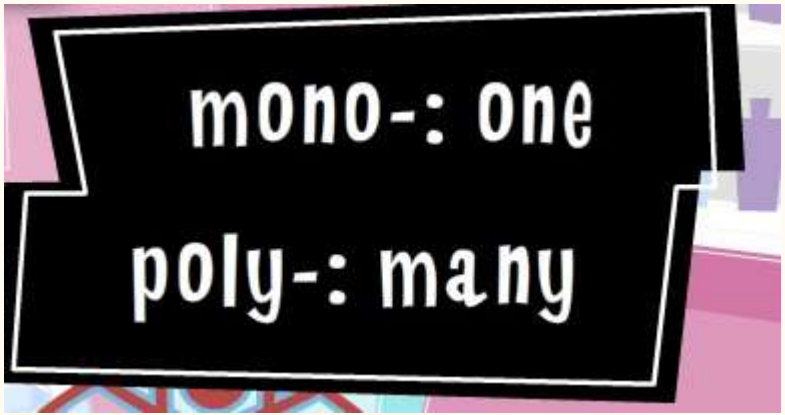
Nomenclature

Naming Ions- Polyatomic Ions

Polyatomic versus Monoatomic Ion

If you've never heard of polyatomic ions, you might not be able to tell one apart from a monatomic ion.



The real difference here is that while

monatomic ions are single atoms

of an element, polyatomic ions are composed

of a two or more atoms from different elements.

They might look like scary compounds with all those letters, but really they're just a group of atoms that acts like a single ion with a single charge.

Common Polyatomic Ions

Charge of −1

Formula	Name
$C_2H_3O_2^-$	Acetate
HSO_3^-	Hydrogen sulfite
HSO_4^-	Hydrogen sulfate
HCO_3^-	Hydrogen carbonate
OH^-	Hydroxide
NO_2^-	Nitrite
NO_3^-	Nitrate
CN^-	Cyanide
MnO_4^-	Permanganate
ClO^-	Hypochlorite
ClO_2^-	Chlorite
ClO_3^-	Chlorate
ClO_4^-	Perchlorate

Charge of −2

Formula	Name
CO_3^{2-}	Carbonate
CrO_4^{2-}	Chromate
$Cr_2O_7^{2-}$	Dichromate
HPO_4^{2-}	Hydrogen phosphate
$C_2O_4^{2-}$	Oxalate
SO_3^{2-}	Sulfite
SO_4^{2-}	Sulfate
SiO_3^{2-}	Silicate

