NEW JERSEY CENTER
FOR TEACHING & LEARNING

Ionic Compounds and Ionic Bonding

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Periodic Table Review

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Periodic Table - Review

The periodic table is "periodic" because of certain trends that are seen in the elements.

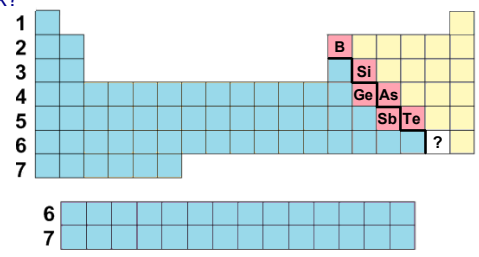
Some of these trends can be seen in the properties of atoms we covered in the last unit: atomic size, ionization energy, electronegativity and metallic character.

Would you predict that elements from the same family/group would have similar physical and chemical properties?

The Periodic Table of the Elements

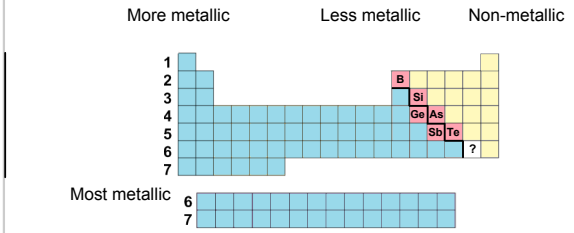
The periodic table can be divided into three large classifications of elements.

What type of elements are highlighted in blue, in yellow and in pink? What is unique about the elements that are highlighted in pink?



Metallic Character of the Elements

What the relationship between metallic character and effective nuclear charge? Are they directly or inversely related? Is it accurate to say "Element A is more metallic than element B" even if element B is a non-metal?



1 In the periodic table, the elements are arranged in _____.

- A alphabetical order
- B order of increasing atomic number
- C order of increasing metallic properties
- D order of increasing neutron content
- E reverse alphabetical order
- F I don't know how to answer this.

2 Elements _____ exhibit similar physical and chemical properties.

- A with similar chemical symbols
- B with similar atomic masses
- C in the same period of the periodic table
- D on opposite sides of the periodic table
- E in the same group of the periodic table

3 Which pair of elements would you expect to exhibit the greatest similarity in their physical and chemical properties?

- A Li, Na
- B Cs, Ba
- C Ca, Si
- D Ga, Ge
- E C, O

4 Which one of the following is a nonmetal?

- A W
- B Sr
- C Os
- D Ir
- E S

5 Potassium is a _____ and chlorine is a _____.

- A metal, nonmetal
- B metal, metal
- C metal, metalloid
- D metalloid, nonmetal
- E nonmetal, metal

Valence Electrons and the Octet Rule

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Review: Octet Rule

Atoms tend towards having complete outer shells of electrons *(remember stability)*.

A full outer shell will have:
2 electrons in the *s* subshell and
6 electrons in the *p* subshell *(s^2p^6 configuration)*

Octet rule: atoms tend towards having a total of 8 electrons

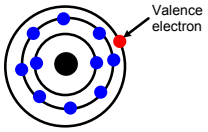
8 valence electrons make an octet

Which elements on the periodic table have a complete outer shell? What is true about these elements relative chemical reactivity?

Valence Electrons

Valence electrons are the electrons in the highest occupied energy level of an element's atoms.

The valence electrons determine the chemical properties of an element. Why do you think this would be true?

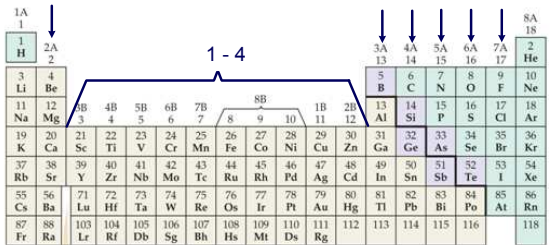


To find the number of valence electrons in an atom of a representative element (elements found in the s and p blocks), simply look at its group number.

Atoms in group 3 have 3 valence electrons,
atoms in group 17 have 7 valence electrons, etc.

Valence Electrons

Number of valence electrons in neutral atoms: 1 2 3 4 5 6 7 8



There is one exception:
helium has only 2 valence electrons.

