INORGANIC NOMENCLATURE II

1. Revision - Conditional Clauses. Ask and answer questions in pairs.[1]

If you had only 24 hours to live, what would you do?
If you could be invisible for a day what would you do and why?
If you could change one thing in the world, what would it be?
If you found a suitcase full of $1,000,000, what would you do?
If you could change one thing about yourself, what would it be?
If you could live anywhere, where would you live?
If you had time machine, where would you go and why?
If you could have dinner with anyone, who would you choose, and why?

List of Common Polyatomic Ions

Positive Ions	Negative 1 Ions	Negative 2 Ions	Negative 3 Ions
Ammonium..... NH_4^{+1}	Acetate..... CH_3COO^{-1}	Carbonate..... CO_3^{-2}	Arsenate ..... AsO_4^{-3}
Hydronium..... H_3O^{+1}	Bicarbonate..... HCO_3^{-1}	Chromate..... CrO_4^{-2}	Arsenite ..... AsO_3^{-3}
Mercury(I)..... Hg_2^{+2}	Bromate ..... BrO_3^{-1}	Dichromate ..... $Cr_2O_7^{-2}$	Borate..... BO_3^{-3}
	Chlorate ..... ClO_3^{-1}	Oxalate ..... $C_2O_4^{-2}$	Phosphate ..... PO_4^{-3}
	Chlorite ..... ClO_2^{-1}	Peroxide ..... O_2^{-2}	Phosphite ..... PO_3^{-3}
	Cyanide..... CN^{-1}	Selenate ..... SeO_4^{-2}	
	Hydroxide..... OH^{-1}	Sulfate..... SO_4^{-2}	
	Hypochlorite..... ClO^{-1}	Sulfite..... SO_3^{-2}	
	Iodate ..... IO_3^{-1}	Thiosulfate ..... $S_2O_3^{-2}$	
	Nitrate..... NO_3^{-1}		
	Nitrite..... NO_2^{-1}		
	Perchlorate ..... ClO_4^{-1}		
	Permanganate . MnO_4^{-1}		

ACIDS

- **Hydroacids: -** hydrogen + non-metal **hydro ....ic acid**

HCl **hydro**chlor**ic** acid HCl → NaCl sodium chloride (salt)
HF **hydro**fluor**ic** acid
HCN **hydro**cyan**ic** acid

Note: H_2S hydrogen sulfide

- **Oxyacids: polyatomic ion + acid**

- only one oxyacid: -ic acid H_3BO_3, - bor**ic** acid → Na_3BO_3 sodium bor**ate** (salt)
H_4SiO_4 - silic**ic** acid

- two oxyacids with different oxygen content:

Polyatomic ion **–ate** - suffix **-ic** - indicates **higher oxygen content**
Polyatomic ion **–ite** - suffix **-ous** - indicates **lower oxygen content**

SULF**ATE** ion…. H_2SO_4 sulfur**ic** acid (higher oxygen content)
SULF**ITE** ion…. H_2SO_3 sulfur**ous** acid (lower oxygen content)
$H_2S_2O_7$ **di**sulfur**ic** acid

H_3PO_4 phosphor**ic** acid
H_3PO_3 phosphor**ous** acid

HNO_3 nitr**ic** acid
HNO_2 nitr**ous** acid

- more than two oxoacids:

Remembering the number of oxygens

Largest:	*per*	*-ate*	ClO_4^-	*perchlorate ion*	*perchloric acid* $HClO_4$
Large:		*-ate*	ClO_3^-	*chlorate ion*	*chloric acid* $HClO_3$
Smaller:		*-ite*	ClO_2^-	*chlorite ion*	*chlorous acid* $HClO_2$
Smallest:	*hypo*	*-ite*	ClO^-	*hypochlorite ion*	*hypochlorous acid* $HClO^-$

prefix hypo [, haipə] means **less than**.
prefix per [pər] means **more**

SALTS OF OXYACIDS

- ternary compound containing oxygen **ends in -ate** if there is **only one such compound**.