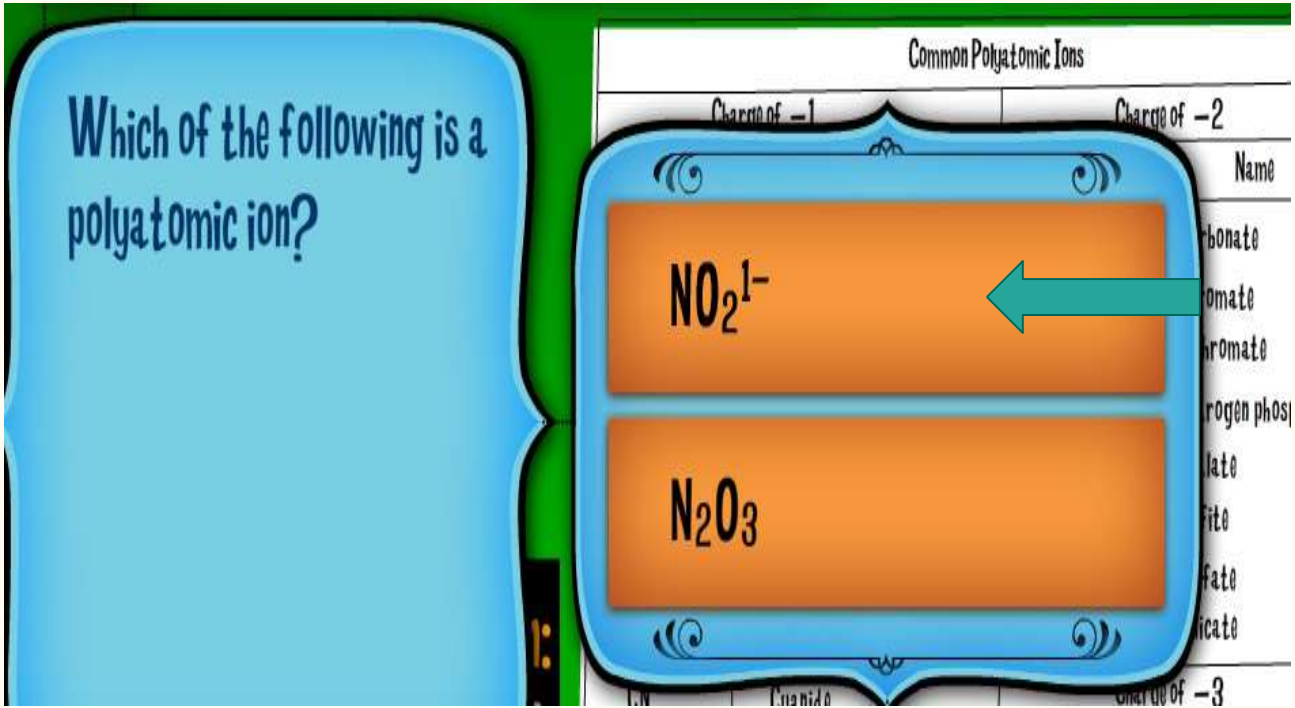
Charge of −3

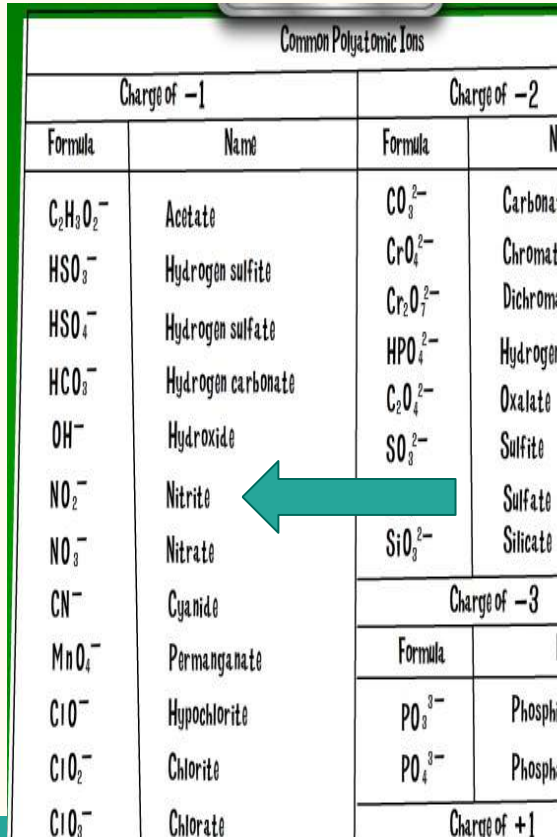
Formula	Name
PO_3^{3-}	Phosphite
PO_4^{3-}	Phosphate

Charge of +1

Formula	Name
NH_4^+	Ammonium

Quick Check


Which of the following is a polyatomic ion?
NO_2^{1-}
N_2O_3
Common Polyatomic Ions
Charge of −1
Charge of −2
Name
Cyanide
Charge of −3