6 How many valence electrons does potassium have?

- A 3
- B 1
- C 19
- D 4
- E 8

7 How many valence electrons does Aluminum have?

- A 5
- B 7
- C 3
- D 27
- E 13

8 How many valence electrons does Barium have?

- A 1
- B 2
- C 52
- D 3
- E 6

9 Arsenic (As) has 6 valence electrons.

- True
- False

Ions

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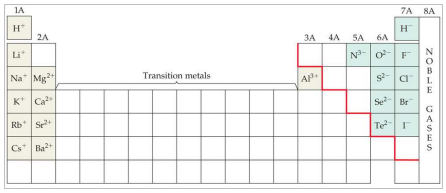
Ions

Ions are atoms or groups of atoms that have become charged by either *gaining or losing electrons*.

Cations are positive and are formed by elements on the left side of the periodic chart (metals).

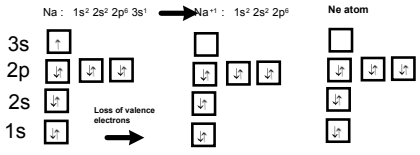
Anions are negative and are formed by elements on the right side of the periodic chart (nonmetals).



The Formation of Cations

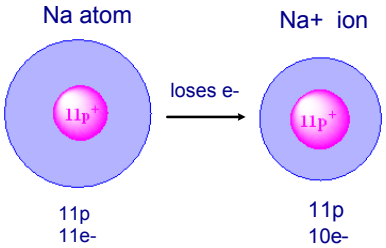
Metals usually give up/lose valence electrons to become more stable.

This often results in a noble gas (8 electron) outer shell.



How many electrons does the Na^+ ion have?

The Formation of Cations



The Na^+ ion is smaller than the Na atom. Do you remember what factors cause this reduction in size?

The Formation of Cations

Cations of Group 1A elements always have a charge of 1+.

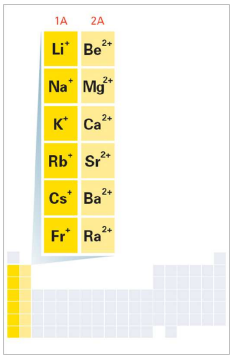
Cations of Group 2A elements always have a charge of 2+.

$Mg \longrightarrow Mg^{2+} + 2e^-$

Magnesium atom (electrically neutral, charge = 0)

Magnesium ion (+2 indicates 2 units of positive charge)

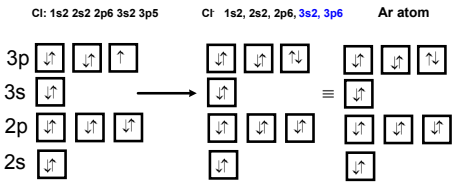
(2 in front of e^- indicates 2 units of negative charge)



The Formation of Anions

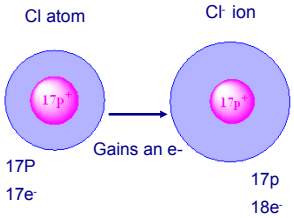
Nonmetals usually gain valence electrons.

This results in a noble gas (8 electrons) outer shell



How many electrons does the Cl^- have?

The Formation of Anions



The Cl^- ion is larger than the Cl atom. Do you remember what factors cause this increase in size?

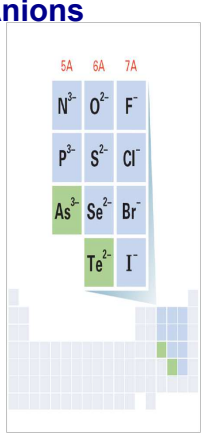
The Formation of Anions

Anions of Group 15 (5A) elements always have a charge of **3**-

Anions of Group 16 (6A) elements always have a charge of **2**-

Anions of Group 17 (7A) elements always have a charge of **1**-

Consider Group 14 (4A) elements, what common charge(s) would you predict for these elements?



