

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.

 Ionic compound	Reference for organizing elements by their chemical properties	1
 Molecular compound	Nonmetallic elements that are held together by covalent bonds	2
 Oxidation state	Number representing the electrons an atom can gain, lose, or share when chemically bonded to another atom	3
 Periodic table	Two or more atoms covalently bonded with an overall positive or negative charge	4
 Polyatomic ions	Cation and anion held together by electrostatic forces	5

Correct answers:

- 1 Periodic table 2 Molecular compound 3 Oxidation state
4 Polyatomic ions 5 Ionic compound

Match each term to the best description.

⚡ Hypochlorite	SnF₂	1
⚡ KMnO₄	Tetraphosphorus trisulfide	2
⚡ P₄S₃	ClO₄¹⁻	3
⚡ Perchlorate ion	PO₄³⁻	4
⚡ Phosphate ion	Potassium Permanganate	5
⚡ Tin(II) fluoride	ClO¹⁻	6

Correct answers:

- 1 Tin(II) fluoride 2 P₄S₃ 3 Perchlorate ion 4 Phosphate ion
5 KMnO₄ 6 Hypochlorite

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

⚡ Cations with a fixed or variable charge		
⚡ Greek prefix may be on first & second element		
⚡ No charge indicated in the formula	⚡ No prefix on the first or second element	
⚡ Positively charged chemical names end in "-onium"		
⚡ Prefixes may begin with "hypo-" or "per-"		
⚡ Roman numerals used to denote charges		
⚡ Second element name ends with the suffix "-ide"		
⚡ Suffixes usually end in "-ite" or "-ate"		
Ionic Compounds 1	Molecular Compounds 2	Polyatomic Ions 3

Correct answers:

- Cations with a fixed or variable charge
 Roman numerals used to denote charges
 No prefix on the first or second element
- Greek prefix may be on first & second element
 No charge indicated in the formula
 Second element name ends with the suffix "-ide"
- 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.

- ☐ 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."

- ☐ Binary acids ✓
- ☐ Oxoacids

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

- ☐ True ✓
- ☐ False

Exercise 1

Photo 1: Colored Periodic Table
(SAMPLE ANSWER BELOW)

1

IA

2

IIA

3

IIIB

4

IVB

5

VB

6

VIB

7

VIIB

8

VIII

9

IIIB

10

VIIB

11

IB

12

IIB

13

IIIA

14

IVA

15

VA

16

VIA

17

VIIA

18

VIIIA

Subcategory in the metal-metalloid-nonmetal trend (color of background)

Alkali metals

Alkaline earth metals

Metalloid

Lanthanides

Actinides

Other nonmetals

Transition metals

Post-transition metals

Halogens

Noble gas

Unknown chemical properties

Student Name

1 H Hydrogen 1.008																	2 He Helium 4.002602																						
3 Li Lithium 6.94	4 Be Beryllium 9.012182															5 B Boron 10.81	6 C Carbon 12.011	7 N Nitrogen 14.007	8 O Oxygen 15.999	9 F Fluorine 18.9984332	10 Ne Neon 20.1797																		
11 Na Sodium 22.98976928	12 Mg Magnesium 24.305	13 Al Aluminum 26.9815385	14 Si Silicon 28.085	15 P Phosphorus 30.973761998	16 S Sulfur 32.06	17 Cl Chlorine 35.45	18 Ar Argon 39.948											19 K Potassium 39.0983	20 Ca Calcium 40.078	21 Sc Scandium 44.955912	22 Ti Titanium 47.88	23 V Vanadium 50.9415	24 Cr Chromium 51.9961	25 Mn Manganese 54.938044	26 Fe Iron 55.845	27 Co Cobalt 58.933194	28 Ni Nickel 58.6934	29 Cu Copper 63.546	30 Zn Zinc 65.38	31 Ga Gallium 69.723	32 Ge Germanium 72.630	33 As Arsenic 74.921595	34 Se Selenium 78.96	35 Br Bromine 79.904	36 Kr Krypton 83.798				
37 Rb Rubidium 85.4678	38 Sr Strontium 87.62	39 Y Yttrium 88.90584	40 Zr Zirconium 91.224	41 Nb Niobium 92.90637	42 Mo Molybdenum 95.94	43 Tc Technetium 98.90625	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.90550	46 Pd Palladium 106.42	47 Ag Silver 107.8682	48 Cd Cadmium 112.414	49 In Indium 114.818	50 Sn Tin 118.710	51 Sb Antimony 121.757	52 Te Tellurium 127.6	53 I Iodine 126.90447	54 Xe Xenon 131.29					55 Cs Cesium 132.90545196	56 Ba Barium 137.327	57-71 Lanthanides	72 Hf Hafnium 178.49	73 Ta Tantalum 180.94788	74 W Tungsten 183.84	75 Re Rhenium 186.207	76 Os Osmium 190.23	77 Ir Iridium 192.222	78 Pt Platinum 195.084	79 Au Gold 196.966569	80 Hg Mercury 200.59	81 Tl Thallium 204.38	82 Pb Lead 207.2	83 Bi Bismuth 208.9804	84 Po Polonium 209	85 At Astatine 210	86 Rn Radon 222
87 Fr Francium 223	88 Ra Radium 226	89-103 Actinides	104 Rf Rutherfordium 261	105 Db Dubnium 262	106 Sg Seaborgium 266	107 Bh Bohrium 264	108 Hs Hassium 277	109 Mt Meitnerium 268	110 Ds Darmstadtium 271	111 Rg Roentgenium 272	112 Cn Copernicium 285	113 Nh Nihonium 284	114 Fl Flerovium 289	115 Mc Moscovium 288	116 Lv Livermorium 293	117 Ts Tennessine 294	118 Og Oganesson 294					57 La Lanthanum	58 Ce Cerium	59 Pr Praseodymium	60 Nd Neodymium	61 Pm Promethium	62 Sm Samarium	63 Eu Europium	64 Gd Gadolinium	65 Tb Terbium	66 Dy Dysprosium	67 Ho Holmium	68 Er Erbium	69 Tm Thulium	70 Yb Ytterbium	71 Lu Lutetium			

