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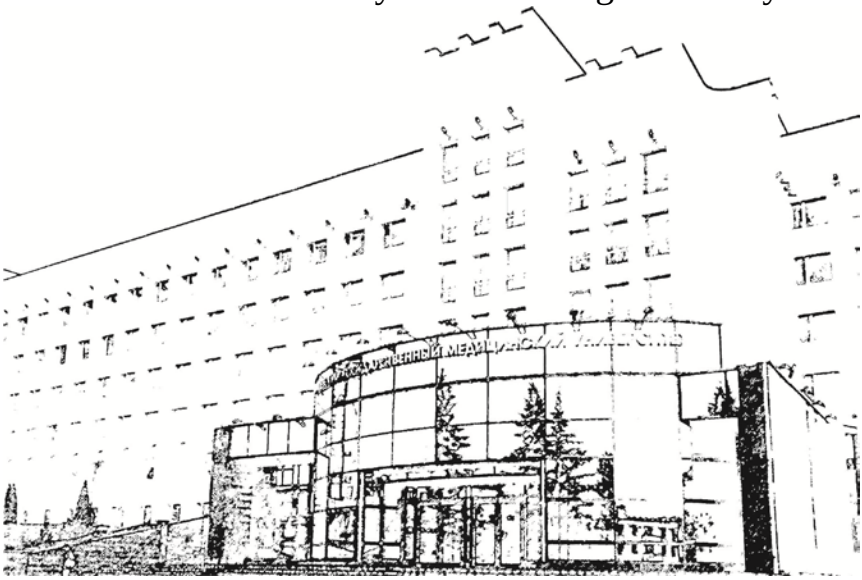
PHYSIOLOGICAL ROLE OF CHEMICAL ELEMENTS

GUIDELINES
for independent work
students of the 1-st year stomatological faculty



Vitebsk,
2018

MINISTRY OF HEALTH OF THE REPUBLIC OF BELARUS
VITEBSK STATE THE ORDER OF FRIENDSHIP OF PEOPLES MEDICAL UNIVERSITY

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УДК 612.014.46(072)
ББК 28.707.3я73 + 24.1я73
К 64

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B 38 Physiological role of chemical elements. Guidelines for independent work students of the 1-st year stomatological faculty : methodical developments / T.O. Kononova, Z.S. Kuntsevich, E.A. Gusakova. – Vitebsk: VSMU, 2018. – 60 p.

ISBN 978-985-466-906-9

Methodical developments is intended for the 1-st year students of the stomatological faculty. It is made up in accordance with the standard curriculum in general chemistry. The edition is designed for internal using.

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ISBN 978-985-466-906-9

CONTENT

Concept of biosphere and noosphere

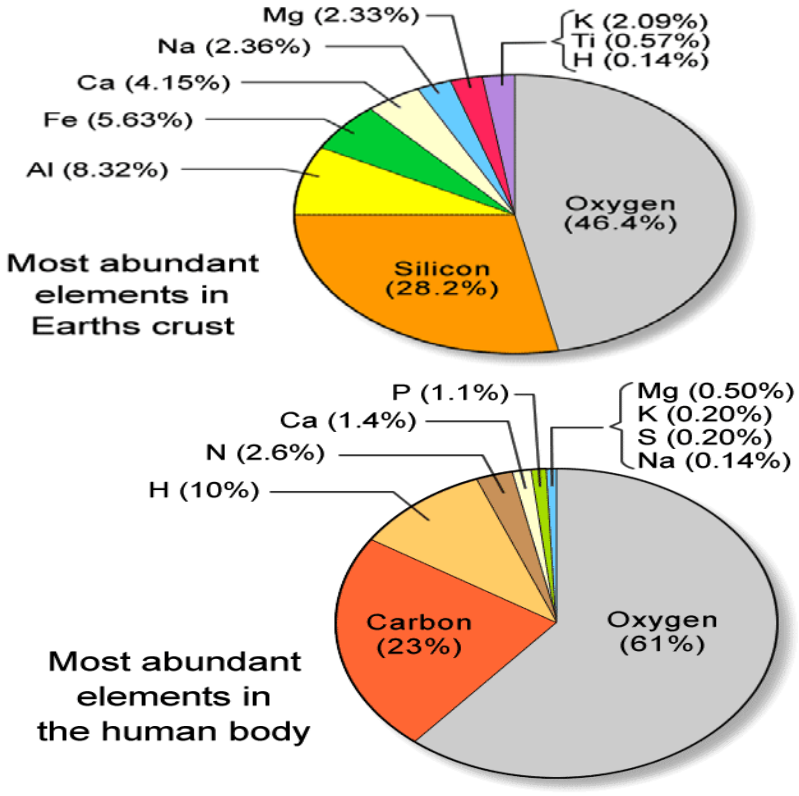
Biosphere – the region of existence of living organisms on Earth. To the concept of "biosphere" close a distinguished biologist J.B. Lamarck (1802). But the term "biosphere" was first used by the geologist E. Suess (1875). He highlighted the biosphere as a separate shell of the Earth, covered with life, which includes part of the atmosphere, hydrosphere and lithosphere.

The biosphere has a number of characteristic features:

- it's uniqueness (originality);
- the almost limitless duration of existence;
- the existence of vast quantities of genetic information and the free energy;
- the presence of sophisticated mechanisms of self-defense from the damaging effects of cosmic and planetary factors;
- a huge variety of subordinate biological systems - organisms, species, ecosystems.

V.I. Vernadsky became interested in the content of chemical elements in various tissues of animals and plants. These studies showed that almost all known chemical elements may be found in some or other organs of the animals and plants. In his studies of the living substance, V.I. Vernadsky approached an analysis of the structure of the envelope of the Earth within which this substance exists.

The average relative content of an element in any natural system is called its abundance or clarke. It is usually expressed as a percentage of mass or atoms.



The chemical composition and patterns of the occurrence and distribution of elements in the Earth are studied by geochemistry. The subject-matter of this science was first defined by V.I. Vernadsky, who considered it the science of the history of the atoms of the Earth and a part of cosmochemistry.

V.I. Vernadsky worked out an overwhelming doctrine concerning the biosphere of the Earth. He defined the boundaries of the biosphere by having shown that the biosphere includes all the hydrosphere, troposphere to the height of about 30 km, and the upper part of the Earth's crust down to a depth of two or three kilometers, for living bacteria still may be found at this depth in the underground waters and in the oil. V.I. Vernadsky's biosphere is not a static life envelope, but an open system having existed since the very beginning of the Earth's history. The contemporary life and its activities are the product of a long and complex evolution of the living substance. Vernadsky, who studied the interaction between living and nonliving systems, reinterpreted the concept of the biosphere. He understood the scope of the unity of the biosphere as living and nonliving.

According to Vernadsky, the biosphere substance consists of:

• living matter - modern biomass of living organisms;

• nutrients - all forms of detritus and peat, coal, oil and gas biogenic origin;

• inert substance - mixtures of nutrients from mineral rocks non-biogenic origin (soil, mud, natural water, gas and oil shale, tar sands, of sedimentary carbonates;

• inert matter - rocks, minerals, deposits not affected by direct biochemical influence organisms.

Biosphere refers to the totality of all living organisms and substances that are controlled consumption, transformation and production of living organisms.

Modern biosphere is the result of a long historical development of the whole organic world in its interaction with inanimate nature. The interaction of biotic and abiotic factors biosphere is in constant motion and development.

Having accepted the idea of the evolution of the biosphere, V.I. Vernadsky also changed his viewpoint upon the technological activities of the mankind. He came to consider them as a law governed evolutionary stage in the development of the biosphere. He believed in the strength of the human reason and supposed that the team scientific thought will overcome the negative results of the technogenesis and will secure, in future, the rational transformation (and not annihilation) of the natural components of the biosphere, for a maximum satisfaction of the material and spiritual demands of the mankind which is growing quantitatively. This future evolutionary stage of the biosphere of the Earth was designated by V.I. Vernadsky as noosphere, the sphere of reason (the term introduced in 1922 by a French philosopher and mathematician Edouard Le Roy).

According to V.I. Vernadsky, the noosphere is the inevitability of the evolutionary transformation of the biosphere into the reign of the human reason.

Classification of biogenic chemical elements

There are various classifications of chemical elements that make up the human body.

1. Depending on the average content (percent by mass) in the body:		
Macro-elements	Content of element in the body is higher than 10^{-2}%	Oxygen, sodium, carbon, hydrogen, nitrogen, sulfur, phosphorus, calcium, chlorine, magnesium, potassium.
Micro-elements	Content of element in the body is from 10^{-3} to 10^{-5}%	Iodine, copper, arsenic, fluorine, bromine, strontium, barium, cobalt, etc.
Ultramicro-elements	Content of element in the body is lower than 10^{-5}%	Mercury, gold, uranium, thorium, radium, etc.
2. Depending on the role in body's life:		
Essential elements	Constantly contained in the human body, are part of proteins, fats, carbohydrates, hormones, enzymes, buffer systems, etc., they are involved in metabolism and redox reactions	Hydrogen, carbon, oxygen, nitrogen, phosphorus, sulfur, potassium, sodium, calcium, iodine, magnesium, cobalt, chlorine, silicon, iron, copper, zinc, manganese, chromium, molybdenum, etc.
Probably Essential Trance elements	Constantly contained in the human body, some are part of coenzymes, participate in the conductivity of impulses, but their role is poorly understood	Strontium, bromine, fluorine, boron, beryllium, lithium, silicon, nickel, vanadium, gallium aluminum, barium, cadmium, lead arsenic, bismuth, chromium, nickel, selenium, silver, tin, mercury, tellurium etc.
Non Essential Trance elements	Found in the human body, however, their biological role is not established	Tungsten, indium, rhenium, scandium, thallium, lanthanum, etc.

Basic functions performed by the biogenic chemical elements are:

- As structural components of proteins, fats, carbohydrates, nucleic acids, ATP, hormones, enzymes and etc.;
- In the maintenance of acid-base and osmotic balances;
- In the regulation of body fluids;
- In transport of gases;
- In muscle contractions;
- In oxidation-reduction reactions;
- In the transmission of nerve impulses and etc.