Common Polyatomic Ions
Charge of −1
Charge of −2
Formula
Name
$C_2H_3O_2^-$ Acetate
HSO_3^- Hydrogen sulfite
HSO_4^- Hydrogen sulfate
HCO_3^- Hydrogen carbonate
OH^- Hydroxide
NO_2^- Nitrite
NO_3^- Nitrate
CN^- Cyanide
MnO_4^- Permanganate
ClO^- Hypochlorite
ClO_2^- Chlorite
ClO_3^- Chlorate
CO_3^{2-} Carbona
CrO_4^{2-} Chromat
$Cr_2O_7^{2-}$ Dichroma
HPO_4^{2-} Hydroge
$C_2O_4^{2-}$ Oxalate
SO_3^{2-} Sulfite
Sulfate
SiO_3^{2-} Silicate
Charge of −3
Formula
PO_3^{3-} Phosphi
PO_4^{3-} Phospha
Charge of +1

Naming Polyatomic Ions

Naming polyatomic ions can be applied to what you learned about ionic compounds!

Let's start with naming this formula: 

Start off by breaking it down: it looks like that potassium is going be the positive cation since it’s on the left .

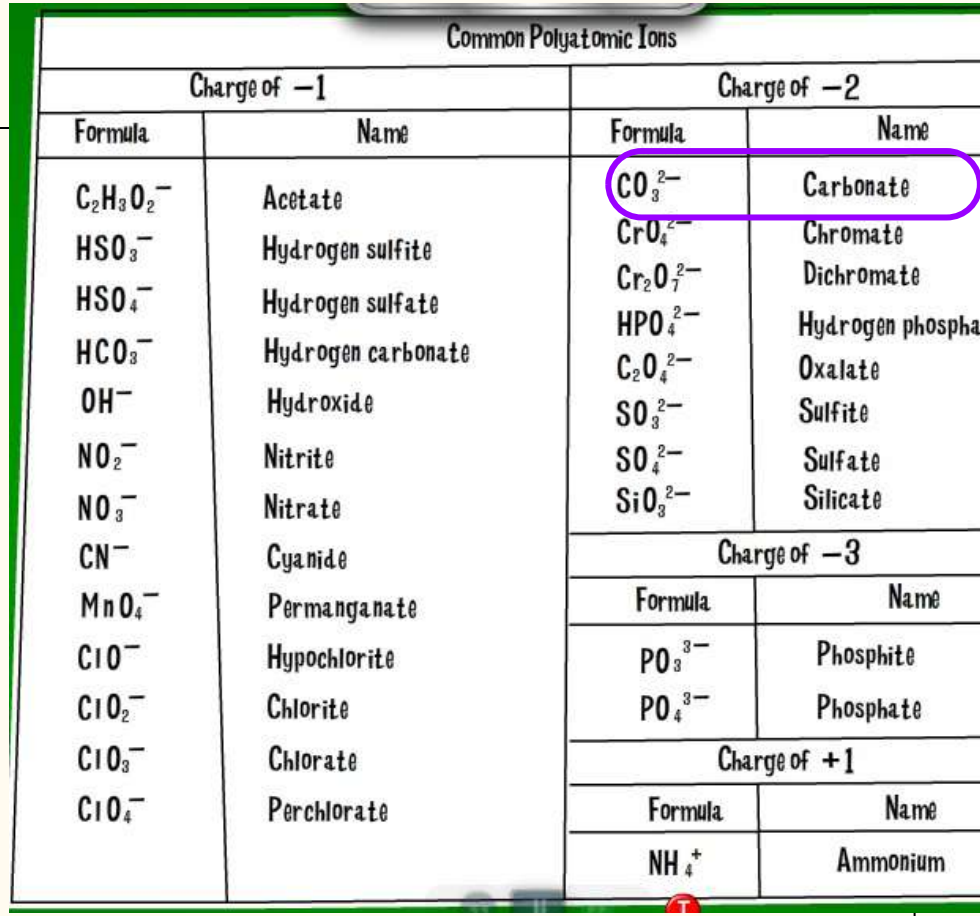
And since it’s all by itself, it’s going be monatomic for sure.