89	90	91	92	93	94	95	96	97	98	99	100	101	102	103
Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr
Actinium (189)	Thorium (90)	Protactinium (91)	Uranium (92)	Neptunium (93)	Plutonium (94)	Americium (95)	Curium (96)	Berkelium (97)	Californium (98)	Einsteinium (99)	Fermium (100)	Mendelevium (101)	Nobelium (102)	Lavrencium (103)

Photo 2: Polyatomic Ion Note Card
(SAMPLE ANSWER BELOW)

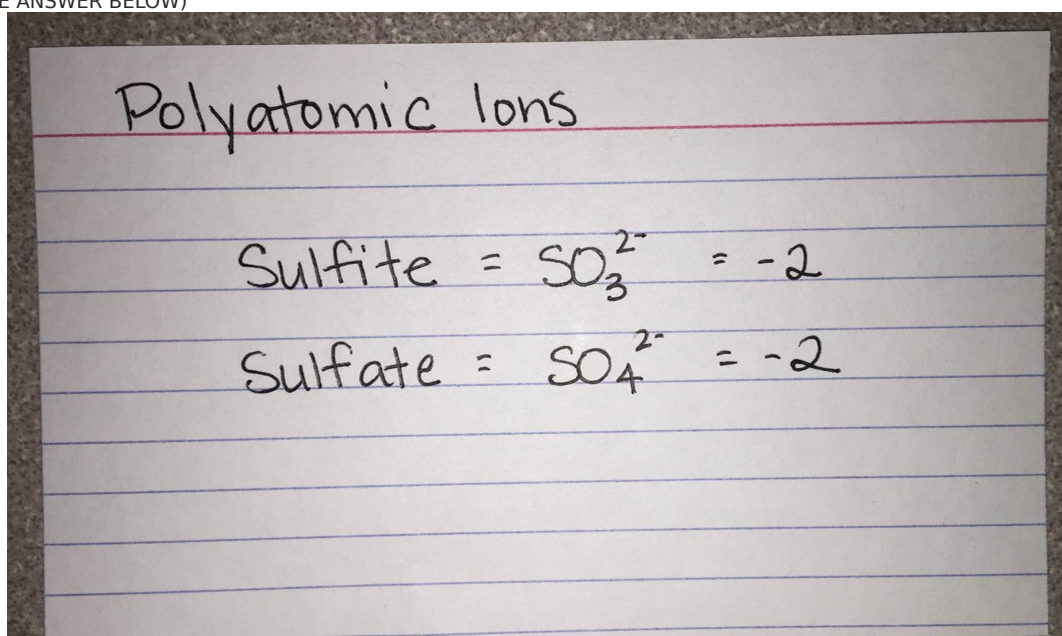


Photo 3: Strong Acid Note Card
(SAMPLE ANSWER BELOW)

