# SI Chemistry - Full Discipline Demo

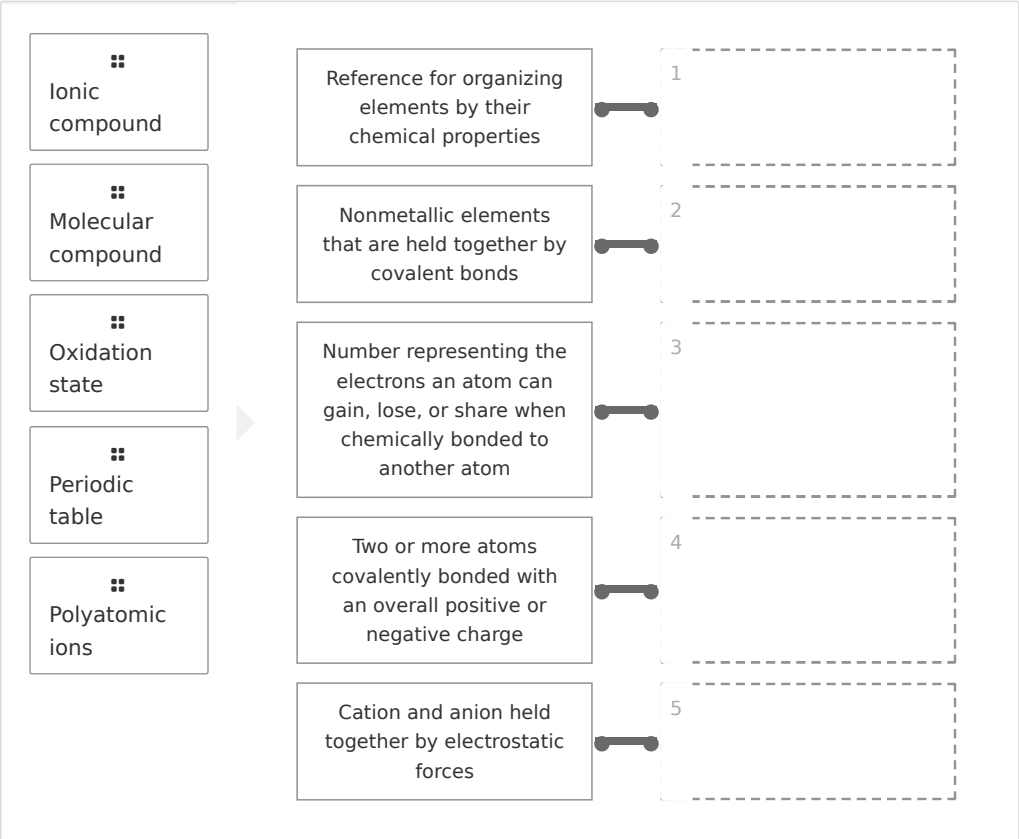
## Naming Ionic and Molecular Compounds

## Final Report - Answer Guide

| | |
|---|---|
| **Institution** | Science Interactive University |
| **Session** | SI Chemistry - Full Discipline Demo |
| **Course** | SI Chemistry - Full Discipline Demo |
| **Instructor** | Sales SI Demo |