Microelements in the body: their requirements and functions

Micro element	Requirement, mg / day	Function	Enzyme class or protein type	Examples
Iron	10-15	Transport of oxygen	Hem containing proteins, oxidoreductases	Myoglobin Hemoglobin Cytochrome-C oxidase
Zinc	12-15	Synthesis of nucleic acids, proteins and porphyrins, metabolism of amino acids and carbohydrates	Transferases, hydrolases, lyases, isomerases, ligases, oxidoreductases, transcription factors	RNA polymerases alcohol dehydrogenase, receptors of glucocorticoids
Copper	1,5-3,0	Synthesis of hemoglobin, metabolic processes in connective tissue, growth and development of bones	Oxidoreductases	Superoxide dismutase, ceruloplasmin (ferroxidase), aminoxidase
Cobalt	0,04-0,07	Metabolism of methionine	Transferases	Methionine synthase
Manganese	2-5	Oxidative phosphorylation; metabolism of fatty acids, glycosaminoglycans and cholesterol	Oxidoreductases, hydrolases, ligases	Placental aminoxidase, pyruvate carboxylase
Molybdenum	0,075 - 0,25	Metabolism of xanthines	Oxidoreductase	Xanthine oxidase
Selenium	0,04-0,07	Antioxidant	Oxidoreductases, transferases	Glutathione peroxidase

Topography of the most important biogenic elements in the human body

The content of some chemical elements in plant and animal organisms

Elements	Content of element, mol/ton	
	Plants	Animals
Hydrogen	55000	70000
Carbon	37833	38750
Oxygen	25625	11625
Nitrogen	2143	7143
Calcium	450	5–212,5
Potassium	360	190
Magnesium	132	41
Sulfur	106	156
Phosphorus	74	548–1420
Chlorine	57	79
Sodium	52	174
Silicon	7–179	4–214
Aluminum	19	0,15–3,70
Manganese	11,45	0,004
Bor	4,63	0,046
Iron	2,5	2,9
Zinc	1,53	2,45
Strontium	0,3	0,16
Rubidium	0,23	0,20
Copper	0,22	0,04
Barium	0,1	0,005
Nickel	0,051	0,014
Vanadium	0,03	0,003
Fluorine	0,026–2,105	7,9–26,3
Titanium	0,02	0,004
Lithium	0,014	0,003
Lead	0,013	0,01
Cobalt	0,008	0,0005
Zirconium	0,007	0,003
Chromium	0,0044	0,0014
Gallium	0,0008	0,00008

Electrolyte composition and pH of human physiological fluids

Body fluids are liquids originating from inside the bodies of living people. They include fluids that are excreted or secreted from the body, and body water that normally is not. Human beings are mostly water, ranging from about 75 percent of body mass in infants to about 50–60 percent in adult men and women, to as low as 45 percent in old age. Your brain and kidneys have the highest proportions of water, which composes 80–85 percent of their masses. In contrast, teeth have the lowest proportion of water, at 8–10 percent.

The chemical reactions of life take place in aqueous solutions. In the human body, solutes vary in different parts of the body, but may include proteins, carbohydrates, and, very importantly, electrolytes. Electrolytes play a vital role in maintaining homeostasis within the body. Electrolytes are important because they are what cells (especially nerve, heart and muscle cells) use to maintain voltages across their cell membranes and to carry electrical impulses (nerve impulses, muscle contractions) across themselves and to other cells. Kidneys work to keep the electrolyte concentrations in blood constant despite changes in the body. For example, during heavy exercise, electrolytes are lost in sweat, particularly in the form of sodium and potassium. These electrolytes must be replaced to keep the electrolyte concentrations of the body fluids constant.

Fluid	**Na^+, mmol/l**	**K^+, mmol/l**	**Cl^-, mmol/l**	**HCO_3^-, mmol/l**	**pH**
Gastric juice	50	10–15	150	0	0.9–1.1
Pancreatic juice	140	5	50–100	100	7.5–8.0
Saliva	20–80	10–20	20–40	20–60	6.35–7.4
Bile	130	5	100	40	5.4–8.5
Sweat	50	5	55	0	6.2–6.9
Blood	140	4–5	100	25	7.4
Urine	0–100(*)	20–100(*)	70–100(*)	0	4.8–7.5
* Varies considerably					

Fluids in the human body function to provide digestion, lubrication, nutrient and oxygen transportation, and protection. To perform these functions, the pH levels must be varied to match the bodily function. Saliva, blood and spinal fluid all have a pH of about 7.4, that prevents tissue damage that may be caused by levels at either end of the pH scale. The highly acidic fluid of stomach breaks down food and allows digestion to continue. Alterations in any of these systems can lead to serious medical conditions. For example, a pH imbalance in the mouth leads to tooth decay, and alterations in the blood can lead to breathing difficulties.

Division of chemical elements into s, p, d, f-blocks

s-Block Elements: The elements whose atoms receive the last electron in the s-sub-orbit of their outermost shell are known as s-block elements. In other words; in these elements ns-sub-orbit is being progressively filled, where n is the number of outermost shell. The electronic configuration of these elements varies from ns^1 to ns^2. The elements of group IA (or 1) have the electronic configuration ns^1 and are called alkali metals. The elements of group IIA (or 2) have the electronic configuration ns^2 and are called alkaline earth metals.

p-Block Elements: The elements whose atoms receive the last electron in the p- sub-orbit of their outermost shell are known as p-block elements. The electronic configuration of these elements varies from ns^2np^1 to ns^2np^6. The elements of IIIA, IVA, VA, VIA, VIIA and zero (or 13 to 18) groups belong to this block; because their general electronic configuration is ns^2np^1, ns^2np^2, ns^2np^3, ns^2np^4, ns^2np^5 and ns^2np^6 respectively. The elements of group VA (or 15) are called pnictogens. The elements of group VIA (or 16) are called chalcogens. The elements of group VIIA (or 17) are called halogens. The elements of group VIIIA (or 18) are called noble gases.

d-Block Elements: The elements whose atoms receive the last electron in the d- sub-orbit of the penultimate (last one) shell are known as d-block elements. In other words, in these elements (n–1) d-sub-orbits are being progressively filled where n is the number of outermost shell. These elements are placed between the s- and p-block elements. The electronic configuration of these elements varies from $(n-1)d^1ns^2$ to $(n-1)d^{10}ns^2$ or $(n-1)d^{1-10}ns^{1-2}$. These elements are also called transition elements. The elements of IIIB, IVB, VB, VIB, VIIB, VIII, IB and IIB (or 3 to 12 respectively) groups belong to this block.

f-Block Elements: 28 elements belong to this category. 28 elements belong to this category. These are called f-block elements because the differentiating or last electron enters (n– 2) f-orbitals. f-block elements have been classified into two blocks namely 4f-block elements or lanthanides or lanthanones, and 5f-block elements or actinides or actinones. Each block consists of 14 elements. These elements are also called inner-transition elements. The characteristics of f-block elements are similar to transition metals, i.e. d-block elements. All f-block elements are metals. They show variable valency. +3 is the most important oxidation state. Few elements show +2 and +4 oxidation state. f-block elements are paramagnetic in nature. They form coloured compounds. f-block elements have tendency to form complexes. Chemically lanthanides are very similar. It is difficult to separate them from a mixture by application of a chemical property. Similarly actinides have similar chemical properties The members of actinides show the phenomenon of radioactivity. Elements above atomic number 92 (transuranic elements) are not found in nature.

S-BLOCK ELEMENTS

General properties of s-block elements

1. ***Electronic configuration:*** The general electronic configuration of s-block elements is ns^{1-2}.

2. ***Electropositivity:*** These elements are electropositive in nature.

3. ***Oxidation state:*** These elements show +1 and +2 oxidation states.

4. ***Atomic size:*** The atomic size of these elements increases from top to bottom in the group.

5. ***Ionization Energy:*** The first ionization energies of these elements are low and decreases from top of bottom.

6. ***Electronegativity:*** The electronegativities of these elements are low and decreases from top to bottom.

7. ***Electron affinity:*** The electron affinity of IA group elements is low and that of IIA group elements is almost zero due to completely filled ns-orbitals.

8. ***Melting and boiling points:*** These values for s-block elements are low due to low binding energies.

9. ***Hardness:*** The elements of IA group are soft while that of IIA group are hard. Hardness decreases from top to bottom in the group.

10. ***Conductivity:*** s-block elements are good conductors of heat and electricity.

11. ***Reducing property:*** These elements are good reducing agent as ionisation potential values are low. Reducing property increases in a group from top to bottom while decreases moving horizontally from IA to IIA.

12. ***Hydration of ions:*** The ions of s-block elements are highly hydrated in aqueous solution. Smaller the ion greater shall be its hydration. The degree of hydration decreases from Li^+ to Cs^+ in group IA and from Be^{2+} to Ba^{2+} in group IIA.

13. ***Flame coloration:*** These elements impart color to flame except Be and Mg of IIA group: lithium is crimson, sodium is yellow, potassium, rubidium and cesium are violet, calcium is brick red, strontium is crimson, barium is apple green.

14. ***Reactivity:*** Reactivity of these elements increases from top to bottom in a group. Li, Be and Mg show somewhat abnormal properties. s-block elements show the following chemical properties:

- they decompose water readily and evolve hydrogen;
- they displace hydrogen from acids and form corresponding salts;
- they have great affinity for oxygen and non-metals (e.g. halogens, oxygen, sulphur, etc.);
- their hydroxides are strong alkalies and oxides are highly basics.

Physiological role of s-block elements

The s-elements are present in human body in the form cations in hydrated state, and more often – as central atoms of complexes compounds. Such s- elements, as hydrogen, sodium, potassium, magnesium, calcium are major biogenic macro-elements. In medicine the medicinal drugs are widely applied, which composition enter the s-elements.

IA group include hydrogen (H), lithium (Li), sodium (Na), potassium (K), rubidium (Rb), cesium (Cs), francium (Fr). Hydrogen under usual conditions – gas, consists of two-nuclear molecules. An electron configuration of the hydrogen atom is $1s^1$. Forms compounds with metalloids, showing oxidation state is +1 and with metals (hydrides), showing oxidation state -1. The valence electron configuration of atoms of alkali metals is formed by one electron which is taking place on spherical s-orbital. A valence electron configuration of atom is ns^1, where n – number of the period. External s-electron is weakly connected to atom and easily separates at chemical interactions. Therefore alkali metals are characterized by low electronegativity and brightly expressed reduction properties. In compounds characteristic oxidation state is +1. At transferring from Li to Fr nuclear radius grows, ionization energy of accordingly falls and electronegativity decreases. A stable form of IA group elements in an organism – is cations Me^{+1}.