10 Metals tend to _____ electrons and nonmetals tend to _____ electrons.

- A gain, gain
- B lose, lose
- C gain, lose
- D lose, gain
- E neither, they keep their electrons

11 Anions tend to be _____ and cations tend to be _____.

- A metals, metals
- B nonmetals, nonmetals
- C metals, nonmetals
- D nonmetals, metals
- E metalloids, metalloids

12 Metals lose electrons to form cations

- True
- False

13 Anions are formed from nonmetals

- True
- False

14 Nonmetals tend to lose electrons forming ions

- True
- False

15 This is the ion formed from a calcium atom

- A Ca^{+}
- B Ca^{2+}
- C Ca^{-}
- D Ca^{2-}

16 Phosphorous forms an ion with a charge of _____.

- A 1+
- B 2-
- C 3+
- D 3-
- E 2+

17 Aluminum forms an ion with a charge of _____.

- **A 2+**
- **B 1-**
- **C 3+**
- **D 2-**
- **E 0**

18 Of the following, _____ contains the greatest number of electrons.

- A P^{3+}
- B P
- C P^{2-}
- D P^{3-}
- E P^{2+}

19 Oxygen forms an ion with a charge of _____.

- A 2-
- B 2+
- C 3-
- D 3+
- E 6+

20 Iodine forms an ion with a charge of _____.

- A 7-
- B 1+
- C 2-
- D 2+
- E 1-

21 This is the ion formed from nitrogen

- A N^{-}
- B N^{2-}
- C N^{3+}
- D N^{3-}

22 Predict the charge of the most stable ion of S?

- A 3+
- B 1-
- C 6+
- D 2+
- E 2-

23

- A +1
- B +2
- C +3
- D +13
- E -5

Ionic Bonding

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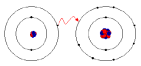
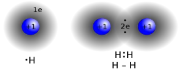
Introduction to Chemical Bonds

There are three basic types of bonds:

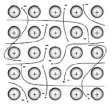
Ionic - The electrostatic attraction between ions



Covalent - The sharing of electrons between atoms



Metallic - Each metal atom bonds to other metals atoms within a "sea" of electrons *(covered in a later unit)*



Ionic Bonding

Electronegativity is **how strongly** an atom **attracts electrons.** Atoms with a high electronegativity will be able to attract electrons away from atoms with a much lower electronegativity.

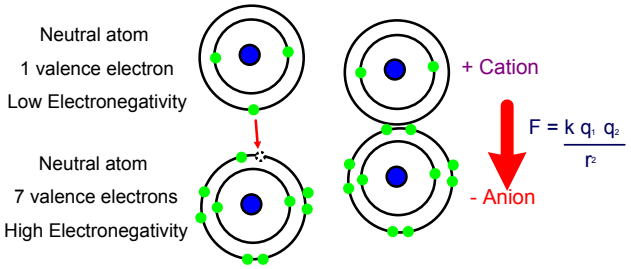
This removal of electrons can occur when the difference in electronegativity between the two atoms is approximately 1.7 or higher.

Once a positive and negative ion are formed, they will be attracted to each other via the electrostatic force:

$$F = \frac{k\, q_1\, q_2}{r^2}$$

Note: The heavier nonmetals from 4,6,5th groups (In, Tl, Sn, Pb, Sb Bi) may act like metals

Ionic Bonding



The atom with high electronegativy attracts valence electrons from the atom with lower electronegativity.

When the atoms become oppositely charged ions the **electrostatic force of attraction** brings them together.

Electrostatic force of attraction = bond

Ionic Bonding

Compounds composed of cations and anions are called ionic compounds.

Although they are composed of ions, **ionic compounds are electrically neutral.**

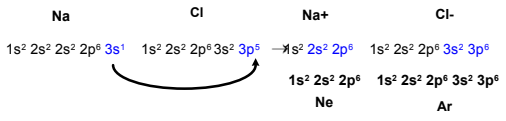
The electrostatic forces that hold ions together in ionic compounds are called ionic bonds.

Ionic Bonds

When sodium and chlorine are close together, sodium's valence electron flies off and "harpoons" the chlorine atom.

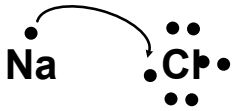
The result is a sodium cation (+) next to a chloride anion (-)

These oppositely charged two ions attract: they reel one another together to form an ionic bond.



