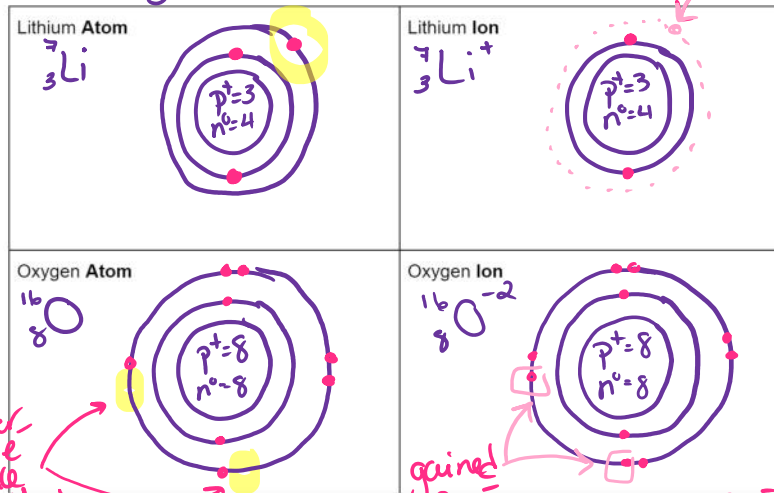


PART E: ATOMS VS IONS

Remember...

Atoms are NEUTRAL with equal p^+ = e^- , whereas IONS have a **charge** due to lost or gained electrons.



Lost $1e^-$ ∴ the whole shell is gone. Li has "downsized" to the next FULL valence shell.

room for 2 more e^- to make shell full

NAMING IONS

gained $2e^-$... now $10e^- > 8p^+$ that is what makes the -2 charge!

1) Naming METAL IONS

- use the **name of the metal**, and add the word "ion" at the end.

Example: Sodium metal (Na) forms the Sodium ion
Aluminum metal (Al) forms the Aluminium ion

1) Naming NON-METAL IONS

- take off the original ending of the name, and add "ide"

~~-ine -ogen
-ygen -orus
-ur~~

Element name	Element symbol	Ion name	Ion symbol
fluorine	F	fluoride	F^-
chlorine	Cl	chloride	Cl^-
bromine	Br	bromide	Br^-
iodine	I	iodide	I^-
oxygen	O	oxide	O^{2-}
sulphur	S	sulphide	S^{2-}
nitrogen	N	nitride	N^{3-}
phosphorus	P	phosphide	P^{3-}

All group 1 elements form a **-1 ion**

All group 2 form **-2**

All group 3 form **-3**

1	2	3	4	5	6	7	8	9	10
I	II	III	IV	V	VI	VII	VIII	IX	X

3) Naming **MULTIVALENT METAL IONS**

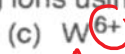
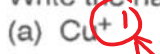
- **Multivalent Ions:** most **transition metals** are multivalent, meaning they have more than 1 stable state.
- if a metal has more than one possible charge, the charge is shown by using a **Roman Numeral** after the name of the metal, and before the word "ion"

Example: Fe³⁺ = iron _____, Fe²⁺ = iron _____, U⁶⁺ = uranium _____, U³⁺ = uranium _____

Iron(III)ion Iron(II)ion Uranium(VI)ion Uranium(III)ion



2. Write the names of the following ions using the Stock system of notation.



Copper(I)ion

chromium(III)ion

Tungsten(VI)ion

3. Write the formula of the following ions to show their charges.



we know they are all + because metals always form cations (not anions)



ASSIGNMENT #2: "Name That Atom" (link on class website) + Bohr Diagrams Atoms to Ions pg 9-10 This assignment is to be completed below in the space provided.

http://www.learner.org/interactives/periodic/basics_interactive.html

Name That Atom

You've just read about the composition of atoms—protons, neutrons, and electrons. The number of protons determine what kind of element the atom is, the neutrons determine if the atom is an isotope, and the electrons tell you if the atom is an ion or not. Let's see how well you've absorbed these ideas.

Scoring: You get 1 point for each correct answer and lose half a point for every wrong one.