Hydrogen (10%) is a part of water, fat (5%), proteins (10%), carbohydrates (6%), nucleic acids and is a necessary reagent of oxidation-reduction reactions, a source of hydrogen protons. Different tissues differ in the amount of water in their composition: the brain – 81%, the blood – 80%, the liver – 70%, the muscles – 50-75%, cartilage – 60%, bones – 30%. The carry of hydrogen ion on a biochemical chain of an organism is one of fundamental processes in an alive nature. The thin frame of protein contains a hydrogen bond. The molecules of nucleic acids, including DNA, are fastened among themselves by hydrogen bond.

Hydrogen peroxide H_2O_2 – 3% the solution is applied as a disinfectant (disinfectant properties are based on oxidizing properties of H_2O_2).

Hydrogen isotopes are used as a label for drug pharmacokinetics (deuterium) and radioisotope diagnostics studies in the study of biochemical reactions of metabolism and others (tritium).

Lithium is found in blood plasma, adrenal glands, liver, lungs and other organs in very small quantities. Lithium reduces nervous excitability, it participates in fat and carbohydrate metabolism, prevents the occurrence of allergies, supports the work of the immune system.

Lithium carbonate Li_2CO_3 apply at treatment mental diseases participating in carrying out of nervous pulses. Thus the concentration Li^+ is strictly monitored, since it is toxic.

***Sodium and potassium*:** the ions of sodium enter mainly into composition of intercellular liquids, the ions of a potassium are mainly inside cells. Concentration of Na+ outside the cell that is some 10 times greater than that inside the cell, and concentration of K+ inside the cell some 20 times greater than that outside the cell.

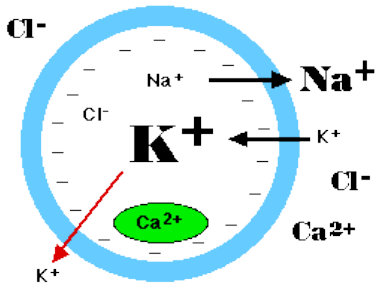


Fig 1. Ionic Relations in the Cell

The organism contains 0.23% of a potassium and 0.08% of a sodium. The sensitivity (conduction) of nerves depends on concentration of both ions. The introduction of potassium ions promotes a relaxation of a cardiac muscle between reductions of heart. The sodium hydrocarbonate enters into composition of the carbonates buffer bolstering acid – base equilibrium in liquid mediums of an organism. The treatment of some mental diseases is based on replacement of potassium, sodium and lithium ions.

Sodium sulfate $Na_2SO_4 \cdot 10H_2O$ is applied, as a purgative and as the antidote at a poisoning with salts of barium and lead, with which gives insoluble deposits $BaSO_4$ and $PbSO_4$:

$$Na_2SO_4 + BaCl_2 = BaSO_4 + 2NaCl$$
$$Na_2SO_4 + PbCl_2 = PbSO_4 + 2NaCl$$

Sodium chloride NaCl (0.9% solution of sodium chloride – normal saline solution) is applied to intravenous injections at the large hemorrhages, besides NaCl is used for inhalations. Sodium chloride serves a source of formation of a hydrochloric acid in a stomach.

Sodium hydrogen carbonate $NaHCO_3$ is applied in powders, tablets and solutions at a hyperoxemia of a gastric juice, gout, diabetes, catarrhs of the top respiratory ways. The aqueous solution of soda enters at diseases accompanying with an acidosis.

$$NaHCO_3 + HCl = CO_2 + H_2O + NaCl$$

Potassium hydrogen tartrate $KHC_4H_4O_6$ is applied in tincture and powder as mild laxative.

Potassium acetate CH_3COOK is a diuretic, well works at cardiac and renal edemas.

Potassium iodide KI will be used for treatment of eye diseases – cataract, glaucoma. Frequently of potassium iodide will use at a poisoning with salts of mercury.

IIA group elements in periodic table include beryllium (Be), magnesium (Mg), calcium (Ca), strontium (Sr), barium (Ba) and radium (Ra). All element of this group – is typical metals. The valence electron configuration is formed by two electrons which are taking place on spherical s-orbital. An electron configuration of a valence electron configuration is ns^2. External s-electrons are connected to atom more strongly, than at alkali metals. Therefore alkaline earth metals are characterized by higher electronegativity, but concern to active metals, have reduction properties. At transferring from beryllium to radium nuclear radius grows, the ionization energy and electronegativity is accordingly decreases. In their compounds elements of IIA group has the oxidation state +2. Properties of beryllium essentially differs from other elements. Oxide and hydroxide it have amphoteric properties. A stable form practically in all area of physiological value pH is the solid hydroxide $Be(OH)_2$. Only at a hyperoxemia in a stomach the beryllium can pass in the ionic form Be^{2+}. A stable form of other elements IIA group in an organism – is cations Me^{2+}.

***Magnesium and calcium*.** Under the characteristics their ions in the greater degree differ from each other, than a sodium and potassium ions. So, the ion of magnesium in comparison with ions of calcium shows the large tendency to formation of the covalent donor-acceptor bonds with various electro-donor atoms (N, O), included in composition of biological macromolecules (protein, nucleic acids).

The activity of the majority of enzymes depends on magnesium. Magnesium is one of the basic activators of enzymatic processes. In particular, it activates enzymes of synthesis and disintegration ATP, participates in carry of phosphatic groups. The magnesium is included into composition of chlorophyll.

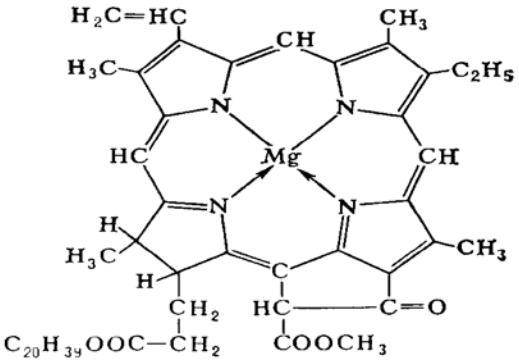


Fig 2. The structures of chlorophyll

The ions of magnesium form in cells complexes with nucleic acids, participate in transfer of a nervous pulse, reduction of muscles, metabolism of carbohydrates. It is possible to name magnesium as the central element of power processes connected to oxidizing phosphorylation, participates in a thermoregulation. Magnesium is part of ribosomes are connected by ions of magnesium. The content of magnesium in an organism is 0.027%. The excess of magnesium plays a role of depresser of nervous

exaltation, the disadvantage – causes tetamy – convulsive attacks as a result of a hyperexcitability of impellent and responsive nerves.

Calcium hydroxide $Ca(OH)_2$ is used in sanitary practice for disinfection.

Calcium chloride $CaCl_2$ has received wide application as antiallergic and antiedematous drugs. Antiallergic property of calcium is caused by that it depresses a permeability of walls of capillaries.

Gypsum $2CaSO_4 \cdot H_2O$ turns out by heating of a natural gypsum $CaSO_4 \cdot 2H_2O$. At mixing with water it quickly hardens, turning again in a crystalline gypsum. On this property its application in medicine for plaster bandages is based at fractures of bones.

Calcium carbonate $CaCO_3$ is applied inside not only as a calcium drug, but also as an agent adsorbing and neutralizing of acids. The apart pure drug goes for manufacturing a denture powder.

Magnesium sulfate $MgSO_4 \cdot 7H_2O$ is applied inside, as laxative. Its purgative action is explained by retentive influence on an adsorption of water from an intestine. Owing to osmotic pressure framed by this salt, water is kept in a lumen of an intestine and promotes faster advance of intestinal contents. Magnesium sulfate is applies at treatment of the tetanus, convulsive condition.

Magnesium hydroxide - carbonate $3MgCO_3 \cdot Mg(OH)_2 \cdot 3H_2O$ is applied outside as powder.

Magnesium oxide MgO is applied in small doses, as a purgative at a poisoning with acids. Enters into composition of denture powders, is applied at a hyperoxemia of a gastric juice: $MgO + HCl = H_2O + MgCl_2$

Strontium (10^{-4}%) is found in minute amounts in blood, bone and muscle tissue. The inhalation of strontium can cause severe respiratory difficulties, anaphylactic reaction and extreme tachycardia. Strontium activates a number of enzymes (catalase, carbonic anhydrase, etc.). Strontium can replace calcium in organisms, inhibit normal calcium absorption and induce strontium "rickets" in childhood.

Strontium isotopes (Sr-85 and Sr-87) are used to study the condition of bones.

Barium (10^{-5}%) ions act as a muscle stimulant in low doses, and higher doses affect the nervous system, causing cardiac irregularities, tremors, weakness, anxiety, shortness of breath, and paralysis. Barium salts may damage the liver. Barium displaces calcium and phosphorus from the bones, causing increased bone fragility and osteoporosis. This toxicity may be caused by Ba^{2+} blocking potassium ion channels, which are critical to the proper function of the nervous system. All compounds of barium, except for $BaSO_4$, are toxicant.

Barium sulfate $BaSO_4$ owing to the insolubility and due to ability strongly to absorb X-ray radiations as a suspension is applied at a radioscopy of a gastrointestinal path.

