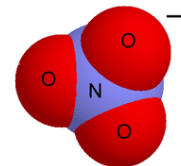


Ion Reference

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_4^-	perchlorate	CrO_4^{2-}	chromate	PO_4^{3-}	phosphate
		ClO_3^-	chlorate	$\text{Cr}_2\text{O}_7^{2-}$	dichromate		
		ClO_2^-	chlorite	HPO_4^{2-}	hydrogen phosphate		
		ClO^-	hypochlorite	O_2^{2-}	peroxide		
		Ion with 2+ charge	CN^-	cyanide	SO_3^{2-}	sulfite	
Hg_2^{2+}	mercury (I)	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_3^-	nitrate				
		NO_2^-	nitrite				
		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 #)
- **Multivalent:** Describes a monatomic ion having more than one possible charge (oxidation #)

1+												3+					0
1 H																	2 He
	2+																
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	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	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba	57 La	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	89 Ac	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn		114 Fl		116 Lv		

- Elements in columns of the Periodic Table labeled above always* take on the indicated charge when they become ions. **Memorize** this pattern!
 - **Examples:** Calcium ions have a 2+ charge; fluoride ions (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.
- Group 14 elements form multivalent cations and anions.
- **Memorize** these monovalent ions not in one of the above columns: **Zinc: Zn²⁺** **Silver: Ag⁺** **Cadmium: Cd²⁺**
- **Memorize the mercury ions:** Mercury: Hg₂²⁺ (mercury I) and Hg²⁺ (mercury II)

Memorize Everything Above This Line

Multivalent Monatomic Ions

With the exception of the above 3 metals, 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.

- **Example:** Copper can be 1+ (Cu⁺, copper (I) ion) **or** 2+ (Cu²⁺, copper (II) ion).

The charge on a multivalent ion found in a chemical formula, such as CuCl₂, can be determined quickly and easily. Your teacher will instruct you on determination of charge for these metals in the Chemical Nomenclature unit.

More examples of common multivalent ions:

- Iron: Fe²⁺ (iron II) and Fe³⁺ (iron III)
- Lead: Pb²⁺ (lead II) and Pb⁴⁺ (lead IV)
- Tin: Sn²⁺ (tin II) and Sn⁴⁺ (tin IV)
- Chromium: Cr²⁺ (chromium II) and Cr³⁺ (chromium III)