Nomenclature

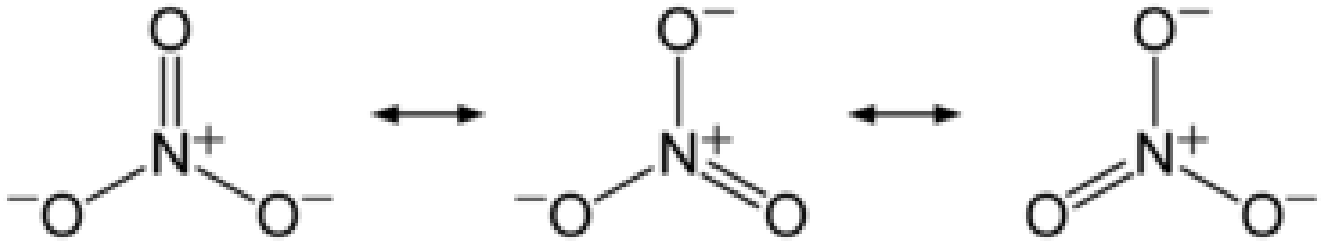
A systematic method of writing chemical formulas and naming compounds

III. Polyatomic Ionic nomenclature

- Polyatomic ions are groups of atoms covalently bonded together, that act as a single ion
- Think of them as lego blocks that have been glued together
- Each have a name and charge that must be memorized

Polyatomic ion examples…

- Nitrate: NO_3^{1-}



- bicarbonate: HCO_3^{1-}

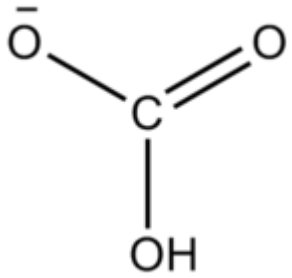
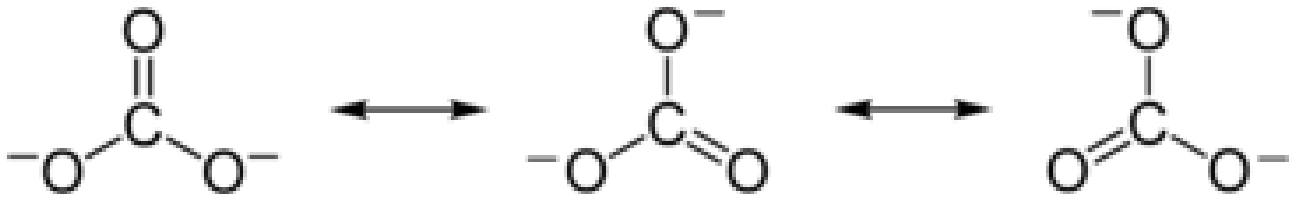


Image source: wikipedia

Polyatomic ion examples…

- carbonate: CO_3^{2-}



- acetate: $C_2H_3O_2^{1-}$ or CH_3COO^-

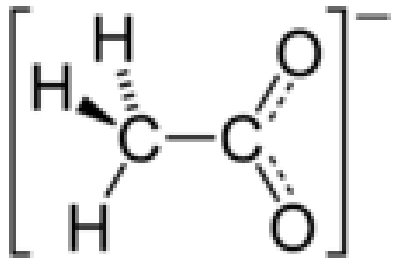


Image source: wikipedia

	(1+)	
	Ammonium	NH_4^+
	(1–)	
	cyanide	CN^-
	hydroxide	OH^-
	cyanide	CN-
	nitrate	NO_3^-
	chlorate	ClO_3^-
	hydrogen carbonate	HCO_3^-
	a.k.a. "bicarbonate"	
	acetate	$C_2H_3O_2^-$

	(2–)	
	sulfate	SO_4^{2-}
	sulfite	SO_3^{2-}
	carbonate	CO_3^{2-}
	(3–)	
	phosphate	PO_4^{3-}

These polyatomic ions must be memorized

	(1–)	
	permanganate	MnO_4^{1-}
	(2–)	
	chromate	CrO_4^{2-}
	dichromate	$Cr_2O_7^{2-}$

These polyatomic ions may be used on worksheets but need not be memorized

III. Polyatomic Ionic nomenclature

- What type of bonding exists in polyatomic ionic compounds?
- **both** ionic *and* covalent!
- The polyatomic ion itself is held together by *covalent bonds*
- The individual cations and anions are held together by *ionic bonds*

a) Writing names

- Same as before:
- Write the name of the cation
- Write the name of the anion
- Simply write the polyatomic ion’s name as it is, without any changes
- Still only two words in the name

$NaNO_3$

- More than two capital letters, so there must be at least one polyatomic ion in the formula
- Na is sodium, so…
- The entire "NO_3 part" must have a one word name:
- Nitrate is NO_3^-
- sodium nitrate

$Al_2(SO_4)_3$

- More than two capital letters, so there must be at least one polyatomic ion in the formula
- Al is aluminum, so…
- The entire SO_4 part must have a one word name:
- Sulfate (SO_4^{2-})
- aluminum sulfate

$(NH_4)_3PO_4$

- Obviously more than two elements
- Look for polyatomic ions
  - the "NH_4" part is ammonium (NH_4^+)
  - the "PO_4" part is phosphate (PO_4^{3-})
- Ammonium phosphate

b) Writing formulas

- Follow the same rules as the other ionic compounds
- Iron(II) sulfate is

➢ $Fe^{2+}SO_4^{2-}$

➢ Charges balance, so formula is $FeSO_4$

b) Writing formulas

- Iron(III) sulfate is
- $Fe^{3+}\ SO_4^{2-}$
- Criss cross to balance charges
- But: we don't want Fe_2SO_{43}
  - There aren't 43 oxygens!
- ***Use parentheses around polyatomic ion***
- $Fe_2\ (SO_4)_3$

Write the formula for:

- Chromium(III) carbonate
- Cr^{3+} CO_3^{2-}
- Crisscross to balance charges
- $Cr_2(CO_3)_3$

Write the formula for:

- Magnesium hydroxide
- Mg^{2+} OH^{-}
- Crisscross to balance charges
- $Mg(OH)_2$
- *you need parentheses around the hydroxide because it is a polyatomic ion, even though it has no subscripts of it's own.*

Now – the trickiest ones

- Name the formula
- $FeSO_4$
- Iron(IV) sulfate?
- No – the subscript 4 is not from balancing charges!
- So, how do you know?
- Look for subscripts from balancing charges to “uncrisscross”

$FeSO_4$

- If the 4 were from balancing charges, the formula would have parentheses around the SO – $Fe(SO)_4$
- There is no subscript on the Fe – or on the SO_4 – from balancing charges
- So, the charges are balanced
- Use the "SO_4" part to determine the charge on the iron – sulfate has a 2- charge
- Iron(II) sulfate

Try these…

$CoCO_3$

- cobalt(II) carbonate

$Co_2(CO_3)_3$

- cobalt(III) carbonate

$Fe(OH)_2$

- iron(II) hydroxide

$Fe(OH)_3$

- iron(III) hydroxide

$CuNO_3$

- copper(I) nitrate

$Cu(NO_3)_2$

- copper(II) nitrate

Cu_3PO_4

- copper(I) phosphate

$Cu_3(PO_4)_2$

- copper(II) phosphate

Must be memorized…

- Ag^{+}, Zn^{2+}, no roman numeral when naming
- Sn, Pb get roman numerals when naming
- Cr, Mn, Sn, Pb – the total negative charge must be determined to get the positive charge
  - Cannot “uncrisscross” these