TESTS FOR SELF-CONTROL
Theme: s-block elements

1. **Sodium has … as compared to potassium**
   a) less electronegativity
   b) lower melting point
   c) more ionization energy
   d) larger atomic radius
2. **Sodium reacts with water more vigorously than Li because it**
   a) has higher atomic mass
   b) is more electropositive
   c) is a metal
   d) is more electronegative
3. **Which is most basic in nature**
   a) RbOH
   b) KOH
   c) LiOH
   d) NaOH
4. **Which one of the following statements regarding the alkali and the alkaline earth metals is false**
   a) they are reactive metals
   b) they belong to s-block elements
   c) they form hydroxides which are basic in character
   d) they form carbonates which decomposes on heating
5. **Which is the most basic of the following**
   a) Na_2O
   b) BaO
   c) c)As_2O_3
   d) Al_2O_3
6. **Which of the following alkali metals is the most reactive**
   a) Na
   b) K
   c) Rb
   d) Cs
7. **Which of the following imparts violet colouraction to the Bunsen burner nonluminous flame**
   a) NaCl
   b) $BaCl_2$
   c) $CaCl_2$
   d) KCl

8. The most abundant alkali metal in nature is

a) Na
b) Li
c) K
d) Cs

9. Soda ash is

a) $Na_2CO_3 \cdot H_2O$
b) NaOH
c) $NaHCO_3$
d) Na_2CO_3

10. Baking soda is

a) $Na_2CO_3 \cdot 10H_2O$
b) $Na_2SO_4 \cdot 10H_2O$
c) Na_2SO_4
d) $NaHCO_3$

11. Which one is the highest melting halide?

a) NaCl
b) NaBr
c) NaF
d) NaI

12. Molecular formula of Glauber′s salt is

a) $MgSO_4 \cdot 7H_2O$
b) $CuSO_4 \cdot 5H_2O$
c) $FeSO_4 \cdot 7H_2O$
d) $Na_2SO_4 \cdot 10H_2O$

13. Which of the following configurations corresponds to alkaline earth metals?

a) [Ar] $4s^2$
b) [Ne] $3s^2 3p^2$
c) [Ar] $3d^{10} 4s^1$
d) [Ar] $3d^{10} 4s^2$

14. The alkaline earth metals are

a) Na and K
b) Mg and Ca
c) Cu and Ag
d) Al and Fe

15. Alkaline earth metals are

a) reducing agent
b) oxidizing agent
c) amphoteric
d) acidic

16.Out of the following elements which one do you expect to be most reactive chemically?

a) Magnesium
b) Calcium
c) Strontium
d) Barium

17.Melting point is lowest for

a) Be
b) Mg
c) Ca
d) Sr

18.The most abundant alkaline earth metal present in earth′s crust is

a) beryllium
b) magnesium
c) calcium
d) strontium

19.Magnesium is present in

a) chlorophyll
b) hemoglobin
c) vitamin C
d) vitamin B_{12}

20.Element found in plant systems, which forms an important constituent of photosynthesis is

a) iron
b) copper
c) magnesium
d) sodium

21.Gypsum is

a) $Na_2CO_3 \cdot 10H_2O$
b) $2CaSO_4 \cdot H_2O$
c) Na_2SO_4
d) $CaCO_3$

22.What color is barium flame?

a) Crimson
b) Yellow
c) Brick red
d) Apple green

P-BLOCK ELEMENTS

General properties of p-block elements

1. ***Electronic configuration:*** The general electronic configuration of p-block elements is ns^2np^{1-6}.

2. ***Atomic size:*** Size of an atom of p-block elements decreases from left to right in a period while increases from top to bottom in a group.

3. ***Ionization energy:*** Ionization energy of p-block elements generally increases from left to right in the period while decreases from top to bottom in the group.

4. ***Metallic and non-metallic character:*** The metallic character of p-block elements decreases from left to right in the period while increases from top to bottom in the group. The non-metallic character of p-block elements in a period from left to right, there is a regular increase and decreases in the groups from top to bottom. Majority of p-block elements are non-metals.

5. ***Electronegativity:*** The electronegativity values increases from left to right in the period while decreases from top to bottom in the group. The elements having maximum electronegativity are the members of this block. There are fluorine (4.0), oxygen (3.5), chlorine (3.0), nitrogen (3.0), bromine (2.8). On accoupt of high value of electronegativity, they form usually covalent compounds.

6. ***Oxidation states:*** The lighter elements of p-block (the elements of 2 and 3rd period) show both positive and negative oxidation states while heavier elements show positive oxidation states (due to inert pair effect).

7. ***Electron affinity:*** This value decreases from top to bottom in the group while increases from left to right in the period with some exceptions of VA group elements due to half filled p-orbitals. Due to high values of electron affinity in the case of O, S, halogens, these are capable of forming anions and act as strong oxidizing agents.

8. ***Flame colouration:*** No member of p-block series or the salts impart a characteristic colour to the flame because the energy released by excited elements does not appear in the visible region of the spectrum.

9. ***Conductivity:*** Except metals, the members of p-block are bad conductors of heat and electricity.

10. ***Chemical properties:*** Chemical properties change from group to group and are different.

11. ***Allotropy:*** A number of elements of p-block show this property. Carbon, silicon, germanium, tin, boron, oxygen, sulphur, phosphorus arsenic, etc., exhibit a number of allotropic forms.

Physiological role of p-block elements

The elements whose atoms receive the last electron in the p-sub-orbit of their outermost shell are known as p-block elements. The electronic configuration of these elements varies from ns^2np^1 to ns^2np^6. In groups from the top to bottom radius of atoms of p-elements increases, the ionization energy decreases, the non-metallic properties decreases, and metal increases.

IIIA group elements in periodic table include boron (B), aluminium (Al), gallium (Ga), indium (In) and thallium (Tl). Out of these aluminium is most abundant element. It is the third most abundant element found on earth crust. Their general electronic configuration is ns^2np^1. The oxidation state +3 are characteristic for boron and aluminium.

Boron (10^{-5}%) concentrates mainly in mild, thyroid gland, liver, lien, brain, kidneys, cardiac muscle, enters into composition of teeth and bones. The excess of boron oppresses diastases, proteinase, reduces activity of an epinephrine. The boron participates in a carbon-phosphatic exchange. The large content of boron in nutrition breaks an exchange of carbohydrates and protein, results in occurrence of enteritises.

Orthoboric acid H_3BO_3 is applied as an antiseptic agent. The high solubility of H_3BO_3 in lipids provides fast infiltration in cells through membranes. In result there is a coagulation of protein of microorganisms and their destruction. It is used in glass industry, in washing eyes, nose, ear, throat, preservation of food stuff, dressing the wounds.

Hydrated sodium borate $Na_2B_4O_7 \cdot 10H_2O$ (tincal) is applied as an antiseptic. The pharmacological action of a drug is caused by a hydrolysis salt with excretion of boric acid. Formed alkali and acid cause coagulation of protein of microbial cells:

$$Na_2B_4O_7 + 7H_2O = 4H_3BO_3 + 2NaOH$$

Aluminium (10^{-5}%) concentrates mainly in serum of a blood, mild, liver, bones, kidneys, nails, hair, enters into frame of nervous environments of a brain of the man. The aluminium influences development of epithelial and connecting tissues, on neogenesis of osteal tissues, influences an exchange of phosphorus. The excess of aluminium brakes synthesis of a hemoglobin, since due to high complexing ability the aluminium blocks active centers of enzymes participating in a hemopoiesis. The aluminium can catalyze reaction of a transamination (carry NH_2-group).

Aluminium oxide Al_2O_3 is applied in an dentists practice, enters into composition of dental cements.

Aluminium hydroxide $Al(OH)_3$ enters into composition of a drug which neutralizes ions H_3O^+ gastric juice:

$$Al(OH)_3 + 3H_3O^+ = Al^{3+} + 3H_2O$$

Alum $KAl(SO_4)_2 \cdot 12H_2O$ is used in the purification of water, in medicine to stop bleeding from a small cut as it coagulates blood; as mordant in dyeing and calico

printing, in tanning of leather and for sizing of cheap quality of paper. It is based that the ions of aluminium form with protein, complexes which are dropping out as gels:

$$Al^{3+} + Protein \rightarrow AlProtein$$

It results in destruction of microbial cells.

IVA group elements in periodic table include carbon (C), silicon (Si), germanium (Ge), tin (Sn), lead (Pb). The general electronic configuration of atoms of elements IVA group is ns^2np^2. In the exited condition the electrons of an external energy level get a configuration ns^1np^3. For C, Si, Sn is most typical oxidation state is +4, for Pb is +2. In hydrides $ЭH_4$ oxidation state of elements is -4. In an alive organism oxidation states of C, Si, Ge are +4, oxidation states of Sn and Pb are +2.

Carbon (21%) is a macroelements enters into composition of all tissues and cells. It is a part of proteins, fats, carbohydrates, nucleic acids, hormones, enzymes, vitamins, etc. Hydrocarbonate of potassium and sodium are part of the buffer systems of blood and tissues that support the pH of the body. Acetic acid takes part in the synthesis of cholesterol.

Carbon dioxide CO_2 is constantly formed in tissues of an organism during a metabolism and plays the important role in a regulation of respiration and circulation. CO_2 is stimulator of respiratory center. The large concentration of CO_2 (more than 10%) cause a strong acidosis. Hydrocarbonate buffer system (H_2CO_3/HCO_3-) is the main buffer system of a blood plasma. Carbon dioxide occurs about 0.03 – 0.05% in the atmosphere. It comes to the atmosphere from animal breathing, decay of vegetable matter, burning of carbon and carbons matter, etc. It is also utilized by plants in photosynthesis.

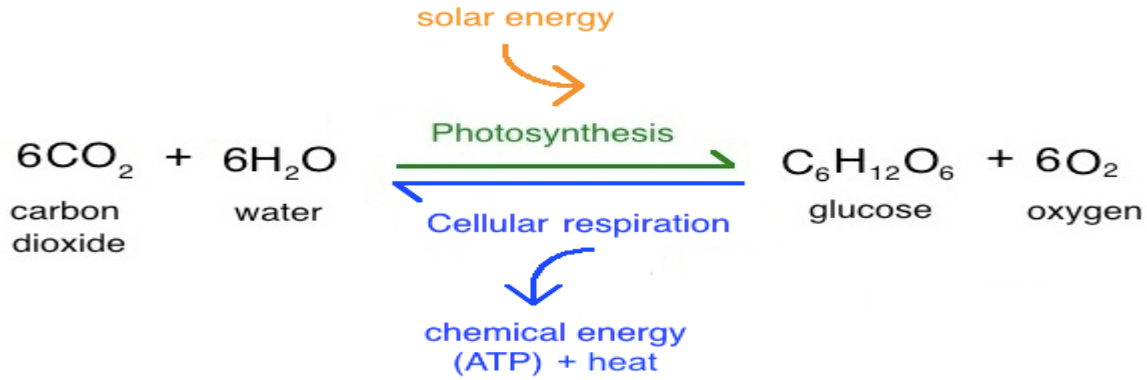


Fig 3. The scheme of photosynthesis

Thus, a CO_2 cycle is operating in nature and the proportion of CO_2 in the atmosphere remains about the same. It is slightly soluble in water under ordinary pressure but at high pressure, the solubility is high. It is heavier than air. It is easily liquefied under pressure into a colorless mobile liquid. If CO_2 under pressure is allowed to escape through a nozzle, a white solid, i.e., dry ice is obtained. Solid CO_2 is a soft, white, snow like substance. It sublimes and leaves no residue.