Play

Homework Bohr Diagrams :ATOMS to IONS

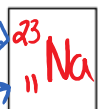
Bohr Diagrams :ATOMS to IONS

For each element:

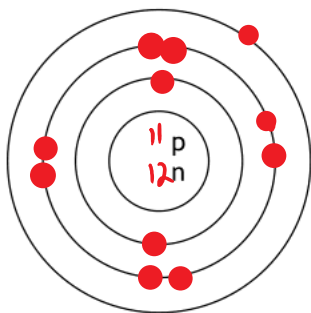
1. Write the *standard atomic notation* in the box.
2. Find the number of protons, neutrons, and electrons in each atom.
3. Draw the Bohr diagram.
4. Find the ion that this atom would create: name it & write it in the box.
5. Draw the diagram for the ion created from the element.

atomic mass
atomic number

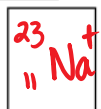
Sodium



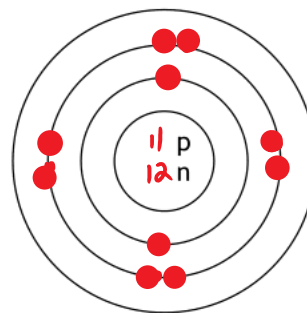
11 p+
12 n
11 e-



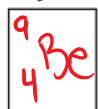
Sodium ION



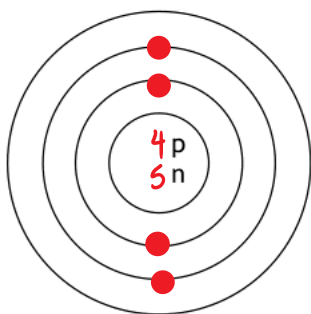
11 p+
12 n
10 e-



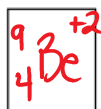
Beryllium



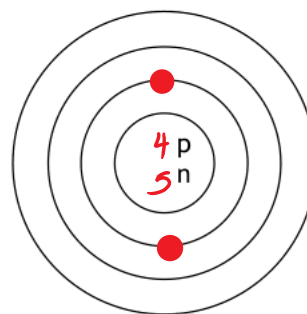
4 p+
5 n
4 e-



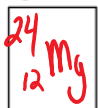
Beryllium ION



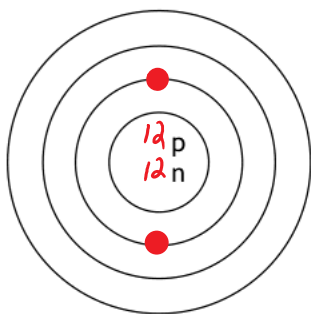
4 p+
5 n
2 e-



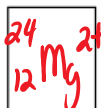
Magnesium



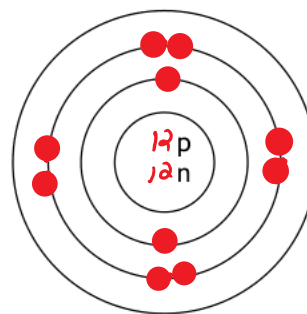
12 p+
12 n
12 e-

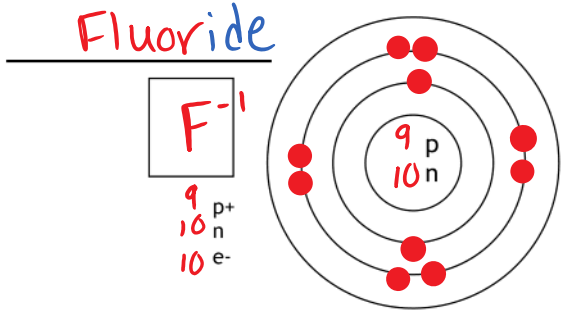
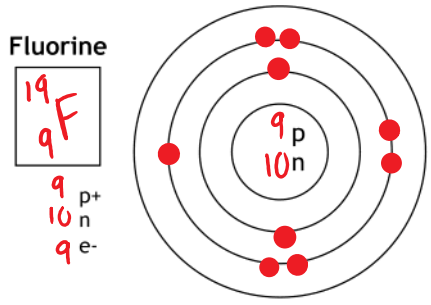
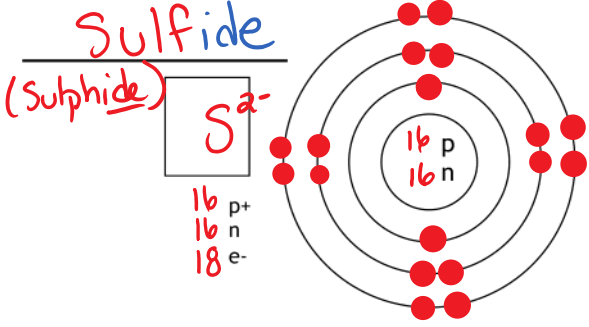
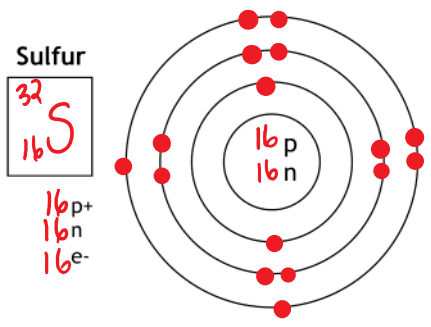
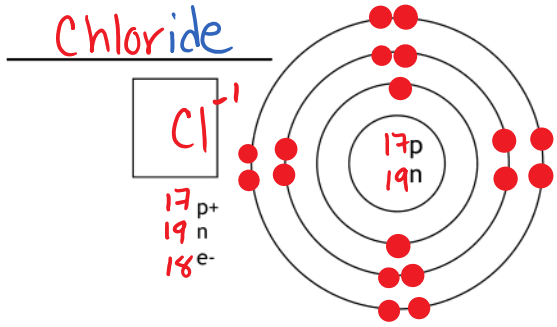
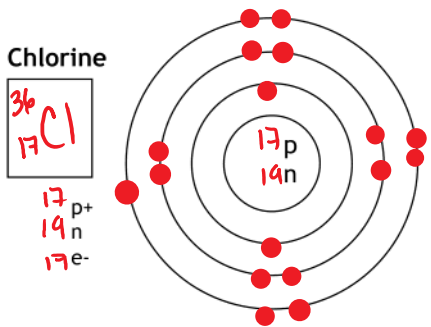