Ionic Bonds

The electron transfer process in creating an ionic bond:



The dots represents the valence electrons in an atom.

click here for an animation of this reaction

27 Which of the following compounds would you expect to be ionic?

- A H_2O
- B CO_2
- C $SrCl_2$
- D SO_2
- E H_2S

Properties of Ionic Compounds

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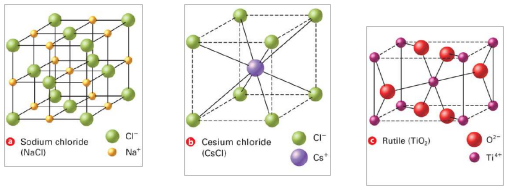
[*]

Properties of Ionic Compounds

They are crystalline solids at room temperature
They have high melting points
They conduct electricity when melted (molten) or dissolved in water (aqueous)

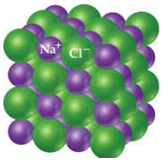


Formula Units

A chemical formula shows the kinds and numbers of atoms in the smallest representative unit of a substance.

A formula unit is the lowest whole-number ratio of ions in an ionic compound.

Every ionic compound has a 3D array of positive and negative ions.



Predicting an Ionic Compound's Formula

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Predicting an Ionic Compound Formula

Potassium (K) with an electronegativity of 0.8 and oxygen (O) with an electronegativity of 3.5 will form an ionic compound.

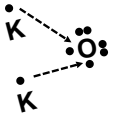
What is the formula for an ionic compound of potassium and oxygen?

How many additional valence electrons does oxygen want? ☐

How many valence electrons does potassium have? ☐

How many potassium atoms will it take to give oxygen the electrons it needs? ☐

The formula unit is K_2O



Always Metal First (low electonegativity)

Predicting an Ionic Compound Formula

What is the formula for an ionic compound of Mg and N?

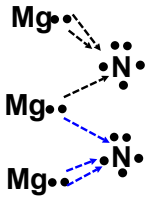
How manyadditional valence electrons does N want? ☐

How many valence electrons does Mg have to offer? ☐

How many Mg atoms will it take to give how many N the electrons it needs? *(Find the lowest common multiplier first.)*

3 Mg : 2 N

The formula unit is Mg_3N_2



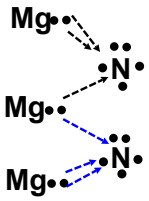
Alternate Method

If you don't like finding least common multipliers, you can use this alternative method:

1. Write down the ions side by side along with their charge. Always write the metal first.

2. "Criss-cross" the numerical values of the charges.

3. Reduce subscripts to lowest ratio.



Predicting an Ionic Compound Formula

Example: Write the formula for calcium sulfide.

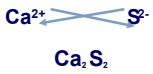
Step 1: Identify the cation & write its common ion

Calcium is in group 2 ⟶ Ca^{2+}

Step 2: Identify the anion & write its formula

Sulfur is in group 6 ⟶ S^{2-}

Step 3: Criss-cross; reduce subscripts if necessary



Ca_2S_2

CaS

Predicting an Ionic Compound Formula

What is the compound formed between Mg and S?

The chemical formula would have to be the lowest ratio of ions.

What would you predict would be the formula for this compound?

Move for Answer

28 The formula for the ionic compound between Cs and O is:

- A CsO_2
- B OCs_2
- C Cs_2O
- D OCs_2
- E I don't know how to do this.

29 The ionic compound formed between Ca and N is:

- A CaN
- B Ca_2N_2
- C Ca_3N_2
- D Ca_2N_3
- E I don't know how to do this.

30 The ionic compound formed between Al and O

- A Al_3O_2
- B Al_2O_3
- C AlO
- D Al_2O_2
- E I don't know how to do this.

31 What is the ionic compound formed between Ca and Al?

- A $CaAl$
- B Ca_3Al_2
- C Al_2Ca_3
- D No compound is formed.

32 What is the ionic compound formed between P and Br?

- A P_3Br
- B BrP
- C This compound is not considered ionic
- D $(BrP)_2$
- E I don't know how to do this.

33 What is the formula for sodium phosphide?

- A SP_3
- B NaP
- C Na_3P
- D NaP_3
- E I don't know how to do this.

34 What is the formula for strontium bromide?

- A $SrBr$
- B $SrBr_2$
- C Sr_2Br
- D $BrSr_2$

35 The formula for barium sulfide is Ba_2S_2.

- True
- False

Naming Ionic Compounds

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Naming Binary Ionic Compounds - Cations

Many cations have the same name as the original, neutral atom.