Carbon monoxide CO (*the charcoal gas*) occurs in small quantity in volcanic gases, chimney gases, exhaust gases of automobile engines and coal gas. It is colorless, odorless gas, slightly soluble in water and is highly poisonous (one part of CO in 500 parts of air produces unconsciousness in about one hour and one part in 100 parts causes death in few minutes). This is due to the fact that it combines with hemoglobin – red coloring matter of blood, to form a stable compound carboxyhemoglobin. With the result the oxygen transportation is disturbed.

Silicon (10^{-5}%) concerns to trace substances and occurs in small quantity in blood, bone and muscle tissue, liver. In an organism basically acts through mild as a dust SiO_2. To infringement of an exchange of silicon bind occurrence of a hypertonia, rheumatic disease, anemias. At regular influence on a mild dust containing particle coal, silicon, aluminium, there are diseases - dust diseases, at action of a silicon dust - silicosis, action of a aluminium dust is aluminosis.

Talc $3MgO \cdot 4SiO2 \cdot H2O$ is used in baby powder.

Silicon (IV) carbide SiC (carborundum) is used in dental practice for grinding seals and plastic prostheses.

Silicon dioxide SiO_2 is a part of silicate cements.

Tin and lead. The inorganic bonds of tin are not so toxicant, and organic – are toxicant.

All bonds of lead (II), especially soluble are toxicant.

The tin concerns to trace substances. It gets in an organism of the man with acidic products, tinned in tin banks covered with bed of tin. In the form of salt tin acts in an organism and shows toxic action. The biological role of tin finally is not found out. In dentists practice will use dental cements materials. For example, the silver amalgam contains 28% of tin, will be used for manufacturing seals. $SnFe_2$ – will be used as an agent against a caries of teeth. The bonds of lead influence synthesis of protein, energy balance of a cell and e the genetic device. Lead is present basically, in a skeleton (up to 90%) in the form of difficultly soluble phosphates:

$$3Pb^{2+}(aq) + 2PO_4^{3-}(aq) = Pb_3(PO_4)_2\downarrow$$

Mass share of lead in an organism 10^{-6}%. Safe for the man consider daily consumption 0.2–2 mg of lead.

Lead acetate $Pb(CH_3COO)_2 \cdot 3H_2O$ will be used, as the knitting antiseptic agent.

Lead oxide PbO enters into composition of a lead plaster for inflammatory skin diseases, furunculosis.

Lead additives are used in the manufacture of clothes for medical staff of X-ray rooms (aprons, mittens, helmets), since lead absorbs X-rays and γ-rays.

VA group elements include nitrogen (N), phosphorus (P), arsenic (As), antimony (Sb), bismuth (Bi). The general electronic configuration is ns^2np^3. In bonds elements of this group shows oxidation states are +1, +2, +3, +4, +5, -3. For nitrogen is most typical oxidation states are +3, +5, -3, and also are +2, +4. Oxidation state of

phosphorus is +5. Oxidation states of As, Sb, Bi are +3, +5, -3. In an organism of the man the nitrogen is in biomolecules: ammonia, amino acids in oxidation state is -3; phosphorus – as salts and esters of the opthophosphoric acid in oxidation states is +5.

Nitrogen (3%) enters into composition of amino acids, protein, vitamins, hormones. Nitrogen is contained in the blood – 3 mg/ml, in muscle tissue – 7%, in bone tissue – 4%. In biomolecules the nitrogen forms covalent linkages with atoms of hydrogen and carbon. In many metal containing enzymes atoms of nitrogen on the donor-acceptor mechanism bind inorganic and organic parts of a molecule. Ammonia neutralizes excess acids in the body.

Nitric oxide NO is one of the most important immunotropic mediators, stimulates phagocytosis and killing of intracellular parasites. NO is involved in maintaining systemic and local hemodynamic, acts as a neurotransmitter in the gastrointestinal tract, urinary and reproductive system. Nitric oxide NO participates in the elimination of "aging" molecules of cytochromes, catalase, hemoglobin, and in the induction of apoptosis in cells where the level of free iron rises.

Nitrous oxide, N_2O or laughing gas is a colorless gas with pleasant odor and sweet taste. When inhaled in moderate quantity, it produces hysterical laughter, hence named as laughing gas. However, when inhaled for long, it produces insensibility and may prove fatal too. It is heavier than air. It is fairly soluble in cold water but not in hot water. It is neutral to litmus. A mixture of nitrous oxide and oxygen is used as an anaesthetic in dental and other minor surgical operations, operative gynecology, surgical dentistry, and also for the anesthesia of labor. It has a weak narcotic activity, so it must be used in high concentrations.

Nitroglycerin is prescribed for relief or prevention of angina attacks, especially preparations of prolonged (prolonged) action.

Sodium nitrite $NaNO_2$ is used as a vasodilator for angina pectoris, sometimes with spasms of brain vessels.

Ammonium hydroxide $NH_3 \cdot H_2O$ is used to stimulate respiration and remove patients from syncope. At high concentrations, ammonium hydroxide can cause reflex stopping of breathing.

Phosphorus (1%) enters into composition of protein, nucleic acids, ATP. Phosphorus compounds are a basis of a skeleton of animals and man $Ca_{10}(PO_4)_6(OH)_2$ and teeth $Ca_{10}(PO_4)_6F_2$. An average person has 3.5 kg of calcium phosphate in his body. The phosphate buffer system is one of the basic buffer systems of a blood. Sucrose and the fatty acids can not be used by cells as energy sources without preliminary phosphorylation.

The exchange of phosphorus in an organism is intimately connected to an exchange of calcium. At decrease of the contents of inorganic phosphorus in a blood the contents of calcium is enlarged. Phosphorus participates in the formation of macroergic compounds (DNA, RNA, ATP, ADP, etc.), it actively participates in the

exchange of proteins, fats, carbohydrates. Phosphorus plays a leading role in the metabolic processes occurring in the muscles, it is necessary for the normal operation of the central nervous system. Phosphorus stimulates the processes of memorization.

The organic compounds of phosphorus containing bond C-P are strong neuroparalytic poisons (venom).

The pure form is white but attains yellow color on long standing due to the formation of a thin film of the red variety on the surface. It is a transparent waxy solid and can be easily cut with knife. It has characteristic garlic smell and is poisonous in nature. 0.15 g is the fatal dose. Vapors are also injurious. Persons working with phosphorus develop a disease in which the jaw bones decay. This disease is known as phossy jaw.

Radioactive isotope phosphorus-32 is used in the treatment of leukemia and other blood disorders.

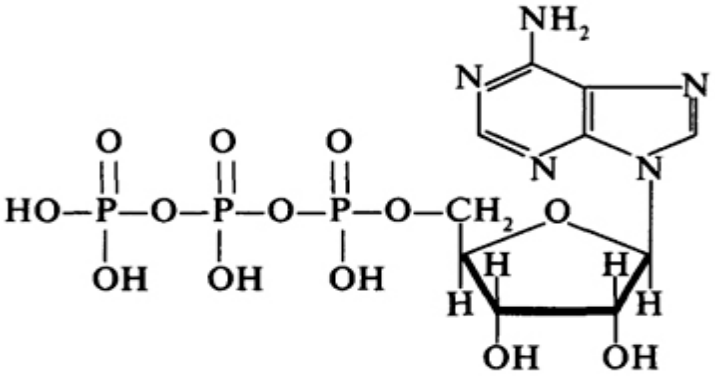


Fig 4. The structures of ATP

Adenosine triphosphate ATP is prescribed for chronic coronary insufficiency, muscular dystrophy and atrophy, spasms of peripheral vessels.

$AlPO_4 \cdot Zn_3(PO_4)_2$ is part of the filling materials.

Calcium glycerophosphate is used as a restorative and tonic for the loss of nutrition, exhaustion of the nervous system, rickets.

Sodium dihydrogen phosphate NaH_2PO_4 is used with increased acidity of gastric juice and poisoning with acids, sometimes as an easy laxative.

Arsenic (10^{-6}) is found in the liver, kidneys, spleen, lungs. Arsenic accumulates in bones and hair and is not completely eliminated for several years. The determination of arsenic in the biomaterial is carried out according to the March reaction: zinc and hydrochloric acid are added to the biopreparation and a black plaque of As is formed:

$As_2O_3 + 6Zn + 12HCl = 2AsH_3 + 6ZnCl_2 + 3H_2O_2$

$AsH_3 = 2As + 3H_2$

Arsenic compounds are very toxic. Arsenic compounds slowly penetrate through the skin, quickly absorbed through the lungs and the gastrointestinal tract.

Arsenic combines with sulfhydryl groups (SH groups) and inactivates enzymes containing SH groups, that is, it is an inhibitor of respiratory enzymes.

In small doses, arsenic compounds exert a tonic effect, stimulate hemoglobin synthesis and erythrocyte maturation, inhibit leukopoiesis. Arsenic is toxic. Toxic dose is 5–50 mg and lethal dose is 50–340 mg. When poisoned, it affects the central nervous system.

Arsenic (III) oxide As_2O_3 in dental practice is used for necroticisation of pulp. Inside prescribe for anemia, exhaustion, neurasthenia.

Potassium arsenite K_3AsO_3 is also used for anemia, exhaustion, neurasthenia.

Antimony and bismuth (10^{-6}) are microelements, whose physiological and biological role is not clear. When most of the bismuth and antimony compounds enter the gastrointestinal tract, they practically do not have a toxic effect. This is due to the fact that the salts of antimony and bismuth undergo hydrolysis with the formation of sparingly soluble products that are not absorbed through the walls of the intestine. This is the basis for the use of bismuth nitrate base, as an astringent antiseptic agent $Bi(OH)_2NO_3$.