Magnesium ION



12 p+
12 n
10 e-





PART F: POLYATOMIC IONS

nitrite NO_2^-
sulphite SO_3^{2-}

nitrate NO_3^-
sulphate SO_4^{2-}

A **molecule** is a **neutral** group of covalently bonded atoms (*share electrons*)

A **polyatomic ion** is a **charged** group of covalently bonded atoms so it's like a **molecule** except that it has a **+ or - charge**.

They are relatively stable species that remain intact in chemical reactions. This means the "polyatomic group" does not separate in a chemical reaction when a bond forms.

Many polyatomic ions are **oxyanions**, consisting of an atom of a given element and some number of **oxygen** atoms. (and a \ominus charge) *anion*

NOTE The names & formulae of these are provided in your DATA BOOKLET.

PRACTICE

Polyatomic Practice

1. Name or write the formula for the following polyatomic ions.

sulfate	SO_4^{2-}	CO_3^{2-}	Carbonate
nitrite	NO_2^-	MnO_3^-	Manganate
perphosphate	PO_5^{3-}	SO_5^{2-}	persulphate
hypoiodite	IO^-	BrO_2^-	Bromite
chlorite	ClO_2^-	CO_4^{2-}	Percarbonate
phosphite	PO_3^{3-}	PO_5^{3-}	Perphosphate
percarbonate	CO_4^{2-}	ClO^-	hypochlorite
bromate	BrO_4^-	IO_2^-	Iodite
hyposulfite	$\text{S}_2\text{O}_3^{2-}$	PO_4^{3-}	phosphate
permanganate	MnO_4^-	NO_2^-	Nitrite
carbonite	CO_2^{2-}	SO_4^{2-}	Sulphate

means another oxygen



ASSIGNMENT #3: Polyatomic Ions pg 13-15

This assignment is to be completed below in the space provided.

Polyatomic Ions

Why?

Can a group of atoms have a charge?

Do you know you eat a lot of “-ates”? Next time you look at a food label, read the ingredients and you will likely find a number of ingredients that end with “-ate,” such as sodium phosphate or calcium carbonate. Did you ever wonder what the chemical formulas of these ingredients look like? In this activity we will explore polyatomic ions, which are groups of atoms that carry a charge. These ions are found in our food ingredients, natural waterways, and many other chemical compounds you encounter every day.

Model 1 – Types of Ions

Monatomic Ions	Nitride 	Sulfide 	Chloride
Polyatomic Ions	Nitrate 	Sulfate 	Ammonium
	Nitrite 	Sulfite 	Hydroxide

1. Use Model 1 to complete the table below.

Name of Ion	Nitride	Nitrate	Sulfate	Sulfite	Ammonium
Charge on Ion	-3	-1	-2	-2	+1
Type and Number of Atoms	1 nitrogen	1 nitrogen 3 oxygen	1 sulfur 4 oxygen	1 sulfur 3 oxygen	1 nitrogen 4 hydrogen
Chemical Formula	N^{3-}	NO_3^{1-}	SO_4^{2-}	SO_3^{2-}	NH_4^{1+}

2. Consider the terms “monatomic” and “polyatomic” as they are used in Model 1. Write a definition for each of these terms. It may be helpful to break the words apart (*i.e.*, poly – atomic). Make sure your group comes to consensus.