Charge	Formula	Name
+1	H^+	Hydrogen ion
	Li^+	Lithium ion
	K^+	Potassium ion
	Cs^+	Cesium ion
	Ag^+	Silver ion
+2	Mg^{2+}	Magnesium ion
	Ca^{2+}	Calcium ion
	Ba^{2+}	Barium ion
	Cd^{2+}	Cadmium ion
+3	Al^{3+}	Aluminum ion

Naming Binary Ionic Compounds - Anions

All monoatomic anions end in "*-ide*".

The ions that are produced from Group 7A (or 17) elements are called halide ions.

Can you guess the origin of the name halides?

Group 15	Group 16	Group 17
Nitride N^{3-}	Oxide O^{2-}	Fluoride F^-
Phosphide P^{3-}	Sulfide S^{2-}	Chloride Cl^-
		Bromide Br^-
		Iodide I^-

Naming Binary Ionic Compounds

Binary (two-element) compounds are named by writing the name of the cation followed by the name of the anion.

The name of the cation is the same as the metal name.

The name of the anion is the name of the non-metal with the suffix changed to *-ide*.

Binary ionic compounds end in *"-ide."*

Examples:

NaCl =

KI =

Li_2S =

Move for Answer

36 The correct name for Na_2S is

- A Sodium sulfate
- B Sodium sulfide
- C Di-sodium sulfide
- D Sulfur nitride

37 The correct name for SrO is _____.

- A strontium oxide
- B strontium hydroxide
- C strontium peroxide
- D strontium monoxide
- E strontium dioxide

38 The correct name for Al_2O_3 is _____.

- A aluminum trioxide
- B dialuminum oxide
- C dialuminum trioxide
- D aluminum oxide
- E aluminum hydroxide

Names and Formulas of Ionic Compounds with Transition Metals

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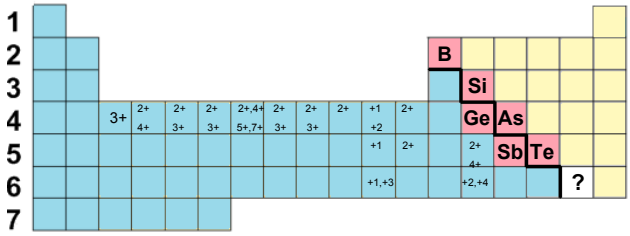
Cations formed by Transition Elements

Recall that s-block metals and some p block elements like aluminum have only one possible ionic charge, based on the Octet Rule.

However, most transition metals (d block elements) can have more than one ionic charge. For this reason, there is a system for designating the charge on each ion.

Sn, Pb from the p-block are called post-transition metals and will form more than one type of ion and behave like transition metals.

Cations formed by Transition Elements



The 2+ charge is very common among the transition metals as they lose their two "s" electrons first, before losing others from their "d" orbital

Cations Formed by Transition Elements

1+		2+		3+		4+	
Copper (I)	Cu^{+}	Cadmium	Cd^{2+}	Chromium (III)	Cr^{3+}	Lead (IV)	Pb^{4+}
Mercury(I)	Hg_2^{+2}	Chromium (II)	Cr^{2+}	Cobalt (III)	Co^{3+}	Tin (IV)	Sn^{4+}
Silver	Ag^{+}	Cobalt (II)	Co^{2+}	Iron (III)	Fe^{3+}		
		Copper(II)	Cu^{2+}	Manganese (III)	Mn^{3+}		
		Iron (II)	Fe^{2+}				
		Lead (II)	Pb^{2+}				
		Mercury (II)	Hg^{2+}				
		Manganese(II)	Mn^{2+}				
		Tin (II)	Sn^{2+}				

Only common transition metals are shown.

Silver, cadmium and zinc only form one cation, Ag, Cd^{2+} and Zn^{2+}

Note the two mercury cations, which one is a polyatomic ion?

Tin (Sn) and Lead (Pb) act like transition metals and they share two common charges, why do you think this is true?

Silver, Zinc, and Cadmium Ions

Why do these ions only have one possible charge?

Let's look at their electron configurations.

The "d" orbital of both zinc and cadmium are full and therefore very stable so the only electrons it will lose are the two "s" electrons...

Zn: $[Ar]4s^2 3d^{10}$ Zn^{2+}: $[Ar]3d^{10}$

The "d" orbital is also full with silver as it has largely taken an electron from it's own "s" orbital to make stabilize the "d" orbital. Therefore, it only has 1 electron left to lose.