## Test Your Knowledge

**Match each term with the best description.**

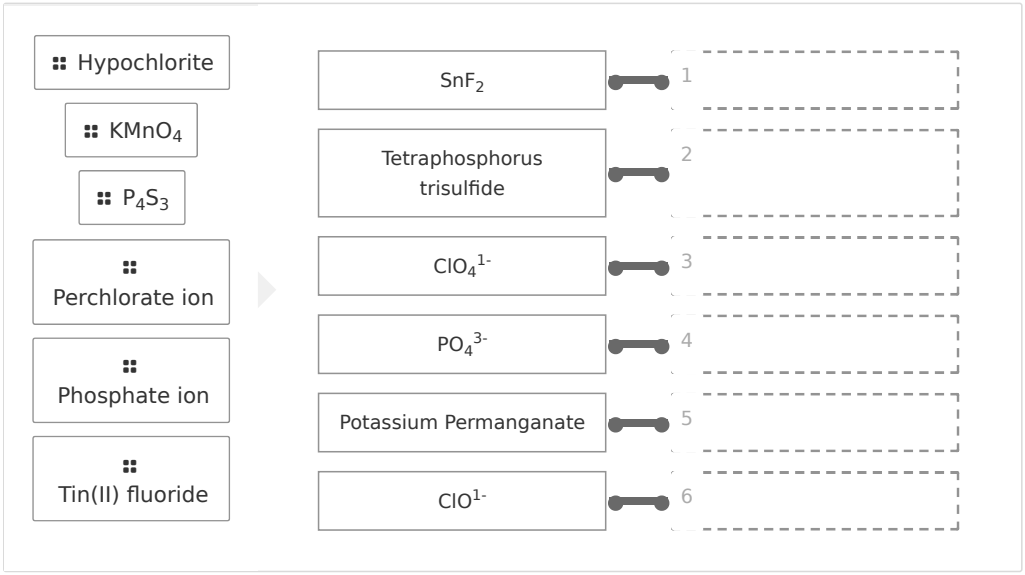



Correct answers:

1 Periodic table 2 Molecular compound 3 Oxidation state

4 Polyatomic ions 5 Ionic compound

**Match each term to the best description.**

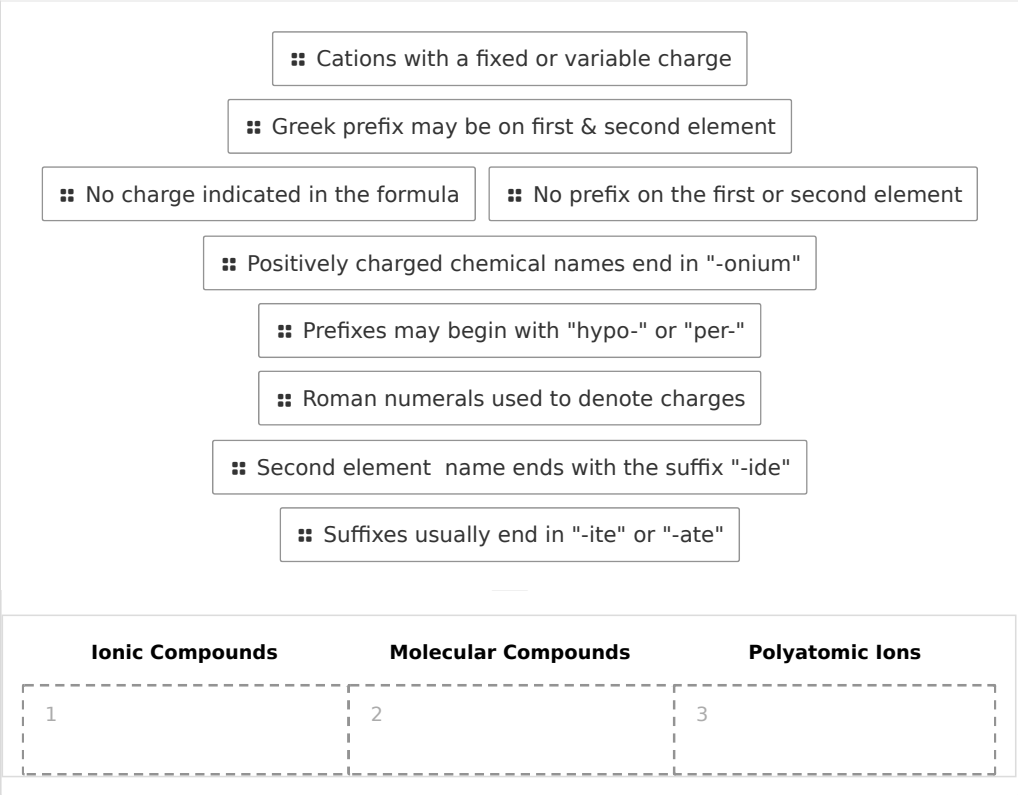



Correct answers:

1 Tin(II) fluoride 2 $P_4S_3$ 3 Perchlorate ion 4 Phosphate ion

5 $KMnO_4$ 6 Hypochlorite

**Categorize each statement as a naming property for molecular compounds, ionic compounds, or polyatomic ions.**




Correct answers:

1 Cations with a fixed or variable charge

Roman numerals used to denote charges

No prefix on the first or second element

2 Greek prefix may be on first & second element

No charge indicated in the formula

Second element  name ends with the suffix "-ide"

