

Students often have questions dealing with naming the polyatomic ions and ionic compounds. Often most questions deal with the polyatomic oxyanions. This is mostly memorization. Writing each one several times will help.

You need to memorize the following:

$\text{MnO}_4^-$	permanganate
$\text{CrO}_4^{2-}$	chromate
$\text{Cr}_2\text{O}_7^{2-}$	dichromate
$\text{OH}^-$	hydroxide
$\text{CN}^-$	cyanide
$\text{C}_2\text{H}_3\text{O}_2^-$	acetate (sometimes written as $\text{CH}_3\text{CO}_2^-$ )
$\text{NH}_4^+$	ammonium

You also need to memorize the following 5 polyatomic oxyanions ending in "-ate". The following oxyanions are used with some rules to get the names of many other polyatomic oxyanions. You need to know how to do this. You will have to know how to name many polyatomic oxyanions not listed in the table in chapter 4. You can only do this by knowing the "base" ions below (ending in -ate) and then how to change the names based on the # of O atoms, H atoms ( $\text{H}^+$ ) added to these and the acids derived from these ions.

$\text{CO}_3^{2-}$	carbonate
$\text{ClO}_3^-$	chlorate (applies to other group 7A elements, Br & I)
$\text{NO}_3^-$	nitrate
$\text{PO}_4^{3-}$	phosphate (applies to other group 5A elements, As, arsenic; ** note that $\text{NO}_3^-$ is different than this even though N is also in group 5A. You can't get 4 O atoms around N, it's too small.)
$\text{SO}_4^{2-}$	sulfate (applies to other group 6A elements, Se & Te)

If you do the following the suffix or prefix changes:

add 1 O atom to -ate	=>	per - ate
remove 1 O from -ate	=>	-ite
remove 1 O from -ite	=>	hypo - ite

For example:

$\text{ClO}_4^-$	perchlorate
$\text{ClO}_3^-$	chlorate
$\text{ClO}_2^-$	chlorite
$\text{ClO}^-$	hypochlorite

Most of the above -ates don't form all of these. Only group 7A elements (Cl, Br, I) form all of these types of polyatomic anions (except F).

You also need to know how to change the name of the polyatomic anions when  $\text{H}^+$  ions are added to form other ions or the related acids.

$\text{CO}_3^{2-}$ carbonate	$\text{PO}_4^{3-}$ phosphate	$\text{SO}_4^{2-}$
+	+	+
$\text{H}^+$	$\text{H}^+$	$\text{H}^+$
⇓	⇓	⇓
$\text{HCO}_3^-$ bicarbonate or hydrogen carbonate	$\text{HPO}_4^{2-}$ monohydrogen phosphate	$\text{HSO}_4^-$ bisulfate or hydrogen sulfate
+	+	+
$\text{H}^+$	$\text{H}^+$	$\text{H}^+$
⇓	⇓	⇓
$\text{H}_2\text{CO}_3$ carbonic acid	$\text{H}_2\text{PO}_4^-$ dihydrogen phosphate	$\text{H}_2\text{SO}_4$ sulfuric acid
	+	
	$\text{H}^+$	
	⇓	
	$\text{H}_3\text{PO}_4$ phosphoric acid	

Note it takes 2 H<sup>+</sup> to "neutralize" the CO<sub>3</sub><sup>2-</sup> and SO<sub>4</sub><sup>2-</sup> and "make" the acid. The "-ate" ions become "-ic acids" and the "-ite" ions become "-ous acids" (SO<sub>3</sub><sup>2-</sup>, sulfite; HSO<sub>3</sub><sup>-</sup>, bisulfite; H<sub>2</sub>SO<sub>3</sub>, sulfurous acid). The bicarbonate is "bi" ( HCO<sub>3</sub><sup>-</sup> ) because it is half-way to the acid form (H<sub>2</sub>CO<sub>3</sub>). The same for bisulfate and bisulfite.

Note that HPO<sub>4</sub><sup>2-</sup> is monohydrogen phosphage NOT biphosphate. I've seen biphosphate used before but it is not correct and shouldn't be used. You should use the "mono" in "monohydrogen" because there is also a dihydrogen phosphate. However, you will probably most often see it w/o the "mono" so that's fine.

Note it takes 3 H<sup>+</sup> to "neutralize" the PO<sub>4</sub><sup>3-</sup> and "make" the acid. Since this ion is phosphate, the name of the acid, H<sub>3</sub>PO<sub>4</sub>, is phosphoric acid.

Using the above rules you should be able to name things that aren't covered in the book. If you see AsO<sub>4</sub><sup>3-</sup> you should know this is arsenate. You find As in group 5A under P. You know phosphorus is in group 5A and that As behaves like P and will form polyatomic oxyanions similar to those formed by P (not like N as in NO<sub>3</sub><sup>-</sup> ).

You also have to know how to use the Stock system for naming metals that can form more than one cation (Fe<sup>3+</sup>, Fe<sup>2+</sup>, Sn<sup>2+</sup>, Sn<sup>4+</sup>, etc.). This is actually most metals. The only ones you don't need the Stock system for is group 1A (always +1), group 2A (always +2), Al<sup>3+</sup>, Zn<sup>2+</sup> & Ag<sup>+</sup> (always these charges). You should be able to determine the charges on the cations from the formulas. This will require a little bit of calculation as shown below.

$$\begin{array}{c} \text{Fe} \quad \text{Cl} \\ \text{FeCl}_3: x + 3(-1) = 0 \end{array}$$

$$x = +3$$

iron (III) chloride

$$\begin{array}{c} \text{Fe} \quad \text{Cl} \\ \text{FeCl}_2: x + 2(-1) = 0 \end{array}$$

$$x = +2$$

iron (II) chloride