Vl A group elements (chalcogens) include oxygen (O), sulfur (S), selenium (Se), tellurium (Te), polonium (Po) The general electronic configuration is ns^2np^4. In combination with metals and hydrogen characteristic oxidation state of elements is -2, with non-metals are +4, +6, +2. The elements of O, S, Se are part of biomolecules of living organisms with oxidation state is -2.

Oxygen is the most abundant element and is found both in free as well as in combined state. Oxygen makes up 46.6% by mass of the earth's crust. Oxygen occurs in the atmosphere to the extent of about 21% by volume. This percentage remains constant by the operation of the highly complex process termed photosynthesis. It is an essential ingredient in all living matter and is of great importance in respiration and combustion. It is most abundant element and forms, about one half of the earth's crust.

Oxygen (70%) is a part of water, proteins (18%), fats (22%), carbohydrates (49%) and other substances. Without oxygen, the processes of respiration, oxidation of proteins, fats, carbohydrates are impossible. Oxidation of nutrients by oxygen serves as a source of energy necessary for the operation of organs and tissues of living organisms. Oxygen is capable of forming oxygenates with various substances. For example, oxyhemoglobin and oxyhemocyanine, which are carriers of oxygen in living organisms. In these compounds, oxygen acts as a electrons donor.

$$HbFe^{2+} + O_2 \rightarrow HbFe^{2+} + \cdot O_2$$

$$HbCu^{2+} + O_2 \rightarrow HbCu^{2+} + \cdot O_2$$

In other compounds in the body, oxygen participates in the formation of hydrogen bonds.

Oxygen is used for inhalation in diseases of the heart, lungs, accompanied by oxygen deficiency, with CO and HCN poisonings. In clinical practice, hyperbaric oxygenation is used.

Ozone O_3 as a very strong oxidizer is used for disinfection of premises, air disinfection and purification of drinking water.

Sulfur (0.2%) is a macroelement, is a part of proteins, amino acids (cystine, cysteine, methionine), hormone of insulin and vitamin B_1. Sulfur accumulates in hair, bones, nervous tissue. Amino acids containing SH-groups in the body are oxidized to sulfates, free sulfur, thiosulphates ($S_2O_3^{2-}$). The sulfuric acid formed in the body takes part in the binding and neutralization of many compounds, forming harmless substances with them.

Sulfur precipitated S has an antimicrobial effect and an antiparasitic agent is used. It is part of a number of ointments used for skin diseases (scabies, psoriasis).

Sodium thiosulfate $Na_2S_2O_3 \cdot 5H_2O$ has a counter-toxic, anti-inflammatory effect. Used for poisoning with As, Hg, and Pb compounds (non-toxic compounds are formed). External applied to the treatment of skin diseases, including scabies. The action is based on the ability of sodium thiosulfate to decompose in an acidic medium, releasing sulfur, SO_2, which have an antiparasitic action:

$H_2S_2O_3 \rightarrow S + SO_2 + H_2O$

Selenium (10^{-7}%) is concentrated in liver and kidneys. As an analogue of sulfur, replaces it in various compounds. Selenium in combination with amino acids is a part of some enzymes. It stimulates the synthesis of sulfur-containing amino acids and is part of the enzyme glutathione peroxidase, which prevents oxidation of blood hemoglobin peroxides. Selenium is an antioxidant, protecting the body from the action of active radicals, including atomic oxygen and peroxides. Selenium positively affects the cardiovascular system, promotes blood supply to the heart and stimulates the formation of red blood cells. In high doses, selenium is toxic, because decomposition of selenium compounds in the body produces a very toxic dimethylselene, CH_3-Se-CH_3.

VIIA group elements (halogens) include fluorine (F), chlorine (Cl), bromine (Br), iodine (I), and astatine (At). The general electronic configuration is ns^2np^5. The elements of this group shows oxidation states are -1, +1, +3, +5, +7. In living organisms oxidation state of all halogens is -1. Chlorine and bromine in the hydrated ions form, fluorine and iodine part of the bioorganic compounds.

Fluorine (10^{-6}%) is concentrated in bone tissue (0.2–1.2%), nails, teeth (0.01%). Fluoride is vital for normal growth and development. In the body, fluorine is involved in many biochemical reactions – it activates adenylate cyclase, inhibits lipases, esterase, lactate dehydrogenase, etc.

Fluoride participates in the mineral metabolism in the formation of solid constituents of the teeth and tissue of the skeleton. Therefore, in the human body,

fluoride is concentrated most in the enamel of teeth and bones. In these tissues, fluorine is in the form of fluorapatite ($Ca_5(PO_4)_3F$). For prevention of caries, drinking water is fluorinated by adding NaF. Excess fluoride in water leads to brittleness of tooth enamel, fragility of bones, there is a general depletion of the body. This disease, caused by an excess of fluoride, is called fluorosis. Gaseous fluoride is a very strong poison. Its inhalation causes an immediate damage to the respiratory system. When in contact with the skin, fluoride vapor causes itching, irritation.

Sodium fluoride NaF is a part of toothpastes and is used to prevent caries.

Chlorine (0.1%) is an important biogenic element. Chlorine anions $C1^-$ participate in biochemical transformations: activate enzymes, affect the electrical conductivity of cell membranes, etc. Ions of $C1^-$ participate in the maintenance of osmotic pressure of biological fluids (blood plasma, lymph, cerebrospinal fluid).

Hydrochloric acid HCl (8% solution of HCl) in drops and potions is used for inadequate acidity of gastric juice.

Bleaching powder $CaOCl_2$ is used as a disinfectant.

Bromine (10^{-5}%) is located in the pituitary gland. The biological role is not sufficiently clarified. Bromine ions are easily absorbed into the digestive tract. The toxicity of ions is low, but they are slowly eliminated from the body, and can accumulate. There is evidence that bromine compounds depress the function of the thyroid gland and increase the activity of the adrenal cortex. The most sensitive to bromine is the nervous system. Chlorine anion Br^- has a calming effect with increased excitability.

Bromides of NH_4Br, KBr and NaBr are used in medicine as sedatives.

Iodine (10^{-5}%) is an essential trace element. Iodine is part of iodine-containing thyroid hormones, which affect the metabolism in the body. With a deficiency of iodine, an endemic goiter develops. Drinking water and food do not cover the body's needs for iodine, so it is iodized (by adding 15-20 mg of KI or NaI per 1 kg of table salt). For iodization of table salt, potassium iodate KIO_3 is also used, which under certain conditions turns into molecular iodine. Lack of iodine affects the health of children: they lag behind in physical and mental development. Iodine vapors are poisonous. They cause a strong catarrhal inflammation of nasal mucosa and eyes.

Radioactive isotopes ^{131}I, ^{132}I, ^{125}I with a short half-life are used for the treatment and diagnosis of thyroid diseases.

Potassium iodide and sodium iodide is used for endemic goiter.

Iodine alcohol solution (5 or 10%) external applied as an aseptic; inside is prescribed for the prevention of atherosclerosis.

Iodine solution in aqueous solution of KI is used to lubricate mucous membrane of pharynx and larynx.

TESTS FOR SELF-CONTROL
Theme: p-block elements

1. **The general electronic configuration of p-block elements is**
   a) ns^1 to ns^2
   b) ns^2 to np^6
   c) ns^2np^1 to ns^2np^5
   d) $(n-1)d^{1-10}$ ns^{0-2}
2. **Silicon exhibits diagonal relationship with**
   a) Be
   b) B
   c) C
   d) N
3. **Which of the following metal exhibits similarities in properties to aluminium?**
   a) Ba
   b) Be
   c) Ca
   d) Sr
4. **Which one of the following is the most electropositive element?**
   a) Al
   b) B
   c) Ga
   d) Sn
5. **Which one of the following is most abundant on the earth crust?**
   a) Al
   b) B
   c) In
   d) Ga
6. **Which is most acidic?**
   a) Na_2O
   b) MgO
   c) CaO
   d) Al_2O_3
7. **Which of the following reacts with hemoglobin of blood to give carboxyhemoglobin?**
   a) CO
   b) CO_2
   c) HCOOH
   d) CH_3COOH

8. When Al is added to KOH solution

a) no action takes place
b) oxygen is evolved
c) water is produced
d) hydrogen is evolved

9. Amphoteric oxide is/are

a) Al_2O_3
b) Ga_2O_3
c) Tl_2O_3
d) CO_2

10. Which one of the following is a typical non-metal?

a) Si
b) Pb
c) Ge
d) Sn

11. The inert form of carbon is

a) Graphite
b) Diamond
c) Coal
d) Charcoal

12. Living in atmosphere of CO is dangerous because it

a) reduced organic matter of tissues
b) dries up the blood
c) combines with O_2 present inside to form CO_2
d) combines with hemoglobin and makes it incapable to absorb oxygen

13. Which is correct oxidation state about lead?

a) +2, +4
b) +1, +2
c) +3, +4
d) +4

14. Which element is most abundant on earth′s crust?

a) Ca
b) C
c) Si
d) O

15. Ozone may not act as

a) bleaching agent
b) dehydrating agent
c) oxidizing agent
d) reducing agent

16.A considerable part of harmful ultraviolet radiation of sun does not reach earth′s surface. This is because high above the earth′s atmosphere there is a layer of

a) CO_2
b) H_2
c) O_3
d) NH_3

17.The electronic configuration of an element is $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^3$. Its properties would be similar to which of the following elements?

a) Boron
b) Oxygen
c) Nitrogen
d) Chlorine

18.Which one of the following elements occurs free in nature?

a) N
b) P
c) As
d) Sb

19.Animals die in nitrogen atmosphere, because

a) It is poisonous
b) It is heavier than air
c) They want oxygen
d) It destroys hemoglobin

20.The gas is commonly used in anaesthesia:

a) Methane
b) Nitrogen
c) Hydrogen peroxide
d) Nitrous oxide

21. The photosynthesis products are

a) Glucose and oxygen
b) Carbon dioxide and water
c) Carbon dioxide and oxygen
d) Glucose and fructose

22.What element is part of thyroid hormones?

a) Aluminum
b) Iodine
c) Bromine
d) Chlorine

D-BLOCK ELEMENTS

General properties of d-block elements

1. **Electronic configuration**: The d-block elements have their outermost as well as penultimate shell incomplete. They generally contains two electrons in their ns- sub-shell (exception – Cr, Cu, Mo, Ru, Pd, Ag, Pt and Au). The anomalies are accounted on the basis of half-filled and completely-filled sub-shells represent particularly stable states owing to the large exchange energy of these configurations.