3 Suffixes usually end in "-ite" or "-ate"

Positively charged chemical names end in "-onium"

Prefixes may begin with "hypo-" or "per-"

## Exploration

**Elements are arranged in the periodic table according to their chemical properties.**

- True ✔
- False

**Binary molecular compounds consist of _____.**

- one nonmetal and one metal element
- two metal elements
- two nonmetal elements ✔
- one metal element and one polyatomic ion

**Molecular compounds must be balanced by mathematically calculating the charge.**

- True
- False ✔

**The _____ must be known to ensure the correct number of atoms of each element are present in an ionic compound.**

- polyatomic ions
- binary molecules
- oxidation state ✔
- Greek prefix

**The sum of the charges for the cation and anion of a neutral ionic compound must equal _____.**

- 0 ✔
- 1
- -1
- 10

**The suffix ____ indicates the lowest oxidation state, and the suffix ____ indicates the highest oxidation state.**

- [x] ite; ate
- [ ] ate; ite
- [ ] hypo; per
- [ ] per; hypo

**____ include the prefix "hydro-," followed by the root of the second element with the addition of the suffix "-ic."**

- [x] Binary acids
- [ ] Oxoacids

**Diatomic elements do not have full valence electron shells and cannot exist as a single atom.**

- [x] True
- [ ] False

# Exercise 1

Photo 1: Colored Periodic Table
(SAMPLE ANSWER BELOW)

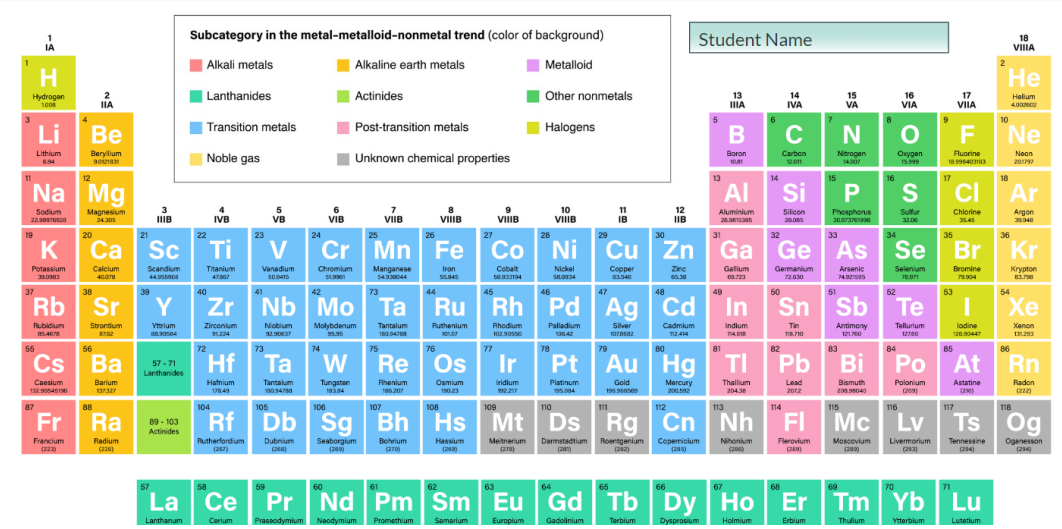



Photo 2: Polyatomic Ion Note Card

(SAMPLE ANSWER BELOW)

