

Unit 4

On completion of the unit you should be able to:

1. define valence electrons and atomic number.
2. define positive and negative ions.
3. identify the elements in the periodic which tend to form positive ions and those which tend to form negative ions.
4. write the name given the formula and vice versa for:

- binary compounds
- ternary compounds
- hydrates
- binary acids
- oxy acids

NAMING COMPOUNDS

4.1 Understanding the construction of a chemical formula

- **Octet rule and valence electrons**
- **Writing chemical formulae**

Reading: Hebden – page 70-71, 166

4.2 Naming compounds

4.3 Greek prefix

4.4 Naming binary compounds

4.5 Naming ternary compounds

4.6 Naming hydrates

4.7 Naming binary acids

4.8 Naming oxy acids

Reading: Hebden – page 65-69, 72-75

PROBLEMS:

Write chemical formulas

Write chemical names

Naming inorganic compounds

Inorganic compounds are compounds that do not contain carbon. Follow the specific rules for each of the different types of inorganic compounds.

- Binary compounds
- Ternary compounds
- Hydrates
- Binary acids
- Oxy acids

Periodic Table of Elements

- Metals
- Non-metals
- Semi-metals

Periodic Table of Elements

		GROUPS																	
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
PERIODS		IA	IIA	IIIB	IVB	VB	VIB	VII B	VIII			IB	IIB	IIIA	IVA	VA	VIA	VIIA	VIIIA
1	1.008 H 1																	4.003 He 2	
2	6.941 Li 3	9.012 Be 4											10.811 B 5	12.011 C 6	14.007 N 7	15.999 O 8	18.998 F 9	20.179 Ne 10	
3	22.990 Na 11	24.305 Mg 12	TRANSITION ELEMENTS										26.982 Al 13	28.0855 Si 14	30.9738 P 15	32.06 S 16	35.453 Cl 17	39.948 Ar 18	
4	39.0963 K 19	40.08 Ca 20	44.956 Sc 21	47.90 Ti 22	50.9415 V 23	51.996 Cr 24	54.938 Mn 25	55.847 Fe 26	58.933 Co 27	58.71 Ni 28	63.546 Cu 29	65.37 Zn 30	69.72 Ga 31	72.59 Ge 32	74.922 As 33	78.96 Se 34	79.904 Br 35	83.80 Kr 36	
5	85.468 Rb 37	87.62 Sr 38	88.906 Y 39	91.22 Zr 40	92.9064 Nb 41	95.94 Mo 42	98.906 Tc 43	101.07 Ru 44	102.906 Rh 45	106.4 Pd 46	107.868 Ag 47	112.41 Cd 48	114.82 In 49	118.69 Sn 50	121.75 Sb 51	127.60 Te 52	126.904 I 53	131.30 Xe 54	
6	132.906 Cs 55	137.33 Ba 56	138.906 *La 57	178.49 Hf 72	180.948 Ta 73	183.85 W 74	186.2 Re 75	190.2 Os 76	192.22 Ir 77	195.09 Pt 78	196.967 Au 79	200.59 Hg 80	204.37 Tl 81	207.2 Pb 82	208.981 Bi 83	(209) Po 84	(210) At 85	(222) Rn 86	
7	(223) Fr 87	226.025 Ra 88	**Ac 89	(261) Rf 104	(262) Ha 105	(263) Sg 106	(262) Ns 107	(265) Hs 108	(266) Mt 109	(269) — 110	(272) — 111								

*Lanthanide series

**Actinide series

140.12 Ce 58	140.908 Pr 59	144.24 Nd 60	(145) Pm 61	150.4 Sm 62	151.96 Eu 63	157.25 Gd 64	158.925 Tb 65	162.50 Dy 66	164.930 Ho 67	167.26 Er 68	168.934 Tm 69	173.04 Yb 70	174.967 Lu 71
232.038 Th 90	231.031 Pa 91	238.029 U 92	237.048 Np 93	(244) Pu 94	(243) Am 95	(247) Cm 96	(247) Bk 97	(251) Cf 98	(254) Es 99	(257) Fm 100	(256) Md 101	(255) No 102	(257) Lr 103

Periodic Table of Elements

For this course, we will mainly focus on the "A" elements, and we will study some "B" elements.

Periodic Table of Elements

"A" Elements are called REPRESENTATIVE elements.

PERIODS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	IA	IIA	IIIB	IVB	VB	VIB	VIIIB	VIII			IB	IIB	IIIA	IVA	VA	VIA	VIIA	VIIIA
1	1.008 H 1																	4.003 He 2
2	6.941 Li 3	9.012 Be 4											10.811 B 5	12.011 C 6	14.007 N 7	15.999 O 8	18.998 F 9	20.179 Ne 10
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TRANSITION ELEMENTS																		
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7	(223) Fr 87	226.025 Ra 88	(227) **Ac 89	(261) Rf 104	(262) Ha 105	(263) Sg 106	(262) Ns 107	(265) Hs 108	(266) Mt 109	(269) — 110	(272) — 111							

"B" elements are called TRANSITION elements.