Monatomic—*one atom*

Polyatomic—*many atoms*

3. What types of elements (metals or nonmetals) are shown in the polyatomic ions in Model 1?

Nonmetals.

4. What types of bonds (ionic or covalent) hold the atoms together in polyatomic ions? Explain your reasoning.

Covalent, because electrons are shared between nonmetal atoms.

5. The net charge on a sulfide ion (S^{2-}) is -2 . Explain how this ion obtains its charge. Your answer should include a discussion of subatomic particles.

Answers will vary.

There are two extra electrons in the ion compared to a neutral S atom.

There are two more electrons than protons in the S^{2-} ion.

Two electrons have been added to an atom of sulfur.

6. The dotted line around each polyatomic ion in Model 1 shows that the group of atoms has a charge. The charge is not on any one atom, but rather on the group of atoms as a whole. Based on your knowledge of monatomic ions, propose an explanation for the net charge on a polyatomic ion. Your answer should include a discussion of subatomic particles.

Somewhere in the ion there are either extra (in the case of an ion) or fewer electrons (in the case of a cation) compared to the total number of protons in the atoms involved.

7. What are the similarities and differences between the nitrate and nitrite ions in Model 1?

Both ions have a -1 charge, and each ion includes both nitrogen and oxygen atoms.

Nitrate has three oxygen atoms; nitrite only has two.

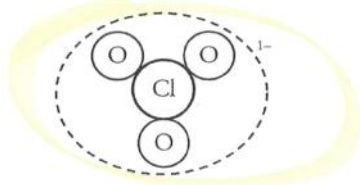
8. What are the similarities and differences between the sulfate and sulfite ions in Model 1?

Both ions have a -2 charge, and each ion includes both sulfur and oxygen atoms.

Sulfate has four oxygen atoms; sulfite only has three.

9. The “chlorate” polyatomic ion has a charge of -1 and is composed of one chlorine atom (the central atom) and three oxygen atoms.

- a. Draw a model of a chlorate ion.



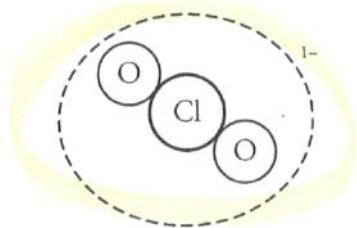
- b. Write the chemical formula for the chlorate ion, including its charge.





10. In your group discuss what "chlorite" would look like.

a. Draw a model of a chlorite ion.



b. Write the chemical formula for the chlorite ion, including its charge.



Model 2 – Common Polyatomic Ions

1+		1-		2-		3-	
ammonium	NH_4^{1+}	acetate	$\text{CH}_3\text{COO}^{1-}$	sulfate	SO_4^{2-}	phosphate	PO_4^{3-}
		hydroxide	OH^{1-}	sulfite	SO_3^{2-}		
		nitrate	NO_3^{1-}	carbonate	CO_3^{2-}		
		nitrite	NO_2^{1-}	chromate	CrO_4^{2-}		
		bicarbonate	HCO_3^{1-}	dichromate	$\text{Cr}_2\text{O}_7^{2-}$		
		permanganate	MnO_4^{1-}				
		perchlorate	ClO_4^{1-}				
		chlorate	ClO_3^{1-}				
		chlorite	ClO_2^{1-}				
		hypochlorite	ClO^{1-}				

11. What is the only polyatomic ion that is a cation?

Ammonium, NH_4^{1+}

12. How are bicarbonate and carbonate related?

Bicarbonate has the same basic formula as carbonate but with an H^+ added. The charge has decreased from -2 to -1 .

13. Predict the chemical formula and charge for the bisulfate ion.

HSO_4^{1-}

14. How are chromate and dichromate related?

Both ions have chromium and oxygen atoms, but dichromate has two chromium atoms and more oxygen atoms than chromate. They both have a -2 charge.

15. Bromine forms polyatomic ions with structures similar to those of chlorine. Using the chlorine family of polyatomic ions as a model, predict the name of the BrO_4^{1-} ion.

Perbromate.

16. Identify the polyatomic ion in each of these ionic compounds. Write out the name and formula of the ions including their charges.

a. CaCO_3

*Carbonate
 CO_3^{2-}*

b. $\text{Mg}(\text{OH})_2$

*Hydroxide
 OH^{1-}*

c. NH_4Cl

*Ammonium
 NH_4^{1+}*