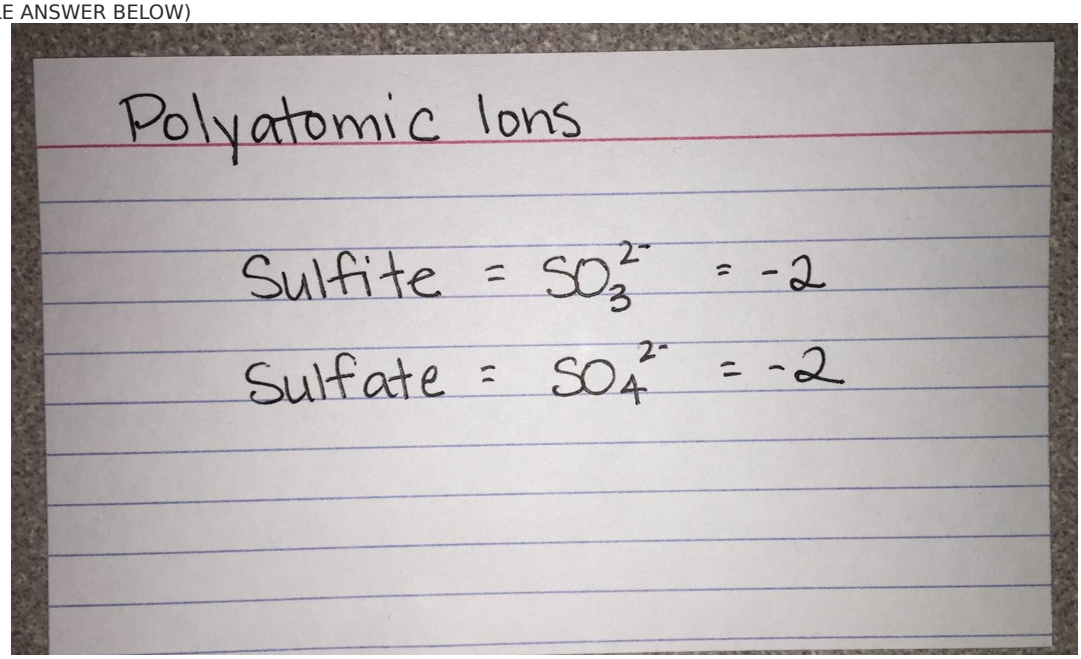


Photo 3: Strong Acid Note Card

(SAMPLE ANSWER BELOW)

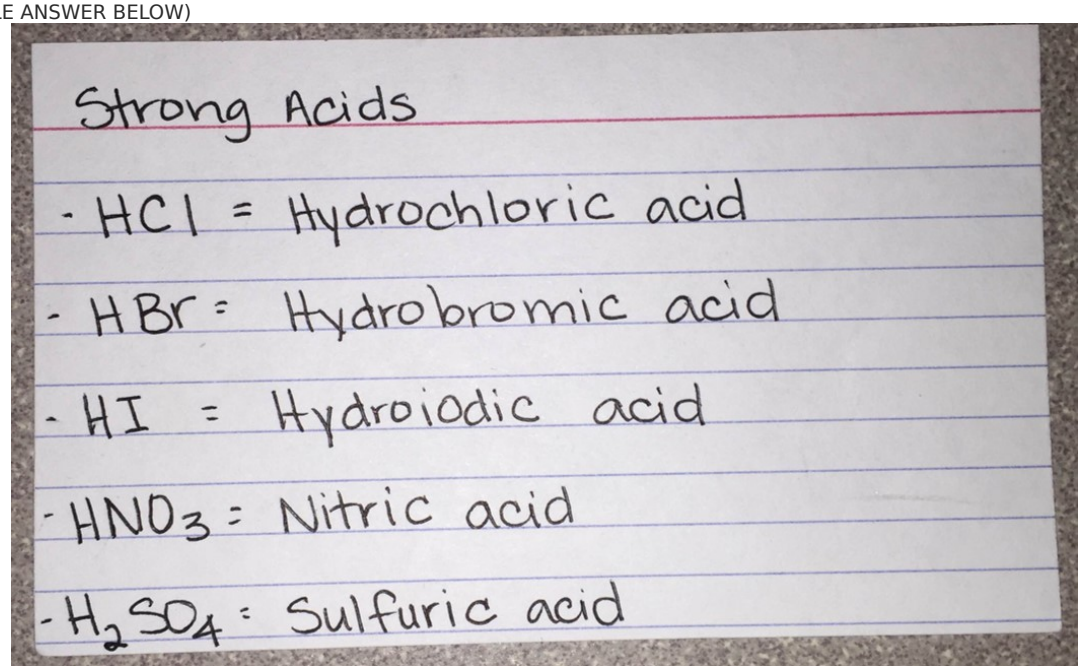
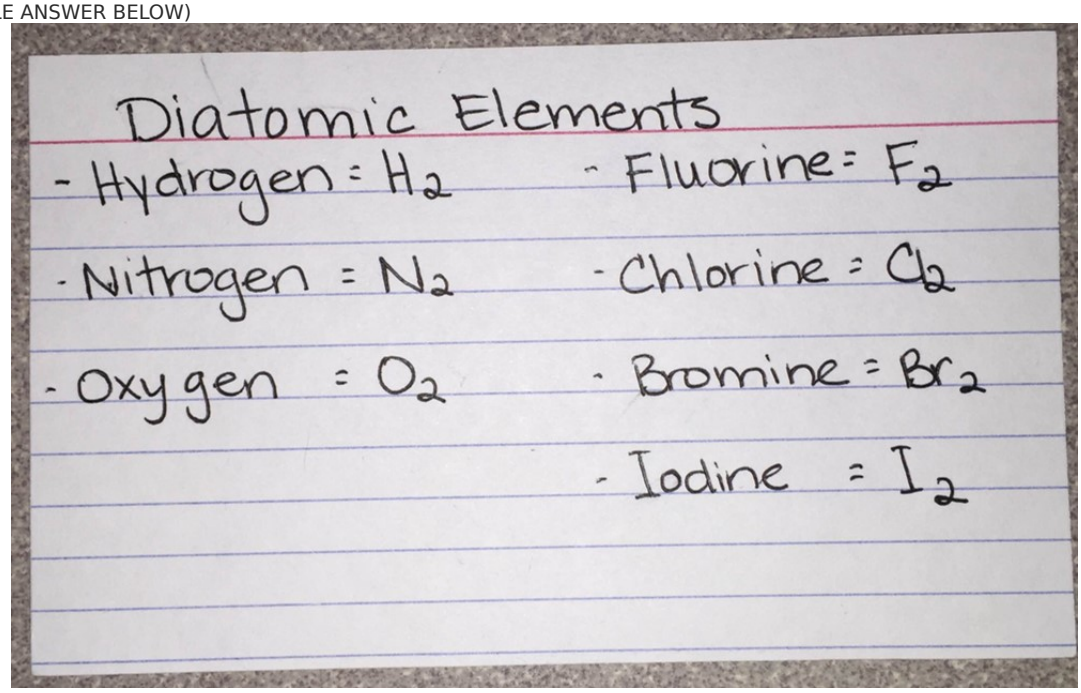