Ag: $[Kr]5s^1 4d^{10}$ Ag^{+} : $[Kr]4d^{10}$

Cations formed by Transition Elements

We will use the Stock naming system (Roman numerals) to name transition metals.

Formula	Name
Cu^{+1}	Copper (I) ion
Co^{+2}	Cobalt (II) ion
Fe^{+2}	Iron (II) ion
Mn^{+2}	Manganese (II) ion
Pb^{+2}	lead (II) ion
Cr^{+3}	Chromium (III) ion
Fe^{+3}	Iron (III) ion

What would be the names of Cu^{2+} and Mn^{7+}?

Writing Formulas with Transition Metals

The charge on the cation is indicated by the Roman numeral, as shown in this example.

Iron (III) oxide

Fe^{3+} O^{2-} Write ion formulas.

Criss-cross charges.

Fe_2O_3 Reduce if necessary.

Writing Formulas with Transition Metals

The charge on the cation is indicated by the Roman numeral, as shown in this example.

Tin (IV) oxide

Sn^{4+} O^{2-} Write ion formulas.

Criss-cross charges.

Sn_2O_4 SnO_2 Reduce if necessary.

39 Which metal is capable of forming more than one cation?

- A K
- B Cs
- C Ba
- D Al
- E Sn

40 Which metal is not capable of forming more than one cation?

- A Cu
- B Au
- C Fe
- D Sn
- E Al

Formulas with Transition Metals

In order to correctly name a formula containing a transition metal, it is necessary to first determine the charge on the cation.

Since all compounds are neutral, then the total positive cation charge must equal the total negative anion charge.

In other words:

Total cation charge + Total anion charge = 0

(charge of cation) (# of cations) + (charge of anion) (# of anions) = 0

Example Formula with Transition Metals

In the case of $FeCl_3$, we make the following substitutions:

(charge of cation) (# of cations) +(charge of anion) (# of anions) = 0

(x) (1) + (-1) (3) = 0

Thus x = 3 and the cation is Fe^{3+} or iron(III).

Formulas with Transition Metals

A short cut method is to "uncriss-cross" the ions, but you must always double check your ions (or you'll get in trouble!).

$FeCl_3$: **Fe_1** **Cl_3**

Fe^{3+} **Cl^{1-}**

Uncriss-cross.

Check the ions

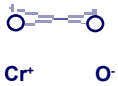
Cl does form a 1-ion and Fe^{3+} is Iron (III)

Iron (III) Cloride

Formulas with Transition Metals

Here's another practice problem.

CrO: **Cr_1** **O_1**



Cr^{+} **O^{-}**

Uncriss-cross.

Check the ions

O forms a 2- ion and Cr+ does not exist!

(this formula had to be reduced from Cr_2O_2)

Chromium (II) Oxide

41 The name of $FeCl_3$ is

- A iron chloride
- B iron (II) chloride
- C iron (III) chloride
- D iron(I)chloride

42

- A SnO_2
- B SnO
- C Sn_4O_4
- D Sn_4O_2
- E SnO_2

43 The formula for copper (II) sulfide is

- A CuS_2
- B CuS
- C Cu_2S_2
- D $(CuS)_2$
- E Cu_2S

44 Which one of the following compounds is copper(I) chloride?

- A CuCl
- B $CuCl_2$
- C Cu_2Cl
- D Cu_2Cl_2
- E Cu_3Cl_2

45 **The charge on the cation in the salt Fe_2O_3 is _____.**

- A 1+
- B 2+
- C 3+
- D 5-
- E 6-

[*]

46 **What is the charge on zirconium ion in ZrO_2 ?**

- A 2+
- B 4+
- C 1+
- D 2-
- E 3+

47

- True
- False

48

- A copper nitride
- B copper (I) nitride
- C copper (II) nitride
- D copper(III)nitride
- E copper(III) nitrogen

Polyatomic Ions

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Polyatomic Ions

A polyatomic ion is a group of atoms bonded together that have a charge and acts like a single unit or ion.

They are not free compounds and like other ions, are not found free in nature.

They are found combined with other ions.

Sulfate = $(SO_4)^{2-}$

Nitrate = $(NO_3)^-$

Carbonate = $(CO_3)^{2-}$

Use ( ) to keep the atoms together.

Do not change the subscripts inside the "( )"

Polyatomic Ions

Most of the polyatomic ions contain oxygen atoms.