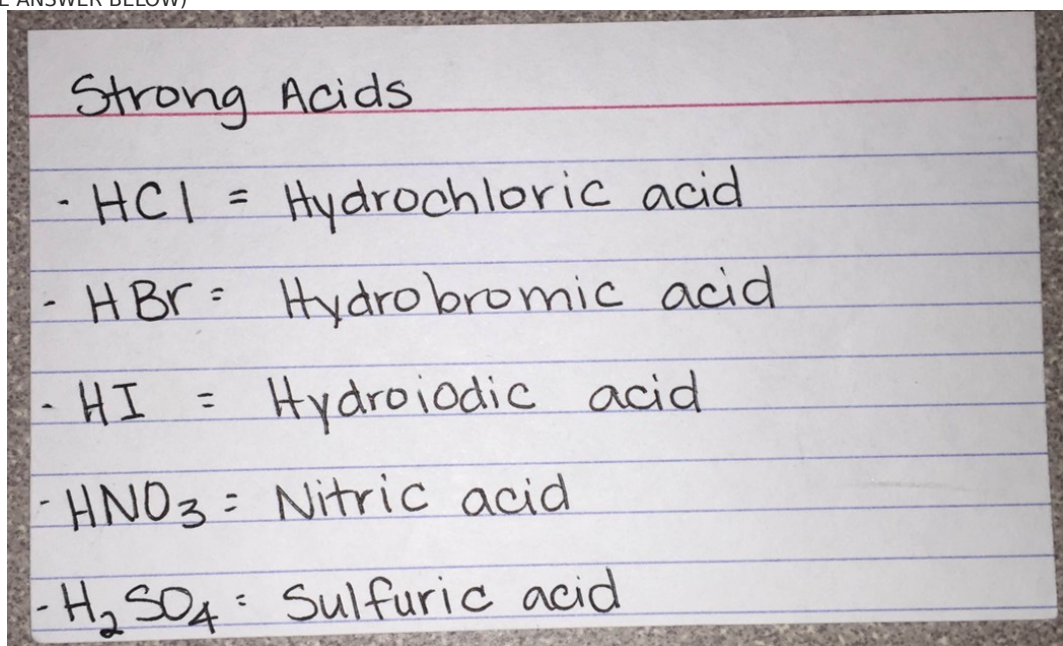
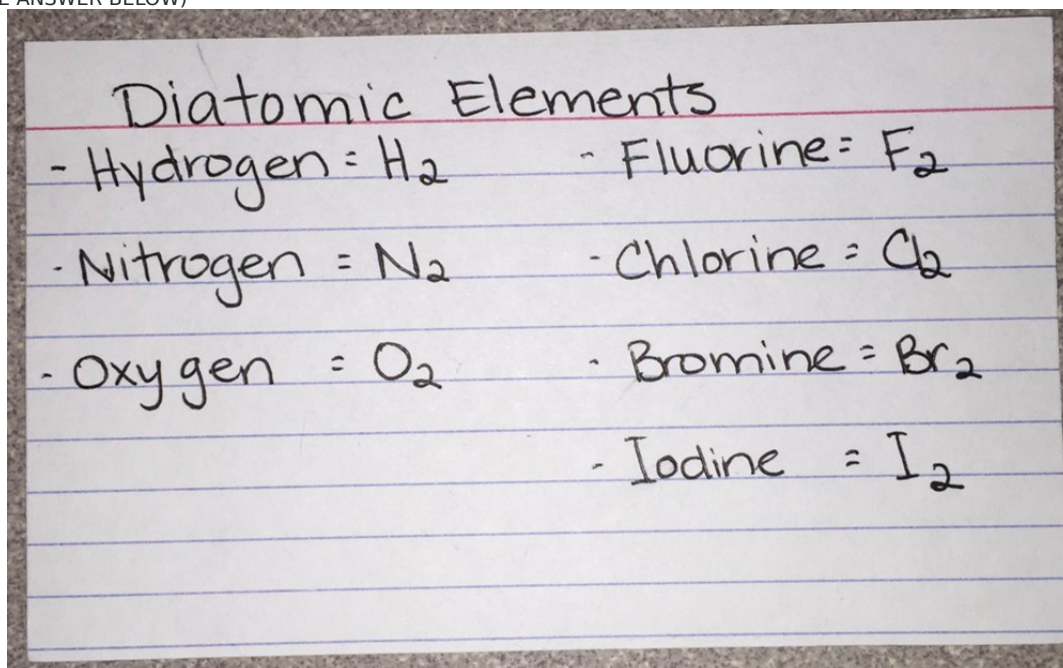


Photo 4: Diatomic Element Note Card
(SAMPLE ANSWER BELOW)



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 ₂ O ₃	molecular	diboron trioxide
2	N ₂ O	molecular	dinitrogen monoxide
3	LiCl	ionic	lithium chloride
4	N ₂ O 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 ₂ O 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 ₂ S 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 ₄ S 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	<i>Molecular</i>	

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

19	potassium chloride	<i>Ionic</i>	<i>KCl</i>
20	calcium oxide		<i>CaO</i>

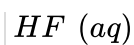
Data Table 3: Polyatomic Ion and Acid Names
(SAMPLE ANSWER BELOW)

#	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	$\text{Cu}_3(\text{PO}_4)_2$	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	$\text{Ca}_3(\text{PO}_4)_2$	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	<i>KNO₃</i>
2	carbonate ion	<i>CO₃²⁻</i>

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	



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)

BaSO₄ – used in medical imaging of the gastrointestinal tract by the patient ingesting it making the stomach and intestines visible to X-rays

LiCl and Li₂Se – treatment for bipolar disorder or other psychiatric conditions

NaCl – catheter flush injections or intravenous infusions

PtCl₂ – 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