

# **Naming Inorganic Compounds**

**common names**

**systematic names**

Molecular  
Formula

Common  
name

Systematic  
name

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**AgCl**

**Lunar caustic**

**Silver chloride**

**H<sub>2</sub>SO<sub>4</sub>**

**Oil of vitriol**

**Sulfuric acid**

**MgSO<sub>4</sub>**

**Epsom salts**

**Magnesium sulfate**

# Nonenclature

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**When naming chemical compounds we distinguish between**

## **Organic compounds**

**- compounds containing carbon.**

**Exceptions: CO, CO<sub>2</sub>, CS<sub>2</sub>, CN<sup>-</sup>, CO<sub>3</sub><sup>2-</sup>, HCO<sub>3</sub><sup>-</sup>, H<sub>2</sub>CO<sub>3</sub>**

## **Inorganic compounds**

**- all other compounds**

**we can break the naming of inorganic compounds into four categories:**

**Ionic compounds**

**Molecular compounds**

**Acids and Bases**

**Hydrates**

Binary compounds contain two different elements

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**Examples: NaCl, FeBr<sub>3</sub>, Al<sub>2</sub>O<sub>3</sub>, N<sub>2</sub>O<sub>5</sub>, P<sub>4</sub>O<sub>10</sub>**

**Instead of concerning ourselves with whether the compound is ionic or molecular, let's reintroduce the idea of **electronegativity**.**

# Electronegativity

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**measure of an elements ability to attract electrons toward itself when bonded to another element**

**An electronegative element attracts electrons.**

**An electropositive element releases electrons.**

decreasing  
electronegativity

Increasing electronegativity



Group	1	2		3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	1A	2A		3B	4B	5B	6B	7B		8B		1B	2B	3A	4A	5A	6A	7A	8A
Period																			
1	1 <a href="#">H</a>																		2 <a href="#">He</a>
2	3 <a href="#">Li</a>	4 <a href="#">Be</a>												5 <a href="#">B</a>	6 <a href="#">C</a>	7 <a href="#">N</a>	8 <a href="#">O</a>	9 <a href="#">F</a>	10 <a href="#">Ne</a>
3	11 <a href="#">Na</a>	12 <a href="#">Mg</a>												13 <a href="#">Al</a>	14 <a href="#">Si</a>	15 <a href="#">P</a>	16 <a href="#">S</a>	17 <a href="#">Cl</a>	18 <a href="#">Ar</a>
4	19 <a href="#">K</a>	20 <a href="#">Ca</a>		21 <a href="#">Sc</a>	22 <a href="#">Ti</a>	23 <a href="#">V</a>	24 <a href="#">Cr</a>	25 <a href="#">Mn</a>	26 <a href="#">Fe</a>	27 <a href="#">Co</a>	28 <a href="#">Ni</a>	29 <a href="#">Cu</a>	30 <a href="#">Zn</a>	31 <a href="#">Ga</a>	32 <a href="#">Ge</a>	33 <a href="#">As</a>	34 <a href="#">Se</a>	35 <a href="#">Br</a>	36 <a href="#">Kr</a>
5	37 <a href="#">Rb</a>	38 <a href="#">Sr</a>		39 <a href="#">Y</a>	40 <a href="#">Zr</a>	41 <a href="#">Nb</a>	42 <a href="#">Mo</a>	43 <a href="#">Tc</a>	44 <a href="#">Ru</a>	45 <a href="#">Rh</a>	46 <a href="#">Pd</a>	47 <a href="#">Ag</a>	48 <a href="#">Cd</a>	49 <a href="#">In</a>	50 <a href="#">Sn</a>	51 <a href="#">Sb</a>	52 <a href="#">Te</a>	53 <a href="#">I</a>	54 <a href="#">Xe</a>
6	55 <a href="#">Cs</a>	56 <a href="#">Ba</a>	*	71 <a href="#">Lu</a>	72 <a href="#">Hf</a>	73 <a href="#">Ta</a>	74 <a href="#">W</a>	75 <a href="#">Re</a>	76 <a href="#">Os</a>	77 <a href="#">Ir</a>	78 <a href="#">Pt</a>	79 <a href="#">Au</a>	80 <a href="#">Hg</a>	81 <a href="#">Tl</a>	82 <a href="#">Pb</a>	83 <a href="#">Bi</a>	84 <a href="#">Po</a>	85 <a href="#">At</a>	86 <a href="#">Rn</a>
7	87 <a href="#">Fr</a>	88 <a href="#">Ra</a>	**	103 <a href="#">Lr</a>	104 <a href="#">Rf</a>	105 <a href="#">Db</a>	106 <a href="#">Sg</a>	107 <a href="#">Bh</a>	108 <a href="#">Hs</a>	109 <a href="#">Mt</a>	110 <a href="#">Uun</a>	111 <a href="#">Uuu</a>	112 <a href="#">Uub</a>	113 <a href="#">Uut</a>	114 <a href="#">Uuq</a>	115 <a href="#">Uup</a>	116 <a href="#">Uuh</a>	117 <a href="#">Uus</a>	118 <a href="#">Uuo</a>
<b>lanthanides</b>			*	57 <a href="#">La</a>	58 <a href="#">Ce</a>	59 <a href="#">Pr</a>	60 <a href="#">Nd</a>	61 <a href="#">Pm</a>	62 <a href="#">Sm</a>	63 <a href="#">Eu</a>	64 <a href="#">Gd</a>	65 <a href="#">Tb</a>	66 <a href="#">Dy</a>	67 <a href="#">Ho</a>	68 <a href="#">Er</a>	69 <a href="#">Tm</a>	70 <a href="#">Yb</a>		
<b>actinides</b>			**	89 <a href="#">Ac</a>	90 <a href="#">Th</a>	91 <a href="#">Pa</a>	92 <a href="#">U</a>	93 <a href="#">Np</a>	94 <a href="#">Pu</a>	95 <a href="#">Am</a>	96 <a href="#">Cm</a>	97 <a href="#">Bk</a>	98 <a href="#">Cf</a>	99 <a href="#">Es</a>	100 <a href="#">Fm</a>	101 <a href="#">Md</a>	102 <a href="#">No</a>		