Many anions names end with "-ite" or "-ate"

In "ite/ate" pairs, the ion with fewer oxygen atoms will have the "ite" ending

Examples: sulfite /sulfate
nitrite /nitrate

Note that the suffix does not indicate the actual number of O atoms.

Polyatomic Ions

Familiarize yourself with the polyatomic ions on your reference sheet
Be careful of *-ide*, *-ite*, and *-ate*!

H⁺ = proton or hydrogen ion

or bicarbonate

Selected Polyatomic Ions			
← H_3O^+	hydronium	CrO_4^{2-}	chromate
Hg_2^{2+}	dimercury(I)	$Cr_2O_7^{2-}$	dichromate
NH_4^+	ammonium	MnO_4^-	permanganate
$C_2H_3O_2^-$ or CH_3COO^-	acetate	NO_2^-	nitrite
		NO_3^-	nitrate
CN^-	cyanide	O_2^{2-}	peroxide
CO_3^{2-}	carbonate	OH^-	hydroxide
← HCO_3^-	hydrogen carbonate	PO_4^{3-}	phosphate
$C_2O_4^{2-}$	oxalate	SCN^-	thiocyanate
ClO^-	hypochlorite	SO_3^{2-}	sulfite
ClO_2^-	chlorite	SO_4^{2-}	sulfate
ClO_3^-	chlorate	HSO_4^-	hydrogen sulfate
ClO_4^-	percholrate	$S_2O_3^{2-}$	thiosulfate

Formulas and Names of Ionic Compounds with Polyatomic Ions

(Ternary Ionic Compounds)

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Writing Formulas for Ternary Ionic Compounds

Ternary ionic compounds, compounds that contain 3 or more elements, are neutral, just like binary ionic compounds. Therefore, the goal is to find the lowest ratio of cations to anions that will yield a neutral compound.

This ratio is represented in **a formula unit.**

Examples of formula units

$CaCO_3$ $Zn(C_2H_3O_2)_2$

$AgNO_3$ Na_2SO_3

Writing Formulas for Ternary Ionic Compounds (con't)

To write a formula, the criss-cross method can again be used.

Example: Write the formula for lithium phosphate.

Step 1: Identify the cation & write its formula

Lithium is in group 1 --> Li^+

Step 2: Identify the anion & write its formula

Phosphate is a polyatomic ion --> PO_4^{3-}

Step 3: Criss-cross; reduce subscripts if necessary

Li^{1+} PO_4^{3-} ⟶ $Li_3(PO_4)_1$ or simply $Li_3(PO_4)$

Writing Formulas for Ternary Ionic Compounds

Example: Write the formula for calcium nitrite.

Ca^{2+} $(NO_3)^-$ ⟶ $Ca(NO_3)_2$

When writing formulas with polyatomic ions, there are two important things to remember:

1) It is helpful to use " ( ) " to keep the atoms together, keeping the charge OUTSIDE the ( )

For example:
nitrate $(NO_3)^{1-}$
carbonate $(CO_3)^{2-}$

2) NEVER alter any symbols or subscripts INSIDE the "( )". Once finished, if there is no subscript outside of the "( )", remove the "( )"

Writing Formulas for Ternary Ionic Compounds

Example 1: Write the formula for lithium chlorate.

Move for Answer

Example 2: Write the formula for manganese(III) carbonate.

Move for Answer

49 The formula for aluminum phosphate is:

- A $AlPO_4$
- B $Al_3(PO_4)$
- C $Al_2(PO_4)_3$
- D $Al_3(PO_4)_3$

50

- A Co_3CO_3
- B Co_2CO_3
- C $Co_2(CO_3)_3$
- D $Co_3(CO_3)_2$
- E $CoCO_3$

51 The formula for sodium hydroxide is

- A $Na(OH)_2$
- B NaOH
- C $Na(OH_2)$
- D Na(HO)
- E $NaOH_2$

52 The formula for calcium sulfate is

- A $CaSO_4$
- B $Ca_2(SO_4)_2$
- C $Ca(SO_3)$
- D $Ca_2(SO_3)_2$
- E CaS

53

- A 1
- B 2
- C 3
- D 4
- E 5

54

- A 1
- B 2
- C 3
- D 4
- E 5

PRACTICE
Writing Formulas for Ionic Compounds

Complete the table by filling in the formula for the ionic compound formed by each pair of cations and anions, as shown for the first pair.