If we know this is an ionic compound, we know that all that left over stuff on the right is probably gonna be the negative ion, or the anion.

Naming Polyatomics

K_2CO_3

Now there's two elements in that ion, so that means it's polyatomic, and if you check it against that chart of common polyatomic ions, you see it's just sitting right there. C-O three is none other than carbonate!



Common Polyatomic Ions

Charge of −1	
Formula	Name
$C_2H_3O_2^-$	Acetate
HSO_3^-	Hydrogen sulfite
HSO_4^-	Hydrogen sulfate
HCO_3^-	Hydrogen carbonate
OH^-	Hydroxide
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NO_3^-	Nitrate
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MnO_4^-	Permanganate
ClO^-	Hypochlorite
ClO_2^-	Chlorite
ClO_3^-	Chlorate
ClO_4^-	Perchlorate

Charge of −2	
Formula	Name
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$C_2O_4^{2-}$	Oxalate
SO_3^{2-}	Sulfite
SO_4^{2-}	Sulfate
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Charge of −3	
Formula	Name
PO_3^{3-}	Phosphite
PO_4^{3-}	Phosphate

Charge of +1	
Formula	Name
NH_4^+	Ammonium

Naming Polyatomics

All that's left is to just put 'em together,

cation then anion,

for a brand new name: **potassium carbonate**!

K sub two, C-O three?

Creating a formula from the name

What if you are given a compound name and need to make the formula? It is just as easy as it was with monatomic ionic compounds.

iron (III) chromate

First you break it down: the cation here is iron-three, which means it has a positive three charge,

and the anion is chromate.

If you check your chart, you'll see that it's got a negative two charge.

cation: iron (III) Fe^{3+}

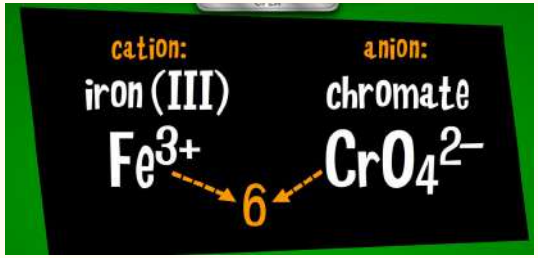
anion: chromate CrO_4^{2-}

Common Polyatomic Ions

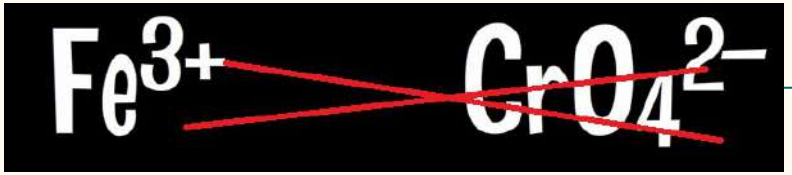
Charge of −1		Charge of −2	
Formula	Name	Formula	Name
$C_2H_3O_2^-$	Acetate	CO_3^{2-}	Carbonate
HSO_3^-	Hydrogen sulfite	CrO_4^{2-}	Chromate
HSO_4^-	Hydrogen sulfate	$Cr_2O_7^{2-}$	Dichromate
HCO_3^-	Hydrogen carbonate	HPO_4^{2-}	Hydrogen phosphate
OH^-	Hydroxide	$C_2O_4^{2-}$	Oxalate
NO_2^-	Nitrite	SO_3^{2-}	Sulfite
NO_3^-	Nitrate	SO_4^{2-}	Sulfate
CN^-	Cyanide	SiO_3^{2-}	Silicate
MnO_4^-	Permanganate	Charge of −3	
ClO^-	Hypochlorite	Formula	Name
		PO_3^{3-}	Phosphite

iron (III) chromate

Two iron-three ions give a positive six charge, and three chromate ions give a negative six charge. And there ya go—a nice and neutral formula for your compound: F-E sub two, parenthesis C-R-O sub four, parenthesis sub three.