# **Naming Ionic Compounds**

# Naming binary compounds

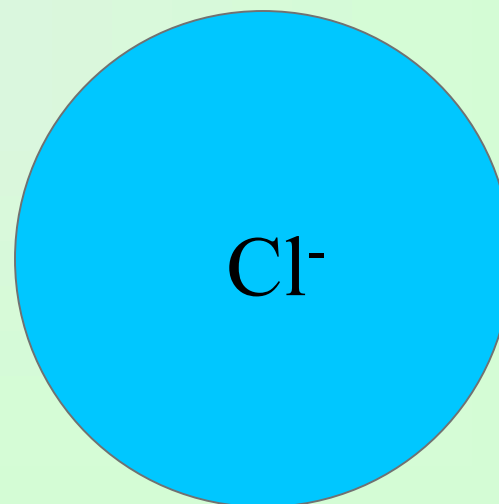
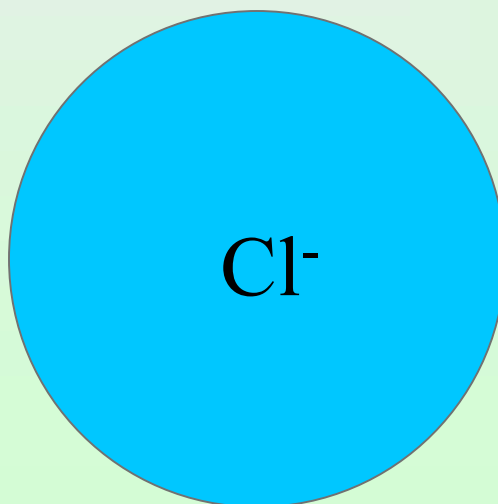
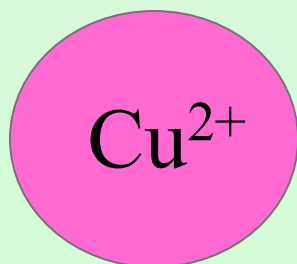
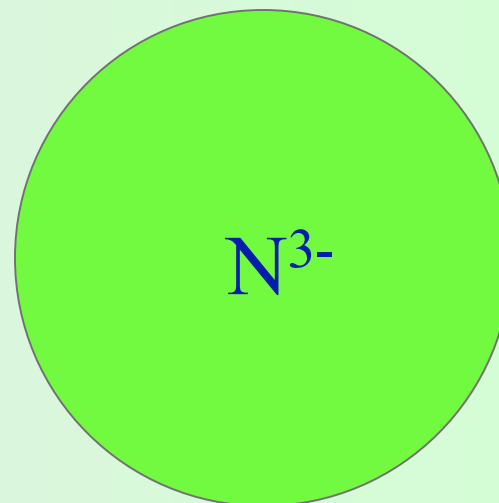
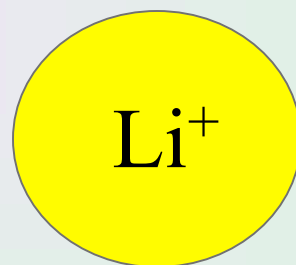
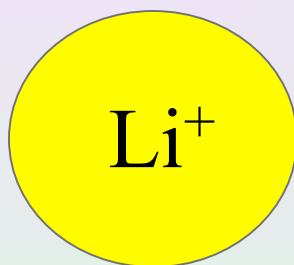
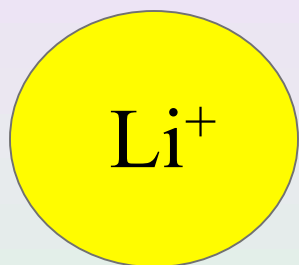
**binary compounds contain two elements**