ION	K^+	NH_4^+	Mg^{2+}	Fe^{3+}
Cl^-	KCl			
OH^-				
CO_3^{2-}				
PO_4^{3-}				

PRACTICE
Writing Formulas for Ternary Ionic Compounds

Write the formula for the following compounds:

1. Magnesium iodide
2. Calcium sulfite
3. Barium hydrogen carbonate
4. Iron (III) phosphate

Move for answer

Naming Ternary Ionic Compounds

Ternary ionic compounds contain three or more different elements due to the presence of polyatomic ion(s).

Just as in binary ionic compounds, the name of the cation is given first, followed by the name of the anion.

Names of ternary compounds often end in *-ite* or *-ate*.

Examples

$CaCO_3$
$Zn(C_2H_3O_2)_2$
$AgNO_3$
Na_2SO_3

Move for answer

55 The correct name for NaClO is

- A sodium chlorate
- B sodium chloride
- C sodium chlorite
- D sodium chloride oxide
- E sodium hypochlorite

56 $Mg(HCO_3)_2$ is

- A Magnesium carbonate
- B Magnesium hydrogen carbonate
- C Magnesium hydroxide
- D Magnesium carboxide
- E Magnesium dibicarbonate

57 Ammonium carbonate is

- A NH_4CO_3
- B $(NH_4)_2CO_3$
- C $NH_4(CO_3)_2$
- D $(NH_4)_2CO_2$

Naming Ternary Ionic Compounds

If the formula involves a transition or post transition element, you must first deduce the charge so it can be included in the name.

For example: Name Cu_2CO_3

1. Un-criss cross the charges.

Cu_2^{+} (CO_3)

2. Cu carries a +1 charge

So.... this compound is called copper(I) carbonate

For example: Name $Ni(NO_3)_2$

Move for answer

58

- A gallium sulfite
- B gallium (I) sulfite
- C gallium (III) sulfite
- D gallium (III) sulfate

Move for explanation

59

- A gold (I) flouride
- B gold(III) flouride
- C gold flouride
- D gold flourine
- E gold triflouride

Move for explanation

60

- A tin carbonate
- B tin(II) carbonate
- C tin carbide
- D tin tetracarbonate
- E tin (IV) carbonate

Polyatomic Patterns

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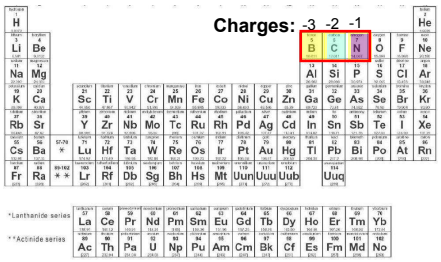
Polyatomic Patterns

Tips for remembering polyatomic ions using patterns: Boron, Carbon, and Nitrogen polyatomic ions have a maximum of 3 oxygens.

Borate	BO_3^{3-}	Borite	BO_3^{3-}
Carbonate	CO_3^{2-}	Carbonite	CO_2^{2-}
Nitrate	NO_3^{1-}	Nitrite	NO_2^{1-}

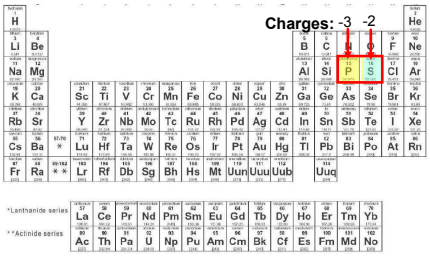


Polyatomic Patterns

Tips for remembering polyatomic ions using patterns:

Phosphorus and Sulfur polyatomic ions have a maximum of 4 oxygens.

Phosphate	PO_4^{3-}	Phosphite	PO_3^{3-}
Sulfate	SO_4^{2-}	Sulfite	SO_3^{2-}



Polyatomic Patterns

Tips for remembering polyatomic ions using patterns: All of the halogens follow the same naming pattern: Per-ate = 4 oxygens, ---ate = 3 oxygens, ---ite = 2 oxygens, --- hypo-ite = 1 oxygen.

Perchlorate	ClO_4^{1-}
Chlorate	ClO_3^{1-}
Chlorite	ClO_2^{1-}
Hypochlorite	ClO^{1-}