# 7. INORGANIC NOMENCLATURE II

**1. SPEAKING. Grammar – Conditional Clauses. Ask and answer questions in pairs.**[1]

**Conditionals – speaking – A**
If you had only 24 hours to live, what would you do?
If a classmate asked you for the answer to a question during an exam while the teacher was not looking, what would you do?
If you could be an animal, any animal, what animal would you be and why?
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 were invited to have tea with the Queen of England, what would you say?

**Conditionals – speaking – B**
If you could be another man or woman for a day, who would you choose?
If you could change one thing about yourself, what would it be?
If you could live anywhere, where would you live?
If you didn't have enough money to get the bus home what would you do?
If you got arrested for murder, whom would you call with your telephone call from prison? And why?
If you had time machine, where would you go and why?
If you could have dinner with anyone (dead OR alive), who would you choose, and why?

**INORGANIC NOMENCLATURE II**[2]

**C. Ternary compounds (compounds that consist of a combination of three elements)**

**A) SALTS OF OXOACIDS**

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

**Example:**

$Na_2CO_3$ sodium carbon**ate** [´ ka:rbə,neit ], (no carbonite is known)
$Na_3BO_3$ sodium bor**ate** [´ 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**[´fosfait ] | $Na_3PO_4$ | sodium phosph**ate**[´fosfeit ] |
| $Na_3AsO_3$ | sodium arsen**ite** [´arsə,nait ] | $Na_3AsO_4$ | sodium arsen**ate** [´arsə,neit] |
| $Na_2SO_3$ | sodium sulf**ite** | $Na_2SO_4$ | sodium sulf**ate** |

*Example:* sodium salts of the oxyacids of chlorine:

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

$NaClO_4$ sodium **per**chlorate [, pər´kloureit] (higher oxygen content)
$NaClO_3$ sodium chlor**ate** [ ´klou,reit] (normal oxygen content)
$NaClO_2$ sodium chlor**ite** (lower oxygen content)[´klourait]
NaClO sodium **hypo**chlor**ite** (even lower oxygen content) [, haipə ´klourait ]

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

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 the chemists use

**Rational nomenclature (named according to IUPAC regulations)**

**prefixes mono-, di-[dai], tri-[trai], tetra-, penta-** express the **absolute number of oxygens**
**Roman numerals** express the **oxidation number + suffix - ate**

*Example:*

$Na_2SO_3$ sodium **tri**oxochlor**ate** (V) – 3 oxygens, oxidation number V
$Na_2SO_4$ 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.$Ca(NO_3)_2$
2. $Ca(NO_2)_2$
3. $BaSO_4$
4. $NaClO_3$
5. $NaClO_2$
6. $NaHSO_4$

**B) 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

- **Oxoacids: polyatomic ion + acid**

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

**- two oxoacids with different oxygen content:**

- **suffix -ic [ ic ]** - indicates **higher oxygen content**
- **suffix -ous [ -s ]** - indicates **lower oxygen content**

$H_2SO_4$ sulfur**ic** acid (higher oxygen content) → SULF**ATE** (salt)
$H_2SO_3$ sulfur**ous** acid (lower oxygen content) → SULF**ITE** (salt)
$H_2S_2O_7$ **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:**

HClO **hypo**chlor**ous** acid → NaClO **hypo**chlor**ite** (salt)
$HC1O_2$ chlor**ous** acid → NaClO chlor**ite**
$HClO_3$ chlor**ic** acid → NaClO chlor**ate**
$HClO_4$ **per**chlor**ic** acid → NaClO perchlor**ate**

**C) 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**

**D) 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:**

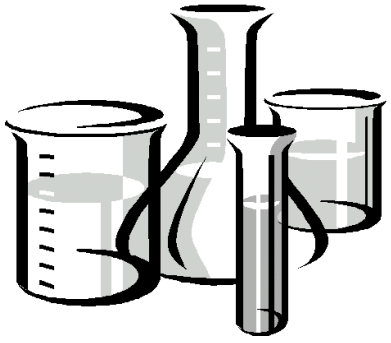
1. phosphorous acid
2. carbonic acid
3. disulfuric acid
4. nitric acid
5. hydrobromic acid

**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" |
| **the sign -** | designates the bond and is not to be read in the formulae |
| **the sign =** | designates two bonds and is not to be read in formulae |
| **$C_3H_2$** | 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) $2\ Ca_3(PO_4) + 6\ SiO_2 + 10$ C-->$6\ CaSiO_3 + P_4 + 10$ CO

e) $2$ Na + $Cl_2$ → $2$ NaCl

f) $ZnO + H_2SO_4$ → $2\ ZnSO_4 + H_2O$

g) $2$ Na + $2\ H_2O$ → $2$ 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.**

**7. Read this text aloud and translate it into Czech/Slovak:**[5]

Diatoms, microscopic organisms, produce carbohydrates from carbon dioxide and water by normal photosynthesis:

6 $CO_2$ + 6 H20 + solar energy --> $C_6H_{12}O_6$ + 6 $O_2$

During the first five years of life whales gain 75 kg of mass per day by feeding on krill. The whale must consume ten times this mass of krill each day. The whale must consume 10.0 kg of diatoms to produce 1.0 kg krill.

a) Assuming that the mass gain in the first years of a whale's life is due to the consumption of carbohydrates, calculate the volume of $CO_2$ at 0 °C and 101 kPa that must be used by the diatoms to produce the carbohydrates consumed by a blue whale in its first five years of life.

b) There is 0.23 mL of dissolved $CO_2$ per 1 sea water (at 24 °C and l0lkPa). If diatoms can completely remove carbon dioxide from the water they process, what volume of water would they process to produce the carbohydrates required by a blue whale during the first five years of life ?

c) 3% of the mass of a $9.1.10^4$ kg adult whale is nitrogen. What is the maximum mass of $NH_4^+$ that can become available for other marine organisms if one adult whale dies?

d) 18% of a adult whale's mass is carbon which can be returned to the atmosphere as $CO_2$ being removed from there by weathering of rocks containing calcium silicate.

$CaSiO_3$ (s) + 2 $CO_2$ + $3H_20(1)$ --> $Ca^{2+}$ (aq) + $2HCO_3^-$(aq) + $H_4Si0_4$(aq)

What are the maximum number of grams of $CaSiO_3$ that can be weathered by the carbon dioxide produced from the decomposition of 1000 blue whales, the number estimated to die annually ?

**Reading numbers and mesurements :**

| | |
|---|---|
| **31%** | thirty one percent |
| **30.7°** | thirty point seven degrees |
| **10°C** | ten degrees Centigrade |
| **-70°F** | minus seventy degrees Fahrenheit /seventy degrees below zero |
| **0.631** | nought point six three one |
| **3.14** | three point fourteen, three point one four |
| **0.002** | nought point nought nought two |
| **1,203.4** | one thousand two hundred and three point four |
| **106** | one hundred and six |
| $\mathbf{y^2}$ | y squared |
| $\mathbf{k^3}$ | k cubed |
| $\mathbf{3a^4}$ | three, a to the four / to the power of four |
| + | plus |
| - | minus |
| **x** | times / multiplied by / multiplication sign |
| **:** | divided by / division sign |
| = | is, are, equals, is equal to, gives / sign of equality |

## 8. 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
[4] *Collection of Competition Tasks 16th – 26 th Iternational Chemistry Olympiad*. Prague 1995.

Lesson adapted from Marie Sabolová and Milada Pavlovová**.**