Photo 4: Diatomic Element Note Card
(SAMPLE ANSWER BELOW)



## Exercise 2

**Consider adding a single $H^+$ to the polyatomic ion phosphate. What is the formula of the new ion (including its charge)? What is the name of the new ion?**

Formula: $HPO_4^{2-}$ (the charge goes from 3- to 2-)
Name: hydrogen phosphate

**The metals in Group IIIA, IVA and VA of the periodic table are not transition metals. However, all but 1 have variable charges. What element in Group IIIA, Period 3 has a fixed charge, and what is that charge?**

Aluminum 3+

**Describe the difference between molecular and ionic compounds.**

Molecular compounds consist of nonmetallic elements that combine through covalent bonds. Ionic compounds consist of one metal (cation) and one nonmetal (anion or polyatomic ion) held together by ionic bonds.

Data Table 1: Binary Molecular and Ionic Compound Names
(SAMPLE ANSWER BELOW)

| # | Formula | Molecular or Ionic Compound? | Compound Name |
|---|---|---|---|
| 1 | $B_2O_3$ | molecular | diboron trioxide |
| 2 | $N_2O$ | molecular | dinitrogen monoxide |
| 3 | LiCl | ionic | lithium chloride |
| 4 | $N_2O_4$ | molecular | dinitrogen tetroxide |
| 5 | $SF_4$ | molecular | sulfur tetrafluoride |
| 6 | $BrF_3$ | molecular | bromine trifluoride |
| 7 | $AlBr_3$ | ionic | aluminum bromide |
| 8 | $SnF_2$ | ionic | tin(II) fluoride |
| 9 | $SiCl_4$ | molecular | silicon tetrachloride |
| 10 | $H_2O_2$ | molecular | dihydrogen dioxide or Hydrogen peroxide |
| 11 | NaCl | ionic | sodium chloride |
| 12 | $TiCl_3$ | ionic | titanium(III) chloride |
| 13 | $SiO_2$ | molecular | silicon dioxide |
| 14 | $Al_2S_3$ | ionic | aluminum sulfide |
| 15 | $CCl_4$ | molecular | carbon tetrachloride |
| 16 | $CuF_2$ | ionic | copper(II) fluoride |
| 17 | $SF_6$ | molecular | sulfur hexafluoride |
| 18 | $P_4S_3$ | molecular | tetraphosphorus trisulfide |
| 19 | $XeF_4$ | molecular | xenon Tetrafluoride |
| 20 | $PtCl_2$ | ionic | platinum(II) chloride |

