

CATIONS

- 1) When a metal forms only one common cation (positively charged ion), then that ion takes the name of the element. Example: the ion Na^+ is simply called the sodium ion. The charge on such an ion is specified in its formula, but not in its name. The charge is sometimes inferred from the position of the element in the periodic table, otherwise it must be memorized.

Each family of active metals forms only one characteristic stable cation in solution:

M^+ a +1 ion, for the alkali metals: Li^+ , Na^+ , K^+ , Rb^+ , Cs^+ (and for H^+) (Group 1 or IA)

M^{2+} a +2 ion, for the alkaline earth metals: Be^{2+} , Mg^{2+} , Ca^{2+} , Sr^{2+} , Ba^{2+} (Group 2 or IIA)

- 2) A number of other metals form only one cation, or one common cation in aqueous solution. Some important common cations of this type that you must **memorize** are the following:

Al^{3+}	Ni^{2+}	Zn^{2+}	Cd^{2+}	Ag^+	Pb^{2+}
aluminum	nickel	zinc	cadmium	silver	lead

- 3) Many transition metals form more than one cation. When there are two common monatomic cations, the older system of nomenclature is to name the cation having the lesser charge with the suffix *-ous* and the cation having the greater charge with the suffix *-ic*. These endings are added to the root of the element name (some atomic symbols derive from Latin names).

Example: The element iron has the atomic symbol Fe (from the Latin name for iron, *ferrum*), and iron forms two common cations, Fe^{2+} , called ferrous ion, and Fe^{3+} , called ferric ion. This older nomenclature requires that you know the actual charges on the common ions.

The internationally accepted modern system of inorganic nomenclature is easier because it specifies the charge (or oxidation state) of each cation explicitly. The cation is named using the name of the metal followed in parentheses by a Roman numeral indicating the magnitude of the positive charge. You must of course learn the modern naming system, but you must be familiar with the old system of nomenclature as well, since those names are still widely used.

- 4) The names and the charges of the following common cations should be **memorized**:

Cr^{2+}	chromous or chromium(II) ion	Cr^{3+}	chromic or chromium(III) ion
Mn^{2+}	manganous or manganese(II) ion	Mn^{3+}	manganic or manganese(III) ion
Fe^{2+}	ferrous or iron(II) ion	Fe^{3+}	ferric or iron(III) ion
Co^{2+}	cobaltous or cobalt(II) ion	Co^{3+}	cobaltic or cobalt(III) ion
Cu^+	cuprous or copper(I) ion	Cu^{2+}	cupric or copper(II) ion
Sn^{2+}	stannous or tin(II) ion	Sn^{4+}	stannic or tin(IV) ion
Hg_2^{2+}	mercurous or mercury(I) ion	Hg^{2+}	mercuric or mercury(II) ion

- 5) **Memorize** the names, formulas, and charges of three important common polyatomic cations:

Hg_2^{2+}	mercurous ion	The <i>diatomic</i> mercurous ion contains mercury(I), not mercury(II).
NH_4^+	ammonium ion	The ammonium ion is chemically similar to the alkali metal cations.
H_3O^+	hydronium ion	Hydronium ion is very often written simply H^+ for short, because $\text{H}_3\text{O}^+ = \text{H}^+ + \text{H}_2\text{O}$ (a proton bound to water, which is understood). Note: The ion written as H^+ is called the hydrogen ion or proton.

ANIONS

- 1) Monatomic anions are named by dropping the ending of the element's name and adding the suffix *-ide* to the root. (Note all the periodic regularities.) Memorize the following common examples:

F^-	fluoride	Cl^-	chloride	Br^-	bromide	I^-	iodide
O^{2-}	oxide	S^{2-}	sulfide	Se^{2-}	selenide	Te^{2-}	telluride
N^{3-}	nitride	P^{3-}	phosphide			H^-	hydride

- 2) Most polyatomic anions containing oxygen (oxyanions) have names that end in *-ite* or *-ate*. If there is only a single oxyanion for an element, the anion name ends in *-ate*. If there are two oxyanions for a particular element, the name of the one with less oxygen ends in *-ite*, and the name of the one with more oxygen ends in *-ate*. When there are more than two oxyanions for a particular element, the prefix *hypo-* may be used to designate the anion containing the fewest oxygen atoms (that is, the anion with the central element in the lowest oxidation state), and the prefix *per-* may be used to designate the anion containing the most oxygen atoms (the anion with the central element in the highest oxidation state).

Example: hypochlorite, ClO^- ; chlorite, ClO_2^- ; chlorate, ClO_3^- ; perchlorate, ClO_4^- .

- 3) **Memorize** the names, formulas, and charges of the following important common oxyanions:

CO_3^{2-}	carbonate	NO_2^-	nitrite	NO_3^-	nitrate	IO_3^-	iodate
SO_3^{2-}	sulfite	SO_4^{2-}	sulfate	ClO_3^-	chlorate	ClO_4^-	perchlorate
PO_4^{3-}	phosphate	BrO_3^-	bromate	CrO_4^{2-}	chromate	MnO_4^-	permanganate

- 4) Many doubly or triply charged anions readily combine with one or more H^+ to form anions of lower charge. These ions are named by prefixing the word *hydrogen* to the name of the anion, or, in the older nomenclature, by adding the prefix *bi-*. A few common examples are:

HCO_3^-	hydrogen carbonate or bicarbonate	HS^-	hydrosulfide or bisulfide
HSO_3^-	hydrogen sulfite or bisulfite	HSO_4^-	hydrogen sulfate or bisulfate
HPO_4^{2-}	hydrogen phosphate	$H_2PO_4^-$	dihydrogen phosphate

- 5) You will encounter other common polyatomic anions. **Memorize** those on the first two lines:

OH^-	hydroxide	$Cr_2O_7^{2-}$	dichromate	CN^-	cyanide	CH_3COO^-	acetate
I_3^-	triiodide	OCN^-	cyanate	O_2^{2-}	peroxide	AsO_4^{3-}	arsenate
C_2^{2-}	carbide	S_2^{2-}	disulfide	N_3^-	azide	IO_4^-	periodate
$C_2O_4^{2-}$	oxalate	$P_2O_7^{4-}$	pyrophosphate	PF_6^-	hexafluorophosphate		
BH_4^-	borohydride or tetrahydridoborate	BF_4^-	tetrafluoroborate				

- 6) A sulfur atom (S, in Group 16 or VIA) sometimes replaces an oxygen atom (O, in Group 16 or VIA also, just above S) in an ion or a molecule. When an anion is derived in this way, the name of the ion takes the prefix *thio-*. Two common examples that you should know are:

SCN^-	thiocyanate	Compare with OCN^- , cyanate
$S_2O_3^{2-}$	thiosulfate	Compare with SO_4^{2-} , sulfate

The thiosulfate ion, $S_2O_3^{2-}$, is most often used in the quantitative analysis of I_2 or I_3^- , with which it reacts to yield the tetrathionate ion, $S_4O_6^{2-}$, and iodide ion, I^- .