**and are named as two words**

**first word is name of more **electropositive** element**

**second word is first part of name of more **electronegative** element followed by **-ide****

In an ionic compound number of positive charges must equal number of negative charges



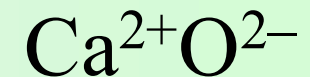
# Examples of binary compounds of metals

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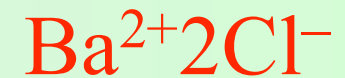
sodium bromide:



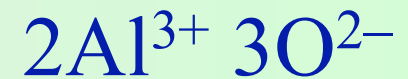
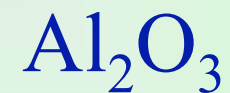
calcium oxide:



barium chloride:



aluminum oxide:



number of positive charges must equal number of negative charges

# Common Monatomic Cations

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**+1: H**

**+1: Li, Na, K, Cs**

**+2: Mg, Ca, Ba**

**+3: Al**

# Common Monatomic Anions

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**-1: F, Cl, Br, I**

**-2: O, S**

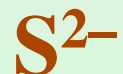
**-3: N, P**

## Example

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**Write the formulas for the following compounds:**

**(a) potassium sulfide**



**Answer:  $\text{K}_2\text{S}$**

## Example

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**Write the formulas for the following compounds:**

**(b) barium oxide**



**Answer: BaO**

## Example

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**Write the formulas for the following compounds:**

**(c) Aluminum chloride**



**Answer:  $\text{AlCl}_3$**

# Example

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**But some metals can form more than one type of cation**

**Often, but not always, a transition metal**

## Binary compounds of metals (cont'd)

**When metal can form more than one type of cation, indicate charge by Roman numeral in parenthesis**

<b>MnO</b>	<b>manganese(II) oxide</b>
<b>Mn<sub>2</sub>O<sub>3</sub></b>	<b>manganese(III) oxide</b>
<b>MnO<sub>2</sub></b>	<b>manganese(IV) oxide</b>

**use of the suffixes -ous and -ic is discouraged**

# Commonly encountered cations that can exist as two different charge types

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**+1, +2:      Cu, Hg**

**+2, +3:      Fe, Co**

**+2, +4:      Sn, Pb**

$Mn^{2+}$   
 $Mn^{3+}$   
 $Mn^{4+}$   
 $Mn^{6+}$   
 $Mn^{7+}$

$Ag^+$

$Fe^{2+}$

$Co^{2+}$

$Ni^{2+}$

$Pb^{2+}$

$Fe^{3+}$

$Co^{3+}$

$Ni^{3+}$

$Pb^{4+}$

$Cu^+$

$Cu^{2+}$

Group	1	2		3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	1A	2A		3B	4B	5B	6B	7B		8B		1B	2B	3A	4A	5A	6A	7A	8A
Period																			
1	1 H																		2 He
2	3 Li	4 Be												5 B	6 C	7 N	8 O	9 F	10 Ne
3	11 Na	12 Mg												13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
4	19 K	20 Ca		21 Sc	22 Ti	23 Y	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
5	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
6	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
7	87 Fr	88 Ra	**	103 Lr	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Uun	111 Uuu	112 Uub	113 Uut	114 Uuq	115 Uup	116 Uuh	117 Uus	118 Uuo
lanthanides			*																
actinides			**																