Or use criss cross method (remove + and - signs)



Quick Check 1

For this ionic compound, what would be the name of the cation?

NH_4OH

Charge of −1	
Formula	Name
$C_2H_3O_2^-$	Acetate
HSO_3^-	Hydrogen sulfite
HSO_4^-	Hydrogen sulfate
HCO_3^-	Hydrogen carbonate
OH^-	Hydroxide
NO_2^-	Nitrite
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MnO_4^-	Permanganate
ClO^-	Hypochlorite
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Charge of −2	
Formula	Name
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$C_2O_4^{2-}$	Oxalate
SO_3^{2-}	Sulfite
SO_4^{2-}	Sulfate
SiO_3^{2-}	Silicate

Charge of −3	
Formula	Name
PO_3^{3-}	Phosphite
PO_4^{3-}	Phosphate

Charge of +1	
Formula	Name
NH_4^+	Ammonium

A nitrogen hydrogen ion

B nitrogen tetrahydride ion

C ammonia ion

D ammonium ion

Quick Check 2

For this ionic compound, what would be the name of the anion?

$Be(C_2H_3O_2)_2$

Charge of −1	
Formula	Name
$C_2H_3O_2^-$	Acetate
HSO_3^-	Hydrogen sulfite
HSO_4^-	Hydrogen sulfate
HCO_3^-	Hydrogen carbonate
OH^-	Hydroxide
NO_2^-	Nitrite
NO_3^-	Nitrate
CN^-	Cyanide
MnO_4^-	Permanganate
ClO^-	Hypochlorite
ClO_2^-	Chlorite
ClO_3^-	Chlorate
ClO_4^-	Perchlorate

Charge of −2	
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CO_3^{2-}	Carbonate
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SO_4^{2-}	Sulfate
SiO_3^{2-}	Silicate