2. **Atomic radii**: Generally, the atomic radii of the d-block elements decreases with the increase in the atomic number. This is due to the fact that nuclear charge increases with increase in the atomic number, which pulls electron cloud inward resulting in decrease in the radii. However, there are some exceptions. The decrease in atomic radii is very small from Cr to Cu. This is due to screening effect. The additional electrons effectively screen the outer ns electrons from the added nuclear charge. The atomic number increases and so does the screening effect. Therefore, there is only a slight change in radii.

3. **Density**: Due to decrease in atomic volume, there is corresponding increase in density. Hence the densities of d-block elements are very high in comparison of those of groups IA and IIA.

4. **Oxidation states**: One of the most frequently remarked characteristic of a typical transitional element is the great variety of oxidation states in their compounds. It is observed that the element of 3d-series show oxidation states ranging from +1 to +7. The elements have their valence electrons it two different sets of orbitals viz. (n-1) d- and ns-orbitals. These orbitals are of comparable energies. When ns-electrons are involved the compounds with lower oxidation states are formed. In compounds with higher oxidation states, the involvement of both ns- and (n-1) d-electrons takes place. As the energy difference between the two sets of orbitals is very small, the d-block elements exhibit several oxidation states differing by 1 unit. The relative stabilities of these oxidation states are governed by the electronic configuration of the element, the type of bonding involved, the lattice energy, the salvation energy, the solvent, stereochemistry etc. The oxidation state of zinc is only one i.e. +2 because after losing two outermost 4s electrons, the Zn^{2+} ion has a stable (18 electrons) configuration and has no tendency to lose any more electrons. It is clear from above discussion that most of the elements exhibit +2 and +3 oxidation states as iron. The oxidation states +8 is important only with ruthenium and osmium.

5. **Metallic properties**: The d-block elements are metals. This is not surprising, since the outer shell contains few electrons. However, unlike the metals of group IA and IIA, these metals are hard and exhibit high melting and boiling points. There are exceptions too to this general hardness as in case of mercury (atomic number 80),

which is a liquid and is about as soft as a metal can be. They are all malleable and ductile in nature as well as good conductors of heat and electricity. Silver, gold and copper outstandingly good in this respect.

6. **Ionization energy**: The first and subsequent ionization energies increases as we move from left to right across the 3d-series. However, the increase is not as pronounced as in the case of the same period for the s-and p-block elements. This is due to the screening effect of the d-electrons. The expected increase in the ionization energy on account of the increase in nuclear charge is almost offset by the extra screening of the nucleus provided by the inner d-electrons. The ionization energies of the d-block elements lie between those of ionic compound forming s-block elements on one side and mainly covalent compound forming p-block elements on the other side. Thus, the d-block elements form ionic as well as covalent compounds.

7. **Reactivity**: The reactivity of d-block elements is low, this is due to high ionization energy, high heat of sublimation i.e. large amount of energy is required to change solid into vapor state and low heats of hydration of their ions. Hence the elements such as Pt and Au (5d-series elements) are called noble metals.

8. **Color**: Most of the transition metal ions contain unpaired d-electrons. The amount of energy needed to promote one or more electrons from a lower to higher to higher level within the same d-sub-shell is quite low. Light radiations corresponding to such small amounts of energy are available within the visible range. The ions absorb certain wave lengths of light in the visible region and emit the remainder as colored light. This explains why transition metal compounds are colored. The relationship between the color absorbed and the complementary color observed is given here.

We know that ions such as Cu^{+} and Zn^{2+} have completely filled d-orbitals while the Sc^{3+} and Ti^{4+} have completely empty d-orbitals. Therefore these ions are colorless. Similarly Cd^{2+} ($4d^{10}$) and Hg^{2+} ($5d^{10}$) are colorless.

Color and Number of Unpaired Electrons of Ions of the Elements of 3d-series

Number of unpaired electrons	Metal ions	Color of the ion
0	Cu^{+}, Zn^{2+}, Sc^{3+}, Ti^{4+}	Colorless
1	Cu^{2+}, V^{4+}	Blue
2	Ni^{2+}, V^{3+}	Green
3	Co^{2+}	Pink
3	Cr^{3+}	Green
4	Fe^{2+}	Light green
4	Cr^{2+}	Blue
5	Mn^{2+}	Pale Pink
5	Fe^{3+}	Yellow

Physiological role of d-block elements

To d-elements 32 elements of Periodic Table concern. They are posed in 4-7 large periods. At d-elements there is a consecutive filling by electrons d-sub-shell up to 10. The trends in the variation of the atomic radii of the d-block elements within periods are irregular. In the three periods shown, there is a small decrease in the radii to the middle of the period, followed by a small irregular variation through the latter part of the period. The reason for this variation is that the outer s-electrons are effectively fielded from the increased nuclear charge by the electrons in the inner d-sub-shell. There is only a small increase of the radii toward the heavier elements in each group of transition metals. Especially characteristic for d - elements is formation of complexes, including with biogenic ligands. The d - elements show variable valency and different oxidation states. It determines oxidation-reduction property of the majority compounds of d - elements.

The compounds of d-elements with highest oxidation states show acid and oxidizing properties. Lowest oxidation states causes the basic and reduction properties. The amphoteric properties are typical for compounds with intermediate oxidation states.

During biological evolution the nature selected compounds of d-metals in such oxidation states, in which they are not neither strong oxidizers, nor strong reducers, i.e. presence d-elements in highest oxidation states for organisms it is poorly probable. Such cations, as Ag^{+}, Fe^{3+} in biological mediums do not show in general reduction properties. The ions Mn^{2+}, Co^{2+}, Fe^{2+} at pH of physiological liquids are not strong reducers.

In biochemical reactions d-elements reacts as bioinorganic complexes. By ligands in these complexes the peptides, protein, hormones, nucleic acids.

Depending on carried out function (biological) bio-complexes divide into the following groups: transport, accumulators, biocatalysts.

The transport bio-complexes are important first of all by that deliver to an organism oxygen and biometals. As metal act a cobalt, nickel, zinc, iron and others.

The role of accumulators is carried out by bio-complexes a myoglobin and hemoglobin containing iron.

The biologically necessary elements – zinc, copper, iron, cobalt, molybdenum enter into composition metal containing enzymes.

The microelements (cobalt, chrome, nickel, copper, zinc, molybdenum, vanadium) work immediately on a tissue of a tooth, thus changing their chemical frame and composition; the enzymatic processes in a saliva and tissues of a tooth influence chemical composition and properties of a saliva, microflora of an oral cavity. The microelements render essential influence on a resistance of solid tissues

of a tooth to a caries. Therefore for prophylaxis of a caries important the prevention of infringements of an exchange of microelements is.

Many compounds of d-elements, especially derivative Zn, Cd, Hg, Ag, Ni, Pb render toxically action on alive organisms. It is connected that these d-elements form with protein insoluble compounds. The denaturation of protein occurs as a result of interaction of ions of hard metals to electron-donating atoms of sulfur of group-SH, which enters into composition of protein.

Copper contains in an organism approximately in quantity 1,1mmol. The copper concentrates in a liver, brain, blood. As ions Cu^{+}, Cu^{2+} the copper is included into major complexes with protein (copper - proteids). Copper – the proteids, similarly to a hemoglobin, participate in carry of oxygen. The copper activates synthesis of a hemoglobin, participates in processes of cells respiration, in synthesis of protein, osteogenesis and pigment of dermal integuments. The ions of copper enter into composition of a copper containing enzymes (oxydases), which catalyze oxidation – reduction reactions. Fixed, that the accumulation of copper in an organism promotes development of a chronic hepatitis.

The excess of copper deposits in a liver, brain, kidneys, eyes, causes serious disease. The all salts of copper are toxically. The toxically action is caused by that the copper forms with protein insoluble albuminates, forming strong chemical bonds with $–NH_2$ group SH - protein.

$CuSO_4 \cdot 5H_2O$ has knitting and cauterizing action is applied as eye drops, and as pencils to treatment of a trachoma.

Silver is trace substance, in an organism contains 7,3 mmol of Ag. Concentrates in a liver, pituitary body, erythrocytes, pigmental environment of an eye. As all serious metals, the silver getting in a body, renders toxically action, since is bridged to protein containing sulfur, blasts and coagulates them. In medicine the drugs of silver will used as knitting, cauterizing, microbicide. From inorganic bonds the silver nitrate is applied $AgNO_3$. The silver will be used for reception "of silver water", which will use treatment of wounds, ulcers.

Silver nitrate $AgNO_3$ in a complex with organic compounds forms albuminates and owing to a denaturation of protein of bacterial cells renders antiseptic action. As 4% of a solution will be used for an impregnation (saturation of decalcified tissues of a tooth by chemical combinations promoting their mineralization) of solid tissues of a tooth. Silver nitrate is apply at an initial, superficial, average caries, hyperesthesia of solid tissues of a tooth and to sterilization of the canal of a root of a tooth.

Colloidal silver contains 70% of silver. 1-2% will use a solution as an antiseptic agent for a gargle of an oral cavity at inflammatory processes.

Protargol contains 8% of silver is applied as knitting, antiseptic and resolvent. Will use as 1-5% of a solutions for greasing a mucosa and for a gargle of an oral cavity at inflammatory processes.

Zinc is included into composition of the large number of enzymes and hormone insulin. It is necessary for maintenance of normal concentration of vitamin A in plasma. The deficiency of zinc causes retardation of body height of animals, infringement of a dermal and hair integument, frustration of sexual function.

According to last data, zinc renders appreciable influence on synthesis of nucleic acids and participates in a storage and transfer of the genetic information. Salt of zinc have antiseptic action, which is connected to formation by ions of zinc insoluble compounds with protein of microorganisms. Depending on concentration of zinc compound render hardening, cauterizing, weak antiseptic action.

Zinc sulfate $ZnSO_4 \cdot 7H_2O$ (dilute solution) is used as eye lotion.

Zinc sulfate $ZnSO_4$ in dentists practice will be used as 0.25 – 1% solution as astringent at stomacite.

Zinc chloride $ZnCl_2$ is applied in pastas, as a caustic, in solutions - at ulcers, fistulas, as a knitting and antiseptic agent.