$Sn^{4+}$   $Sn^{2+}$

$Cr^{2+}$   $Cr^{3+}$   $Cr^{6+}$

## Example

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**Write the formulas for the following compounds:**

**(a) tin(II) fluoride**



**Answer:  $\text{SnF}_2$**

## Example

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**Write the formulas for the following compounds:**

**(a) mercury(II) oxide**



**Answer: HgO**

## Example

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**Write the formulas for the following compounds:**

**(a) mercury(I) iodide**

**Hg<sup>+</sup> actually exists as Hg<sub>2</sub><sup>2+</sup>**

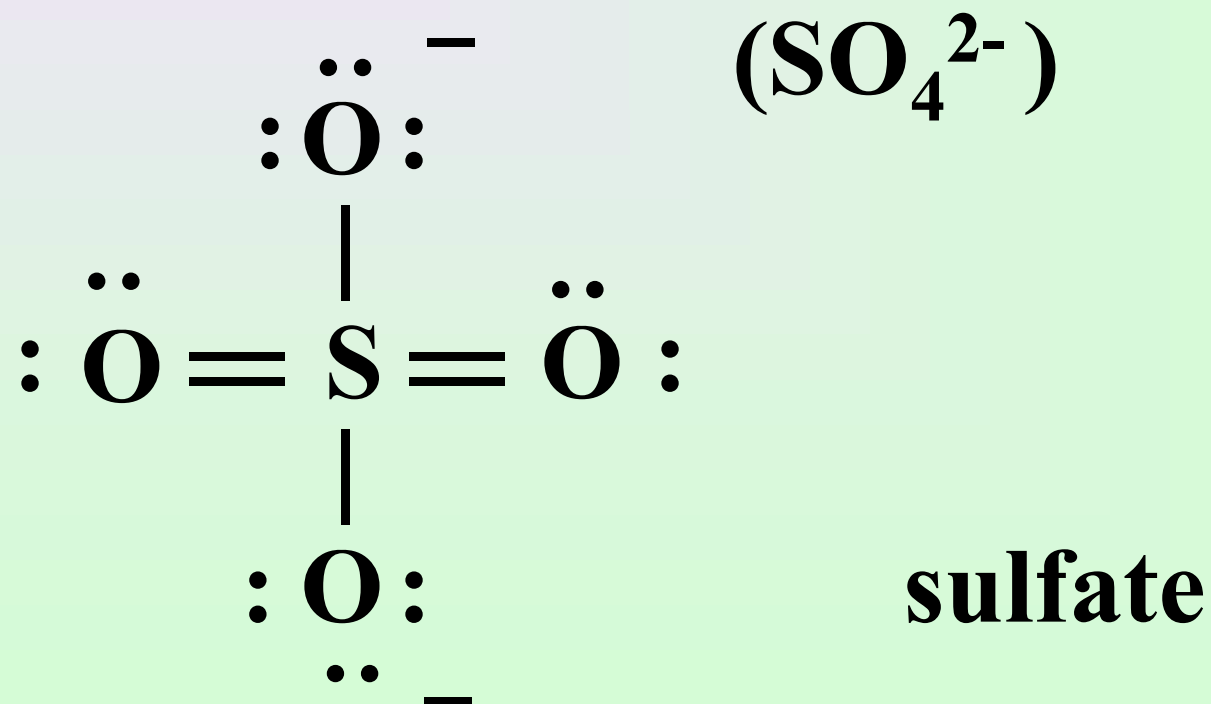
**I<sup>-</sup>**

**Answer: Hg<sub>2</sub>I<sub>2</sub>**

# Polyatomic Ions

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**molecules with a charge**



# Polyatomic Ions

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<b>(CO<sub>3</sub><sup>2-</sup>)</b>	<b>carbonate</b>
<b>(CrO<sub>4</sub><sup>2-</sup>)</b>	<b>chromate</b>
<b>(OH<sup>-</sup>)</b>	<b>hydroxide</b>
<b>(NO<sub>3</sub><sup>-</sup>)</b>	<b>nitrate</b>
<b>(Cr<sub>2</sub>O<sub>7</sub><sup>2-</sup>)</b>	<b>dichromate</b>
<b>(ClO<sub>3</sub><sup>-</sup>)</b>	<b>chlorate</b>