*Lanthanide series

**Actinide series

140.12 58 Ce	140.908 59 Pr	144.24 60 Nd	(145) 61 Pm	150.4 62 Sm	151.96 63 Eu	157.25 64 Gd	158.925 65 Tb	162.50 66 Dy	164.930 67 Ho	167.26 68 Er	168.934 69 Tm	173.04 70 Yb	174.967 71 Lu
232.038 90 Th	231.031 91 Pa	238.029 92 U	237.048 93 Np	(244) 94 Pu	(243) 95 Am	(247) 96 Cm	(247) 97 Bk	(251) 98 Cf	(254) 99 Es	(257) 100 Fm	(256) 101 Md	(255) 102 No	(257) 103 Lr

Binary compounds - containing two nonmetals

1. Name the first element by its name.
2. The second element has the ending -ide.
3. The number of atoms of each element is indicated with Greek prefixes.

Greek prefixes

1	mono-	6	hexa-
2	di-	7	hepta-
3	tri-	8	octa-
4	tetra-	9	nona-
5	penta-	10	deca-

In the case of mono-, it is only used for the second nonmetal.
When no prefix appears, one atom is assumed.

Binary compounds - containing two nonmetals

4. If two vowels appear next to each other, the vowel from the Greek prefix is dropped. This is for ease of pronunciation.

monoxide becomes monoxide

tetroxide becomes tetroxide

pentoxide becomes pentoxide

Examples:

CO carbon monoxide

CO₂ carbon dioxide

CCl₄ carbon tetrachloride

SO₂ sulfur dioxide

N₂O₄ dinitrogen tetroxide

Binary compounds - containing metals with fixed ionic charges

Learn these thirteen metals on the periodic table have fixed charges

Group	Metal	Fixed charge	
Group IA	Lithium, Li	+1	Know this already
	Sodium, Na		
	Potassium, K		
	Rubidium, Rb		
	Cesium, Cs		
Group IIA	Magnesium, Mg	+2	Know this already
	Calcium, Ca		
	Strontium, Sr		
	Barium, Ba		
Group IIIA	Aluminum, Al	+3	Know this already
	Zinc, Zn	+2	
Group B	Cadmium, Cd	+2	
	Silver, Ag	+1	

Periodic Table of Elements

Periodic Table of Elements

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These metals have fixed charges.

*Lanthanide series

**Actinide series

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Binary compounds - containing metals with fixed ionic charges

1. Name the metal first followed by the nonmetal with the ending -ide.
2. No Greek prefixes necessary here because the metal has a fixed charge and, therefore, in forming a compound, there is only one possible combination with the nonmetal.

Examples:

KCl potassium chloride

CaH₂ calcium hydride

Al₂S₃ aluminum sulfide

ZnCl₂ zinc chloride

Lithium, Li

Sodium, Na

Potassium, K

Rubidium, Rb

Cesium, Cs

Magnesium, Mg

Calcium, Ca

Strontium, Sr

Barium, Ba

Aluminum, Al

Zinc, Zn

Cadmium, Cd

Silver, Ag

Binary compounds - containing metals with variable ionic charges

There are five common metal ions with variable charges that are named using their Latin stem. Learning the Latin names will help in figuring out the charge on the metal ions.

Metal	Symbol	Cation	Latin Name of ion	Systematic Name of ion
Copper	Cu	Cu^+	Cuprous ion	Copper (I)
		Cu^{2+}	Cupric ion	Copper (II)
Iron	Fe	Fe^{2+}	Ferrous ion	Iron (II)
		Fe^{3+}	Ferric ion	Iron (III)
Lead	Pb	Pb^{2+}	Plumbous ion	Lead (II)
		Pb^{4+}	Plumbic ion	Lead (IV)
Mercury	Hg	Hg_2^{2+}	Mercurous ion	Mercury (I)
		Hg^{2+}	Mercuric ion	Mercury (II)
Tin	Sn	Sn^{2+}	Stannous ion	Tin (II)
		Sn^{4+}	Stannic ion	Tin (IV)

Binary compounds - containing metals with variable ionic charges

1. Determine the charge of the metal in the compound.
2. Name the metal followed by a Roman numeral in parentheses immediately following the name of the metal. The Roman numeral represents the charge of the metal.
3. Name the nonmetal with the ending -ide.

(No Greek prefixes necessary here because the charge on the metal is labelled, therefore, in forming a compound, there is only one possible combination with the nonmetal.)

Examples:

CuS copper (II) sulfide or cupric sulfide

SnF₄ tin (IV) fluoride or stannic fluoride

Fe₂O₃ iron (III) oxide or ferric oxide

PbCl₂ lead (II) chloride or plumbous chloride

Copper, Cu

Iron, Fe

Lead, Pb

Mercury, Hg

Tin, Sn

Naming ternary compounds

1. Decide if the metal is a metal with fixed ionic charge or variable charge.
2. Name the metal, following the rules in naming for:
metal with fixed ionic charge, or metal with variable charge.
3. Name the polyatomic anion following the name of the metal.

(No Greek prefixes necessary here because the charge on the metal is labelled, therefore, in forming a compound, there is only one possible combination with the nonmetal.)

