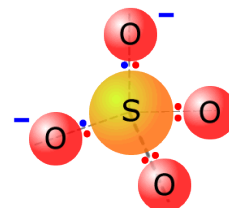


Ion Reference

Pre-AP Chemistry



- **Ion:** An atom or group of atoms that has a charge (+ or -)
- **Charge:** atoms develop a charge when electrons are lost or gained. Present in ionic substances.
- **Oxidation number:** atoms take on an oxidation number when electrons are shared unequally in covalent/molecular substances. In an ionic substance, charge = oxidation number.
- **Monatomic ion:** An ion made from a single atom (example: Na^+ , sodium ion)
- **Polyatomic ion:** An ion made from more than one atom (example: NO_3^- , nitrate ion)

Common Polyatomic Ions

~to be memorized~

Ions with 1+ charge		Ions with 1- charge		Ions with 2- charge		Ions with 3- charge	
Symbol	Name	Symbol	Name	Symbol	Name	Symbol	Name
NH_4^+	ammonium	$\text{C}_2\text{H}_3\text{O}_2^-$	acetate	CO_3^{2-}	carbonate	PO_3^{3-}	phosphite
H_3O^+	hydronium	ClO^-	hypochlorite	CrO_4^{2-}	chromate	PO_4^{3-}	phosphate
		ClO_2^-	chlorite	$\text{Cr}_2\text{O}_7^{2-}$	dichromate		
		ClO_3^-	chlorate	HPO_4^{2-}	hydrogen phosphate		
		ClO_4^-	perchlorate	O_2^{2-}	peroxide		
		CN^-	cyanide	SO_3^{2-}	sulfite		
		HCO_3^-	hydrogen carbonate (bicarbonate)	SO_4^{2-}	sulfate		
		HSO_4^-	hydrogen sulfate (bisulfate)				
		HSO_3^-	hydrogen sulfite (bisulfite)				
		H_2PO_4^-	dihydrogen phosphate (biphosphate)				
		MnO_4^-	permanganate				
		NO_2^-	nitrite				
		NO_3^-	nitrate				
		OH^-	hydroxide				

Other Polyatomic Ions

~for reference only; not to be memorized~

Symbol	Name	Symbol	Name	Symbol	Name
FO_3^-	fluorate	SiF_6^{2-}	hexafluorosilicate	AsO_4^{3-}	arsenate
BrO_3^-	bromate	TeO_4^{2-}	tellurate	$\text{C}_6\text{H}_5\text{O}_7^{3-}$	citrate
N_3^-	azide	$\text{S}_2\text{O}_3^{2-}$	thiosulfate	BO_3^{3-}	borate
SCN^-	thiocyanate	$\text{Si}_2\text{O}_3^{2-}$	silicate		
IO_3^-	iodate	$\text{C}_2\text{O}_4^{2-}$	oxalate		
OCN^-	cyanate	SeO_4^{2-}	selenate		
		$\text{C}_4\text{H}_4\text{O}_6^{2-}$	tartarate		
		MoO_4^{2-}	molybdate		

Monovalent Monatomic Ions

- **Monovalent:** Describes ion having only one possible charge (oxidation #)

1+																	0
* 1 H	2+											3+		3-	2-	1-	2 He
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn 2+	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag 1+	48 Cd 2+	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba	71 Lu	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
87 Fr	88 Ra	103 Lr	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Nh	114 Fl	115 Mc	116 Lv	117 Ts	118 Og

- Elements (**unshaded**) in groups (columns) of the Periodic Table labeled: 1+, 2+, 3+, 3-, 2-, 1- and 0) above always* take on the charge indicated above the column when they become ions. **Memorize** this pattern!
 - **Examples:** Calcium ions (Ca^{2+}) have a 2+ charge; fluoride ions (F^-) (from fluorine) have a 1- charge.
 - ***Exception:** Hydrogen can also form a 1- ion (less common than 1+). **In this case, H^- is called the hydride ion.**
- **Memorize** these monovalent ions not in one of the above columns: **Silver: Ag^+ Zinc: Zn^{2+} Cadmium: Cd^{2+}**

Memorize Everything Above This Line

Multivalent Monoatomic Ions

- **Multivalent:** Describes a monatomic ion having more than one possible charge (oxidation #)
- With the exception of Zn, Cd and Ag, other metals not found in one of the above labeled columns of the Periodic Table can be assumed to have **variable** charge. This means that the charge for these ions is not always the same; they are **multivalent**. Roman numerals are used to indicate the charge in the written chemical name of the ion.
- For example: copper: can be 1+ (Cu^+ , copper (I) ion) **or** 2+ (Cu^{2+} , copper (II) ion).
- Group 14 elements can form multivalent cations (positive ions) and/or anions (negative ions).

More examples of common multivalent ions:

- Iron: Fe^{2+} , iron (II) and Fe^{3+} , iron (III)
- Lead: Pb^{2+} lead (II) and Pb^{4+} , lead (IV)
- Tin: Sn^{2+} tin (II) and Sn^{4+} , tin (IV)

A special note about mercury ions:

Mercury can be: Hg^{2+} , (mercury (II) ion) **or** a polyatomic ion (see list at front), Hg_2^{2+} , (mercury (I) ion)

Note: The charge (oxidation #) on a multivalent ion found in a chemical formula, such as CuCl_2 , can be determined quickly and easily. Your teacher will instruct you on determination of charge for these metals in the Chemical Nomenclature unit.