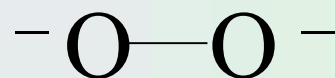
**bromate**



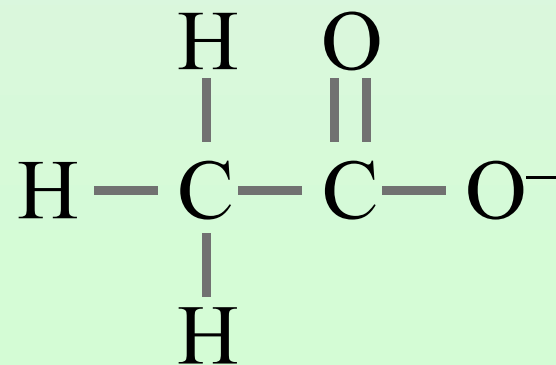
**Iodate**



peroxide  $\text{O}_2^{2-}$



acetate  $\text{C}_2\text{H}_3\text{O}_2^-$



# Example

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**Name the following ionic compounds:**



**Answer: sodium sulfate**

# Example

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**Name the following ionic compounds:**



**Answer: barium chlorate**

# Example

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**Name the following ionic compounds:**



**Answer: copper(II)nitrate**

# **Naming Molecular Compounds**

# Molecular Compounds

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Electrons are shared by the atoms.

## **Covalent Bonds**

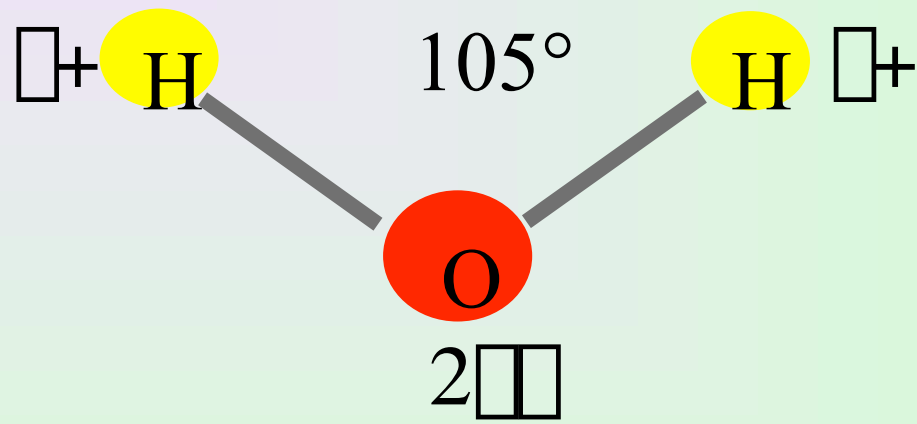
Electrons however are not shared equally.

# Molecular Compounds

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Elements that are more electronegative assume an **apparent negative charge** ( $\delta^-$ ).

Elements that are more electropositive assume an **apparent positive charge** ( $\delta^+$ ).



## naming binary compounds of nonmetals

- 1) more electropositive element named first  
(and listed first in chemical formula)
- 2) more electronegative element named in usual  
way (with -ide suffix)
- 3) **counting prefixes** are used with each name  
but mono is not used with first name

# Greek prefixes used in naming molecular compounds

<u>Prefix</u>	<u>Meaning</u>	<u>Prefix</u>	<u>Meaning</u>
Mono-	1	Hexa-	6
Di-	2	Hepta-	7
Tri-	3	Octa-	8
Tetra-	4	Nona-	9
Penta-	5	Deca-	10

## Examples

CO	carbon monoxide
CO <sub>2</sub>	carbon dioxide
SO <sub>2</sub>	sulfur dioxide
SO <sub>3</sub>	sulfur trioxide
PCl <sub>3</sub>	phosphorus trichloride
PCl <sub>5</sub>	phosphorus pentachloride
NO <sub>2</sub>	nitrogen dioxide
N <sub>2</sub> O <sub>4</sub>	dinitrogen tetroxide
Cl <sub>2</sub> O <sub>7</sub>	dichlorine heptoxide

# Name the following compounds

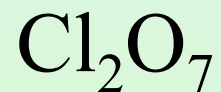
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chlorine trifluoride



sulfur dichloride



dichlorine heptoxide

# Name the following compounds

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nitrogen trifluoride



tetraphosphorous decoxide



dinitrogen tetrafluoride



iodine pentafluoride

# **Naming Acids and Bases**

# Acids and Bases

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An acid is a substance that yields hydrogen ions ( $\text{H}^+$ ) when dissolved in water.