Data Table 2: Binary Molecular and Ionic Compound Formulas
(SAMPLE ANSWER BELOW)

| # | Compound Name | Molecular or Ionic Compound? | Formula |
|---|---|---|---|
| 1 | bromine dioxide | $Molecular$ | |

| | | | |
|---|---|---|---|
| | | | $BrO_2$ |
| 2 | lithium selenide | $Ionic$ | $Li_2Se$ |
| 3 | iodine monochloride | $Molecular$ | $ICl$ |
| 4 | nitrogen monoxide | $Molecular$ | $NO$ |
| 5 | iron(II) sulfide | $Ionic$ | $FeS$ |
| 6 | hydrogen chloride | $Molecular$ | $HCl\ (g)$ |
| 7 | diboron hexahydride | $Molecular$ | $B_2H_6$ |
| 8 | barium iodide | $Ionic$ | $BaI_2$ |
| 9 | cadmium sulfide | $Ionic$ | $CdS$ |
| 10 | bromine trichloride | $Molecular$ | $BrCl_3$ |
| 11 | nitrogen trihydride | $Molecular$ | $NH_3$ |
| 12 | molybdenum(VI) fluoride | $Ionic$ | $MoF_6$ |
| 13 | carbon tetrabromide | $Molecular$ | $CBr_4$ |
| 14 | sulfur trioxide | $Molecular$ | $SO_3$ |
| 15 | lead(II) chloride | $Ionic$ | $PbCl_2$ |
| 16 | iodine hexafluoride | $Molecular$ | $IF_6$ |
| 17 | tetraphosphorus decasulfide | $Molecular$ | $P_4S_{10}$ |
| 18 | dichlorine trioxide | $Molecular$ | $Cl_2O_3$ |

| | | | |
|---|---|---|---|
| 19 | potassium chloride | $Ionic$ | $KCl$ |
| 20 | calcium oxide | $Ionic$ | $CaO$ |

Data Table 3: Polyatomic Ion and Acid Names
(SAMPLE ANSWER BELOW)

| # | Formula | Name |
|---|---|---|
| 1 | $SO_4^{2-}$ | sulfate ion |
| 2 | $SnCl_4$ | tin(IV) chloride |
| 3 | $ClO_2^-$ | chlorite ion |
| 4 | $H_3PO_4$ | phosphoric acid |
| 5 | $Cu_3(PO_4)_2$ | copper(II) phosphate |
| 6 | $FeSO_4$ | iron(II) sulfate |
| 7 | $NH_4Cl$ | ammonium chloride |
| 8 | $HClO_4$ (aq) | perchloric acid |
| 9 | $PO_4^{3-}$ | phosphate ion |
| 10 | $K_2SO_3$ | potassium sulfite |
| 11 | $MnO_2$ | manganese(IV) oxide |
| 12 | $Ca_3(PO_4)_2$ | calcium phosphate |
| 13 | NaOH | sodium hydroxide |
| 14 | HCl (aq) | hydrochloric acid |
| 15 | $HNO_3$ (aq) | nitric acid |
| 16 | $FeSO_3$ | iron(II) sulfite |
| 17 | $WO_3$ | tungsten(VI) oxide |
| 18 | $H_2CO_3$ | carbonic acid |
| 19 | $KMnO_4$ | potassium permanganate |
| 20 | $H_2S$ (aq) | hydrosulfuric acid |