Charge of −3	
Formula	Name
PO_3^{3-}	Phosphite
PO_4^{3-}	Phosphate

Charge of +1	
Formula	Name
NH_4^+	Ammonium

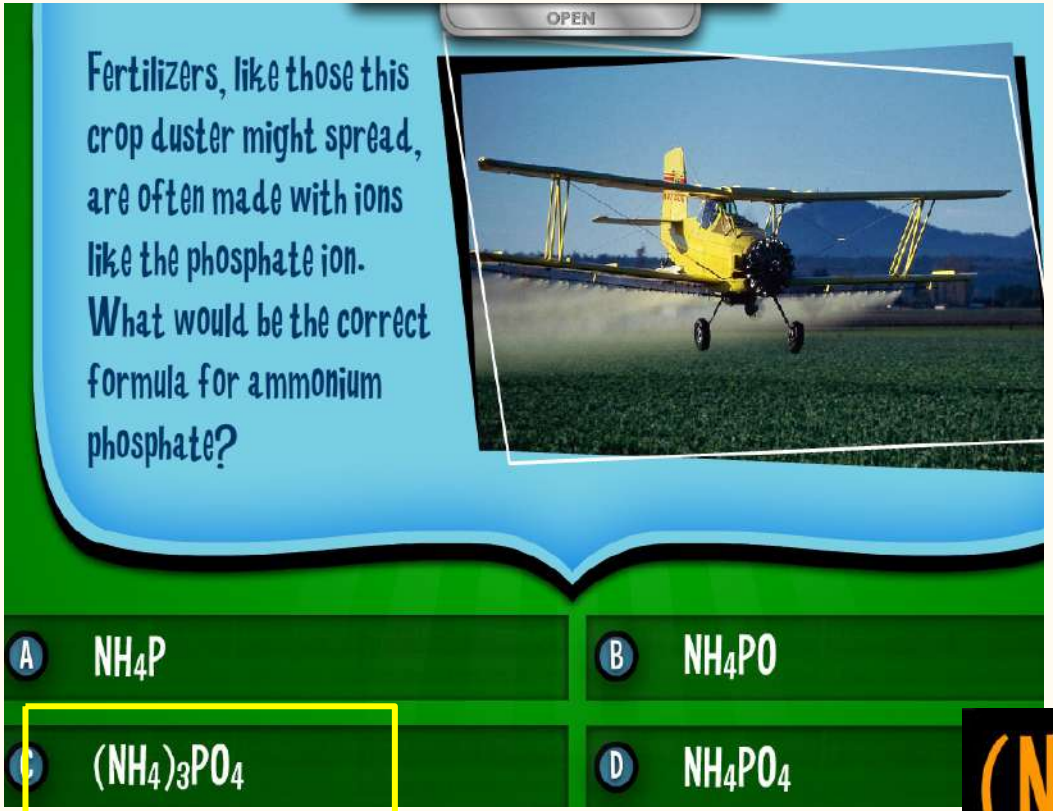
A beryllium ion

B acetate ion

C dicarbon trihydrogen dioxide ion

D hydrocarbon dioxide ion

Quick Check 3



Steps:

1. Cation $NH4^{1+}$ ammonium ion
2. Anion $PO4^{3-}$ phosphate ion

Common Polyatomic Ions

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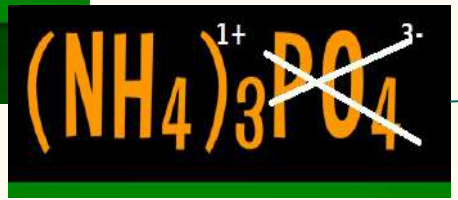
HSO_4^-	Hydrogen sulfate	$Cr_2O_7^{2-}$	Dichromate
HCO_3^-	Hydrogen carbonate	HPO_4^{2-}	Hydrogen phosphate
OH^-	Hydroxide	$C_2O_4^{2-}$	Oxalate
NO_2^-	Nitrite	SO_3^{2-}	Sulfite
NO_3^-	Nitrate	SO_4^{2-}	Sulfate
CN^-	Cyanide	SiO_3^{2-}	Silicate
MnO_4^-	Permanganate	**Charge of −3**	
ClO^-	Hypochlorite	Formula	Name
ClO_2^-	Chlorite	PO_4^{3-}	Phosphate
ClO_3^-	Chlorate	**Charge of +1**	
ClO_4^-	Perchlorate	Formula	Name
		NH_4^+	Ammonium



Naming polyatomic ions:

- use polyatomic ion chart

Common Polyatomic Ions

Charge of −1		Charge of −2	
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NO_2^-	Nitrite	SO_3^{2-}	Sulfite
NO_3^-	Nitrate	SO_4^{2-}	Sulfate
CN^-	Cyanide	SiO_3^{2-}	Silicate
MnO_4^-	Permanganate	**Charge of −3**	
ClO^-	Hypochlorite	Formula	Name
ClO_2^-	Chlorite	PO_3^{3-}	Phosphite
ClO_3^-	Chlorate	PO_4^{3-}	Phosphate
ClO_4^-	Perchlorate	**Charge of +1**	
		Formula	Name
		NH_4^+	Ammonium

- ions with oxygen
  - *-ite* and *-ate* tell you how many oxygens
- ions with hydrogen
  - *hydrogen*, *monohydrogen*, and *dihydrogen*

Naming polyatomic ions:

- use polyatomic ion chart
- ions with oxygen
  - -ite and -ate tell you how many oxygens
- ions with hydrogen
  - hydrogen, monohydrogen, and dihydrogen

Writing out a formula for ionic compounds with polyatomic ions:

1. Write out symbol and charge for cation.
2. Write out symbol and charge for anion.
3. Write cation and anion next to each other.
4. Use lowest common multiple to obtain neutral compound.

Or use criss-cross method

5. Write formula using multiplier as subscript for ion.

The End