Acids that contain hydrogen, oxygen, and another element are called oxyacids.

# Acids and Bases

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Bases are substances that yield hydroxide ions ( $\text{HO}^-$ ) when dissolved in water.

$\text{NaOH}$ ,  $\text{KOH}$ ,  $\text{Ba}(\text{OH})_2$ ,  $\text{NH}_3$

# Naming Acids

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**Naming an acid depends on whether the anion contains oxygen**

**If the anion does not contain oxygen the acid is named with the prefix *hydro* and the suffix *-ic***

**If the anion contains oxygen the acid name is formed from the root name of the anion with the suffix *-ic or -ous***

## Names for some binary acids

### Anion

### Corresponding Acid

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$F^-$  (fluoride)

HF (hydrofluoric acid)

$Cl^-$  (chloride)

HCl (hydrochloric acid)

$Br^-$  (bromide)

HBr (hydrobromic acid)

$I^-$  (iodide)

HI (hydroiodic acid)

$CN^-$  (cyanide)

HCN (hydrocyanic acid)

$S^{2-}$  (sulfide)

$H_2S$  (hydrosulfuric acid)

## Polyatomic anions

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sulfite  $\text{SO}_3^{2-}$

sulfate  $\text{SO}_4^{2-}$

hypochlorite  $\text{ClO}^-$

chlorite  $\text{ClO}_2^-$

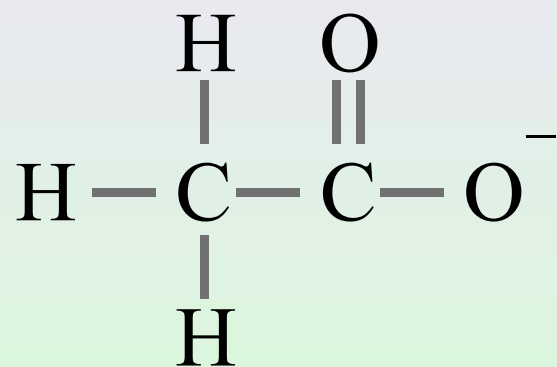
chlorate  $\text{ClO}_3^-$

perchlorate  $\text{ClO}_4^-$

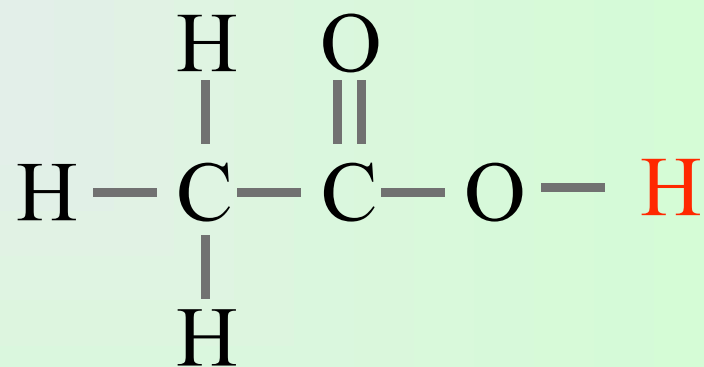
# Oxyacids

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**acetate anion**



**acetic acid**



# Oxyacids

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**sulfite**       $\text{SO}_3^{2-}$       **sulfurous acid**       $\text{H}_2\text{SO}_3$

**HOSO<sub>2</sub>OH**

**sulfate**       $\text{SO}_4^{2-}$       **sulfuric acid**       $\text{H}_2\text{SO}_4$

**HOSO<sub>2</sub>OH**

# Oxyacids

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**perchlorate**     $\text{ClO}_4^-$     **perchloric acid**     $\text{HClO}_4$   
 $\text{HOClO}_3$

**Addition of one O atom**

**chlorate**     $\text{ClO}_3^-$     **chloric acid**     $\text{HClO}_3$   
 $\text{HOClO}_2$

**removal of one O atom**

**chlorite**     $\text{ClO}_2^-$     **chlorous acid**     $\text{HClO}_2$   
 $\text{HOClO}$

**removal of two O atoms**

**hypochlorite**     $\text{ClO}^-$     **hypochlorous acid**     $\text{HOCl}$

# Hydrates

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**Compounds that have a specific number of water molecules attached to them**

**Copper(II) sulfate pentahydrate**



**Copper(II) sulfate anhydrous**



**Anhydrous** - the water molecules have been driven off by heating