Example:

Na_2CO_3 sodium carbon**ate** [ˊ ka:rbə,neit], (no carbonite is known)
Na_3BO_3 sodium bor**ate** [ˊ bo:reit], (no borite is known)
Na_4SiO_4 sodium silic**ate** [siləkeit], (no silicite is known)

- If there are **two compounds**, differing only in their oxygen content and oxidation number of the central atom, there are **two ways of nomenclature**:

Older (trivial) names: the one which contains **more oxygen** ends in **- ate** and the other, with **less oxygen**, ends in **-ite**.

Example: sodium salts:

lower oxygen content		higher oxygen content	
$NaNO_2$	sodium nitr**ite** ['naitrait]	$NaNO_3$	sodium nitr**ate** [' naitreit]
Na_3PO_3	sodium phosph**ite**[ˊfosfait]	Na_3PO_4	sodium phosph**ate**[ˊfosfeit]
Na_3AsO_3	sodium arsen**ite** [ˊarsə,nait]	Na_3AsO_4	sodium arsen**ate** [ˊarsə,neit]
Na_2SO_3	sodium sulf**ite**	Na_2SO_4	sodium sulf**ate**

Example: sodium salts of the oxyacids of chlorine:

ACID		**SALT**
▪ HClO **hypo**chlor**ous** acid	→	NaClO sodium **hypo**chlor**ite** [, haipə ´klourait]
▪ $HC1O_2$ chlor**ous** acid	→	$NaClO_2$ sodium chlor**ite** [´klourait]
▪ $HClO_3$ chlor**ic** acid	→	$NaClO_3$ sodium chlor**ate** [´klou,reit]
▪ $HClO_4$ **per**chlor**ic** acid	→	$NaClO_4$ sodium **per**chlorate [, pər´kloureit]

$KMnO_4$ - potassium permanganate [,pər´məngə,neit].

Rational nomenclature (named according to IUPAC regulations)

Since the oxygen-acid nomenclature of ternary compounds does not give the absolute number of oxygens involved, the name must be derived from experience. That´s why chemists use **prefixes mono-, di-[dai], tri-[trai], tetra-, penta-** which express the **absolute number of oxygens**. **Roman numerals** express the **oxidation number + suffix - ate**

Example:

Na_2SO_3 sodium **tri**oxochlor**ate** (IV) - 3 oxygens, sulphur: oxidation number IV
Na_2SO_4 sodium **tetra**oxosulf**ate** (VI)

sodium salts:

$NaClO_4$ sodium **tetra**oxochlor**ate** (VII)
$NaClO_3$ sodium **tri**oxochlor**ate** (V)
$NaClO_2$ sodium **di**oxochlor**ate** (III)
NaClO sodium oxochlor**ate** (I)

2. Exercises a) Write the chemical formula for:

1. sodium tetraoxochlorate (VII)
2. sodium trioxochlorate (V)
3.sodium phosphite
4. sodium phosphate
5. sodium sulfate
6. sodium sulfite

b) Write the name for:
1.Ca(NO3)2
2. $Ca(NO_2)_2$
3. $BaSO_4$
4. $NaClO_3$
5. $NaClO_2$
6. $NaHSO_4$

HYDROXIDES: (bases containing the OH group) – the same rules applied

NaOH sodium hydrox**ide**
$Ca(OH)_2$ calcium hydrox**ide**
$Mg(OH)_2$ magnesium hydrox**ide**
$Fe(OH)_2$ iron **(II)** hydrox**ide** = ferr**ous** hydrox**ide**
$Fe(OH)_3$ iron **(III)** hydrox**ide** = ferr**ic** hydrox**ide**

OTHER IMPORTANT COMPOUNDS:

Hydrates
$3CdSO_4 . 8\ H_2O$ cadmium sulfate - water (3/8)

$[Al(H_2O)_6]^{3+}$ hexaaquaaluminum (3+) ion
$[\ CoCl\ (NH_3)_5\ ]^{2+}$ pentaaminnechlorocobalt (2+) ion

3. Exercises: a) Write the formulas for:

1. phosphorous acid
2. carbonic acid
3. disulfuric acid
4. nitric acid
5. hydrobromic acid

b) Write the names for:

1. H_3PO_4
2. H_2SO_4
3. H_4SiO_4
4. $HClO$
5. H_3BO_3
6. $Ba(OH)_2$
7. KOH
8. $CaSO_4 . 2\ H_2O$
9. $[Al(H_2O)_6]^{3+}$

4. LISTENING / WATCHING. Listen and fill in the gaps with names of chemicals.[4]

A solution of ……. and dilute …… covers a drop of …… in a watchglass. An ……. nail is positioned so that it nearly touches the mercury. Eventually, the mercury drop starts to beat rhytmically, like a beating heart. The dichromate oxidizes the mercury to ……., which combine with …… at the surface of the mercury drop to form a film of an insoluble ……..... This film decreases the surface tension of the mercury, allowing the drop to flatten. Eventually, the mercury drop expands to touch the iron nail, at which time electrons flow from the nail to the mercury. The electrons reduce the …….. to mercury, destroying the surface film. The surface tension increases and the mercury drop becomes more spherical. Point back from the nail, then the mercury and the iron nail no longer touch, ……. again builds up on the surface and the process repeats.

HOW TO READ CHEMICAL EQUATIONS IN ENGLISH[3]:

Example:	**HCl**	**+**	**NaOH**	**→**	**NaCl**	**+**	**H_2O**
We spell as:	H Cl	**plus**	Na OH	**gives**	Na Cl	**plus**	H_2O

We read as: hydrochloric acid **reacts with** sodium hydroxide **to form** sodium chloride **and** water

Reading chemical formulae:

+	is read „reacts with, „combines with " "plus", "and" or "together with"
=	is read "give", "form", "pass over to", "yield" or "go to"
-->	is read "give", "pass over to" or "lead to"
<-->	is read "forms and is formed from"
C_3H_2	c three h two
2 CO_2	two molecules of c o two
CO_2 + CaO	c o two plus c a o give c a c o three
→ $CaCO_3$	c o two reacts with c a o to give give c a c o three
$Ca(OH)_2$	c a o h twice

You can also use time clauses / conditional clauses to describe the reactions:

When we mix …… with …….., we will get …… .

If …… mixes together with …… , it will lead to ……. .

If we mixed …..... and ……, it would lead to ……. .

5. Read these equations in pairs.

First spell them, then express in words. You can use a time / conditional clause.

a) $CO_2 + H_2O$ ---> H_2CO_3

b) $CaCO_3$--->$CaO + CO_2$

c) $2\ CO + O_2$-->$2\ CO_2$

d) $2\ Na + Cl_2 \rightarrow 2\ NaCl$

e) $ZnO + H_2SO_4 \rightarrow 2\ ZnSO_4 + H_2O$

f) $2\ Na + 2\ H_2O \rightarrow 2\ NaOH + H_2$

6. Work in small groups. Write down two or three equations on a piece of paper. Then present the equations to to the others.

HOMEWORK: VOCABULARY IN CONTEXT

Circle the letter of the answer that best matches the meaning of the italicized word.

1. Frayed electrical wires are *potential* fire hazards.
a. probable b. unlikely

2. The *velocity* of the wind increases during the storm.
a. sound b. speed

3. The *conservation* of natural resources, such as rivers and forests, is an important issue of our time.
a. preservation b. observation

4. When the temperature dropped, *vapour* accumulated on the inside of the window.
a. steam b. dust

5. Pasteur´s germ theory proved to be *valid* and was a major breakthrough in the history of medicine.
a. false b. true

6. When the bottle was uncapped, all the pressure inside was *released*.
a. set free b. increased

7. Energy is released by the *fission* of atomic nuclei.
a. splitting b. combining

8. The cold on top of the mountain got more *intense* later in the evening.
a. extreme b. moderate

9. An alloy is a *fusion* of two or more metals that makes a stronger metal.
a. combination b. separation

10. The best way to solve a problem is to find the *source*.
a. origin b. effects

11. Flemming *revealed* that his discovery of penicillin was accidental.
a. made known b. kept hidden

12. The earth *absorbs* the water from the rain.
a. drinks in b. gives off

13. The driver went in the *reverse* direction.
a. identical b. opposite

14. Air is the *medium* through which sound travels.
a. process b. environment

15. The old building was *transformed* into an emergency hospital.
a. enlarged b. changed

Sources: [1] **Available at** http://iteslj.org/questions/
[2] Adaptefd from www.fch.vutbr.cz/angl2/ Zpracovala Lenka Fišerová a Gabriela Clemensová
[3] Available at http://jchemed.chem.wisc.edu/JCESoft/CCA/pirelli/pages/cca3heart.html

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