Examples:

$\text{Fe}_2(\text{SO}_4)_3$ iron (III) sulfate or ferric sulfate

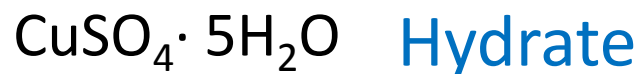
Ag_2CO_3 silver carbonate

$\text{Cu}(\text{NO}_3)_2$ copper (II) nitrate or cupric nitrate

NH_4Cl ammonium chloride

Naming hydrates

A crystalline compound that contains chemically bound water molecules in definite proportions is called a hydrate. Greek prefixes are used to indicate the number of water molecules in the formula unit.



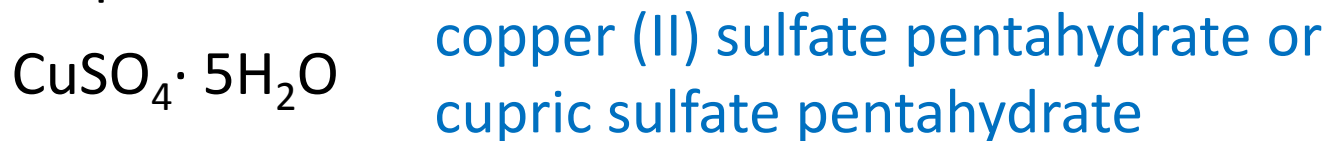
With the water molecules removed,



1. Name the anhydrous salt. Again, determine whether the metal in the anhydrous salt is one that is fixed ionic charge or variable charge and follow the rules for naming for metal with fixed ionic charge, or metal with variable charge

2. Name the chemically bound water molecules with the word **hydrate** with the appropriate Greek prefix to indicate the number of water molecules in the formula unit.

Examples:



Binary Acids

Acids are hydrogen-containing compounds that yield hydrogen ions (H^+) in water. Binary acids are acids that consist of two elements, one of the elements hydrogen-containing compounds.

As the pure compound

(ie - in the gaseous or liquid state),

- Start with 'hydrogen'
- follow by the anion name ending in '-ide'.

As aqueous acid solutions,

- Start with 'hydro-'.
- change the anion name to end with '-ic'.
- Add the word 'acid' at the end.

	Name of the pure compound	Name of the acid in aqueous solution
HCl	Hydrogen chloride	hydrochloric acid
HBr	hydrogen bromide	hydrobromic acid
HF	hydrogen fluoride	hydrofluoric acid
H ₂ S	dihydrogen sulfide	hydrosulfuric acid

Oxy Acids

Oxy acids are acids which contain oxygen in the chemical formula. The table below shows five common oxy acids.

Chemical Formula	Name
HNO_3	nitric acid
CH_3COOH or $\text{HC}_2\text{H}_3\text{O}_2$	acetic acid
H_2SO_4	sulfuric acid
H_2CO_3	carbonic acid
H_3PO_4	phosphoric acid

Try worksheet

Scanned Lecture Notes

Road Maps:

- Mole – Mass – Volume – Particles conversion
- From Percent Composition to Empirical Formula to Chemical Formula

Worksheets:

- Lab Report Write up Instructions
- Unit 2 – Density Questions Worksheet
- Unit 3 – Name to Chemical Formula and Chemical Formula to Name Worksheet
- Unit 5 – Mole Concept Worksheet
- Unit 5 – Salt & Sugar Worksheet

Try worksheet

Unit 4 - Naming Worksheet

Part A: Write the correct chemical names for the following compounds. Pay attention to spelling.

What type of compound is this?

1. two nonmetals
2. metal with fixed charge + nonmetal
3. metal with variable charge + nonmetal
4. hydrate
5. binary acid
6. oxyacid

Compound	What type of compound is this?	Name of compound
1. Cu_2O		
2. $\text{Fe}_2(\text{SO}_4)_3$		
3. $\text{K}_2\text{Cr}_2\text{O}_7$		
4. P_4O_{10}		
5. $\text{AlCl}_3 \cdot 6\text{H}_2\text{O}$		

Assignment 3 is a Paper Assignment

The image shows a screenshot of a website for CHEM 0011 Introductory Applied Chemistry. At the top, there is a navigation bar with buttons for HOME, WELCOME, CALENDAR, MAPLE TA (circled in red), UNIT 1, UNIT 2, UNIT 3, UNIT 4, UNIT 5, UNIT 6, UNIT 7, UNIT 8, and UNIT 9. Below the navigation bar is a banner featuring the BCIT logo and a periodic table of elements. The periodic table is color-coded and has several elements highlighted with green arrows and labels: Ca in Calcite (pointing to Calcium), Cu in Malachite (pointing to Copper), Pb in Galena (pointing to Lead), and Bromine (pointing to Bromine). Below the banner is a footer with links for ANNOUNCEMENTS, CHEMIST'S TOOLS, LABS, LECTURES (with a dropdown arrow), and SCANNED LECTURE NOTES.

Go down to the Assignment section to
download Assignment 3!!

Hand it in during class.