	1		+2	-3	3	2
+1	-3	3	1		+4	-3	3	4

$[X_a Y_b]$ and $+X \cdot a + -Y \cdot b = 0$

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Ionic Compound Names

The following format is used for ionic compounds...

General Format

Cation (Charge) + Anion (Polyatomic Ion) –ending

Cations

Representative Metals

Trans. Metals (*Charge*)

Positive Polyatomic Ions

Anions

Representative Non-Metals (-ide)

Negative Polyatomic Ions

Standard (-ate, -ide, -ic)

Conjugated (-ite, -ous)

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Polyatomic Ion Endings

Polyatomic Ion Structures can change based on a changed ending

Common Binary Ion and Polyatomic Ion Endings

-ide ending

Binary Non-Metals

Simple Polyatomic Ions

-ium ending

Specific Polyatomic

Ions w/ + Charge

Special –ide endings

Most Polyatomic Ions

-ine → -ide

Examples

Cl¹⁻: Chloride Ion

O²⁻: Oxide Ion

OH¹⁻: Hydroxide Ion*

CN¹⁻: Cyanide Ion*

*Polyatomic Ions

NH₄¹⁺: Ammonium Ion

H₃O¹⁺: Hydronium Ion

Both lose 1e⁻ in ion form

H¹⁺: Hydride Ion

N³⁻: Nitride Ion

P³⁻: Phosphide Ion

O²⁻: Oxide Ion

S²⁻: Sulfide Ion

Se²⁻: Selenide Ion

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Polyatomic Ion Endings

Polyatomic Ion Structures can change based on a changed ending

Common Binary Ion and Polyatomic Ion Endings

-ate ending

Standard Polyatomic Ions (*Base Form*)

Examples

ClO_3^{1-} : Chlorate Ion

NO_3^{1-} : Nitrate Ion

SO_4^{2-} : Sulfate Ion

PO_4^{2-} : Phosphate Ion

CrO_4^{2-} : Chromate Ion

$\text{Cr}_2\text{O}_7^{2-}$: Dichromate Ion

$\text{C}_2\text{O}_4^{2-}$: Oxalate Ion

CO_3^{2-} : Carbonate Ion

per__-ate ending

Polyatomic Ion with and extra oxygen (+1 O)

ClO_4^{1-} : Perchlorate Ion

BrO_4^{1-} : Perbromate Ion

MnO_4^{1-} : Manganate Ion

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Polyatomic Ion Endings

Polyatomic Ion Structures can change based on a changed ending

Common Binary Ion and Polyatomic Ion Endings

-ite ending

Polyatomic Ion with one fewer oxygen (-1 oxygen)

Examples

ClO_2^{1-} : Chlorite Ion

NO_2^{1-} : Nitrite Ion

SO_3^{2-} : Sulfite Ion

PO_3^{2-} : Phosphite Ion

CrO_3^{2-} : Chromite Ion

CO_3^{2-} : Carbonite Ion

hypo__-ite ending

Polyatomic Ion with two fewer oxygens (-2 oxy)

ClO^{1-} : Hypochlorite Ion

NO^{1-} : Hyponitrite Ion

CO^{2-} : Hypocarbonite Ion

SO^{2-} : Hyposulfite Ion

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Polyatomic Ion Chart

The following is a list of common polyatomic ions

Polyatomic Ion	Ion Formula	Polyatomic Ion	Ion Formula	Polyatomic Ion	Ion Formula
Ammonium	NH_4^{1+}	Hydronium	H_3O^{1+}	Carbonate	CO_3^{2-}
Nitrate	NO_3^{1-}	Cyanide	CN^{1-}	Sulfate	SO_4^{2-}
Fluorate	FO_3^{1-}	Hydroxide	OH^{1-}	Chromate	CrO_4^{2-}
Chlorate	ClO_3^{1-}	Acetate	$\text{C}_2\text{H}_3\text{O}_2^{1-}$	Dichromate	$\text{Cr}_2\text{O}_7^{2-}$
Bromate	BrO_3^{1-}	Permanganate	MnO_4^{1-}	Oxalate	$\text{C}_2\text{O}_4^{2-}$
Iodate	IO_3^{1-}	Bicarbonate	HCO_3^{1-}	Phosphate	PO_4^{3-}

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Polyatomic Ion Conjugations

Some polyatomic ions can be changed by change number of oxygens

-ate (Base)	Ion Formula	-ite (-1 oxy)	Ion Formula	per__ite (+1 oxy)	Ion Formula
Chlorate	ClO_3^{1-}	Chlorite	ClO_2^{1-}	Perchlorate	ClO_4^{1-}
Bromate	BrO_3^{1-}	Bromite	BrO_2^{1-}	Perbromate	BrO_4^{1-}
Nitrate	NO_3^{1-}	Nitrite	NO_2^{1-}		
Carbonate	CO_3^{2-}	Carbonite	CO_2^{2-}	Hypo__ite	(-2 oxy)
Sulfate	SO_4^{2-}	Sulfite	SO_3^{2-}	Hypochlorite	ClO^{1-}
Phosphate	PO_4^{3-}	Phosphite	PO_3^{3-}	Hypocarbonite	CO^{2-}

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