Data Table 4: Polyatomic Ion and Acid Formulas
(SAMPLE ANSWER BELOW)

| # | Name | Formula |
|---|---|---|
| 1 | potassium nitrate | $KNO_3$ |
| 2 | carbonate ion | $CO_3^{\ 2-}$ |

| | | |
|---|---|---|
| 3 | dihydrogen phosphate | $H_2PO_4^-$ |
| 4 | hypochlorous acid | $HClO$ |
| 5 | hydrogen cyanide | $HCN\ (g)$ |
| 6 | cobalt(III) sulfite | $Co_2(SO_3)_3$ |
| 7 | permanganic acid | $HMnO_4$ |
| 8 | magnesium hypochlorite | $Mg(ClO)_2$ |
| 9 | hydroiodic acid | $HI\,(aq)$ |
| 10 | titanium(IV) nitrate | $Ti(NO_3)_4$ |
| 11 | silver chromate | $Ag_2CrO_4$ |
| 12 | nickel(II) phosphate | $Ni_3(PO_4)_2$ |
| 13 | sulfuric acid | $H_2SO_4$ |
| 14 | magnesium nitride | $Mg_3N_2$ |
| 15 | hydrobromic acid | $HBr\,(aq)$ |
| 16 | ammonium ion | $NH_4^+$ |
| 17 | lithium hypochlorite | $LiClO$ |
| 18 | nitrous acid | $HNO_2$ |
| 19 | barium hydrogen sulfite | $Ba(HSO_3)_2$ |
| 20 | hydrofluoric acid | |

| | | |
|---|---|---|
| | | $HF\ (aq)$ |

## Competency Review

**The Periodic Table includes an element's _____.**

- atomic number
- polyatomic ions
- atomic mass
- atomic number and atomic mass ✔
- All of the above

**_____ compounds include a prefix on the first and second elements and a suffix on the second element, whereas _____ compounds do not have prefixes and only include a suffix on the second element.**

- Ionic; molecular
- Molecular; ionic ✔
- Molecular; binary

**Metals with a _____ charge are indicated by Roman numerals in the chemical name.**

- fixed
- variable ✔
- fixed and variable
- None of the above

**Polyatomic ions with the lowest oxidation state will include the prefix _____ and the suffix _____.**

- hypo-; -ite ✔
- hypo; -ate
- per-; -ite
- per-; -ate

**Greek prefixes are used in the naming of the number of atoms of each element for ionic compounds.**

- True
- False ✔

**An example of an oxoacid is _____.**

- hydrochlorous acid
- hypochlorous acid ✔
- hydrochloric acid
- hyperchloric acid

**Diphosphorus pentoxide is a(n) _____.**

- ionic compound
- molecular compound ✔
- polyatomic ion

**_____ is an ionic compound.**

- $TiCl_3$ ✔
- $CCl_4$
- $B_2O_3$
- $Xe_3F_4$

**The name for the formula $CuCl_2$ is _____.**

- monocopper(II) dichloride
- copper(III) chloride
- copper(II) chloride ✔
- copper(III) dichlorine

**Dichlorine trioxide is a(n) _____ compound with the formula _____.**

- molecular; $ClO_3$
- molecular; $Cl_2O_3$ ✔
- ionic; $ClO_3$
- ionic; $Cl_2O_3$

**The formula for potassium sulfate is _____.**

- $KSO_3$
- $KSO_4$
- $K_2SO_3$
- $K_2SO_4$ ✔

**Perchloric acid is a(n) _____ acid with the formula _____.**

- binary; HClO
- binary; $HClO_4$
- oxo-; $HClO_4$ ✔
- oxo-; $HClO_2$

**The elements chromium, molybdenum, and manganese are _____ with a _____ charge.**

- alkali metals; variable
- transition metals; variable ✔
- nonmetals; fixed
- transition metals; fixed

## Extension Questions

**Use the internet to research the ionic compounds listed below to determine if they have medicinal uses. Write the formulas of these compounds and state their use.**

**Barium sulfate**
**Lithium chloride**
**Lithium selenide**
**Sodium chloride**
**Platinum(II) chloride**
**Potassium chloride**

(SAMPLE ANSWER BELOW)

$BaSO_4$ – used in medical imaging of the gastrointestinal tract by the patient ingesting it making the stomach and intestines visible to X-rays
LiCl and $Li_2Se$ – treatment for bipolar disorder or other psychiatric conditions
NaCl – catheter flush injections or intravenous infusions
$PtCl_2$ – some forms used as anti-cancer drugs
KCl – mineral supplement used to treat or prevent low amounts of potassium in the blood to help human cells, kidneys, heart, muscles, and nerves work properly