Zinc chloride $ZnCl_2$ will be used as 30% of a solution in an odontology. As the precipitating substance will be used with 10% solution of a potassium hexacyanoferrate(II). The mixture of syrupy zinc chloride solution and zinc oxide is used for dental filling.

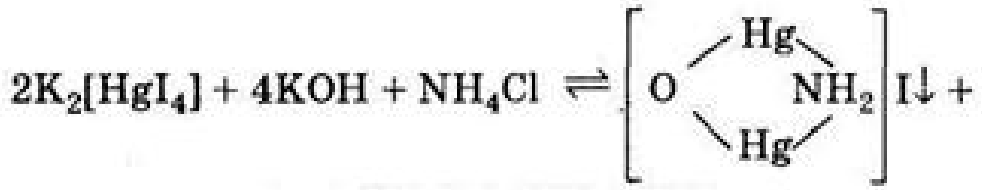
Zinc oxide ZnO is included into antiseptic protective pastas, is applied as a drying and hardening agent.

Mercury is found in the blood, bone and muscle tissues, liver and kidneys, accumulates in the hair. Mercury is toxic. Mercury blocks biologically active groups of protein molecules, changes the membranes of the endoplasmic reticulum, it activates the release of hormones, stimulates the phagocytic activity of leukocytes, it is an antagonist of the iodine. When poisoning with mercury and its compounds, there is a metallic taste in the mouth, strong salivation, auditory and olfactory hallucinations, headaches, memory impairment ("mercury") is observed.

Mercury is used in barometers, thermometers, electric cells, vacuum tube light.

Mercury (I) chloride Hg_2Cl_2 is used in electrodes, ceramics, intestinal antiseptic.

Mercuric (II) chloride. $HgCl_2$ is disinfectant and its 5% solution is used for washing wounds. It is used in preservation of leather and making Nessler′s reagent which is used in the identification of ammonia.



$$2K_2[HgI_4] + 4KOH + NH_4Cl \rightleftharpoons [O(Hg)(Hg)NH_2]I\downarrow + 3H_2O + 7KI + KCl;$$

$$2[HgI_4]^{2-} + 4OH^- + NH_4^+ \rightleftharpoons [Hg_2ONH_2]I\downarrow + 3H_2O + 7I^-.$$

Molybdenum contains in biological systems as Mo^{5+}, Mo^{6+}, and less often Mo^{3+}, Mo^{4+}. The excess of a molybdenum results in decrease of concentration of copper and cobalt. The molybdenum with copper participates in an exchange of hormones. Molybdenum is part of a number of enzymes (aldehyde oxidase, sulfite oxidase, xanthine dehydrogenase, etc.), which catalyze the redox reactions in plant and animal organisms. The lack of molybdenum in the body is accompanied by a decrease of xanthine oxidase in the tissues. With a lack of molybdenum, anabolic processes decrease, the weakening of the immune system is observed. High content of molybdenum is found in the liver and kidneys. In the blood, liver and kidneys molybdenum forms protein complexes. Toxicity of molybdenum compounds is small. The toxic dose for humans is 5 mg/kg, the lethal dose is 50 mg/kg.

Radioisotopes of molybdenum are used to scan the liver and study the circulation of blood in muscles.

Manganese contains in an organism in quantity 0,36 mmol. In biological systems meets in two condition: Mn^{2+} and Mn^{3+} and enters into composition of enzymes catalyzing oxidation - reduction reactions. Concentrates in an osteal tissue, liver, kidneys, is especial in mitochondrios. Daily need 5-7 mg. Mn contains in beet, carrots, potatoes, liver.

Potassium permanganate $KMnO_4$ is an oxidizing agent and has antiseptic action. $KMnO_4$ renders superficial action, does not damage healthy tissues even in strong solutions. Is applied as 0.1% and 0.01% of solutions to a gargle of an oral cavity. $KMnO_4$ will be used as 5% of a solution for greasing burnt places.

Manganese sulphate $MnSO_4$ is applied to treatment of an atherosclerosis.

Iron contains in an organism of the man in quantity peer approximately to 5 g. as Fe^{2+} and Fe^{3+}. It enters into composition of the hemoglobin.

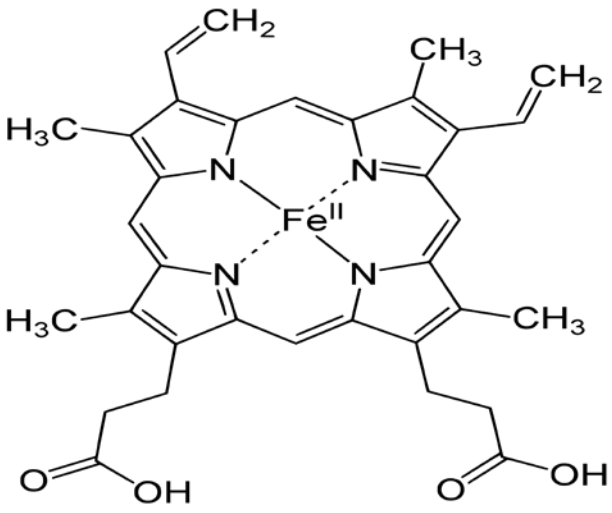


Fig 5. The structure of heme

Hemoglobin is the oxygen transport protein of red blood cells. Hemoglobin contains structural units called *heme*. The physiological function of a hemoglobin consists in ability is convertible to bind oxygen and to transfer it from mild to tissues:

$$[Hb \cdot Fe^{2+}] + O_2 \leftrightarrow [Hb \cdot Fe^{2+} \cdot O_2]$$

desoxyhemoglobin oxyhemoglobin

Frame similar to a hemoglobin, there is also myoglobin. It is convertible binds oxygen in muscles, on the mechanism of action is similar to a hemoglobin:

$$[MbFe^{2+}] + O_2 \leftrightarrow [MbFe^{2+} \cdot O_2].$$

The process of carry in mitochondrions is catalyzed by the large group of ironcontaining enzymes - cytochromes. It is known about 50 cytochromes. The cytochrome C is most investigated. Is proved, that the carry of electrons in redox chain.

$FeCl_3 \cdot 6H_2O$ is a rather strong oxidizer is applied as disinfectant and blood stopping agent.

Cobalt enters into composition of the important albuminous molecules, activates action of series of enzymes. A complex Co^{3+} (coordination number 6) makes a basis of one of major vitamins B_{12}. The appreciable disadvantage of this vitamin of an organism causes a malignant anemia. Let consider that the deficiency of a cobalt in tissues reduces ability of an organism to be protected from various infections.

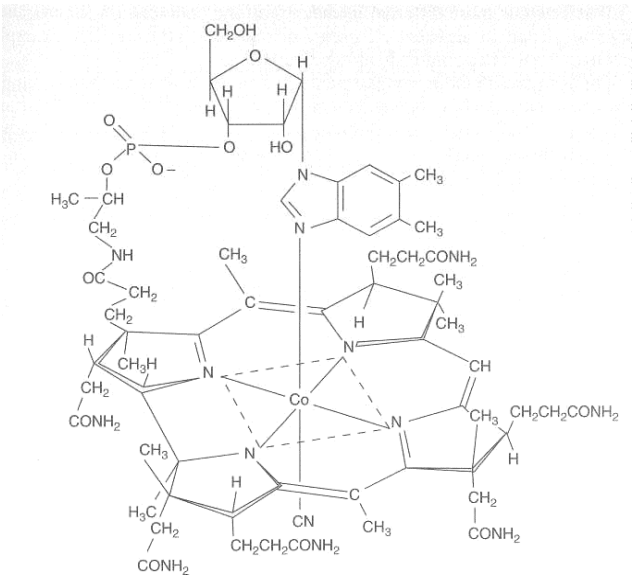


Fig 6. The structure of vitamin B_{12} or cyanocobalamin

Vitamin B_{12} is applied to treatment of an anemia, nervous diseases.

Isotopes of Co^{60} are applied to treatment of malignant tumours. The nickel, as well as cobalt, participates in blood formation, influences a carbohydrate exchange.

TESTS FOR SELF-CONTROL
Theme: d-block elements

1. **The oxide reacts both with HCl and NaOH separately**
   a) CO_2
   b) CaO
   c) N_2O_5
   d) ZnO
2. **Zn, Cd and Hg exhibit the properties of**
   a) s-block element
   b) p-block elements
   c) d-block elements
   d) f-block elements
3. **Which of the following is used as purgative**
   a) calomel
   b) corrosive sublimate
   c) zinc chloride
   d) philosopher′s wool
4. **Calomel is**
   a) Hg_2Cl_2 and Hg
   b) Hg_2Cl_2
   c) Hg and $HgCl_2$
   d) $HgCl_2$
5. **An alkaline solution of potassium mercuric iodide is known as**
   a) Fenton′s reagent
   b) Nessler′s reagent
   c) Lassaigne reagent
   d) Baeyer′s reagent
6. **The trace metal present in insulin is**
   a) Zn
   b) Mn
   c) Fe
   d) Co
7. **Iron is present in**
   a) chlorophyll
   b) hemoglobin
   c) vitamin C
   d) vitamin B_{12}

8. Nessler′s reagent is

a) K_2HgI_4
b) $K_2HgI_4 + NH_4OH$
c) $K_2HgI_4 + KOH$
d) $KHgI_4 + NH_4OH$

9. Cobalt is present in

a) chlorophyll
b) hemoglobin
c) vitamin C
d) vitamin B_{12}

10. The metal which gives no amphoteric oxide is

a) Zn
b) Sn
c) Al
d) Cu

11. The most important oxidation state of Cu is

a) +2
b) +3
c) +1
d) +4

12. Complex ion is formed by

a) Ag
b) Au
c) Cu
d) All of these

13. Cu gives following gas when heated with conc. H_2SO_4

a) O_2
b) H_2S
c) SO_2
d) SO_3

14. Silver nitrate is not used

a) as purgative
b) in hair dyes
c) in silvering of mirrors
d) for estimation of halides

15. Silver nitrate produces a black stain on skin due to

a) its corrosive nature
b) its strong reducing action
c) its reduction to metallic silver
d) the formation of complex compound with skin

16.Which of the silver salt is used in medicine?

a) AgF
b) AgCl
c) AgBr
d) $AgNO_3$

17.Which of the colloidal is used to cure disease of eyelid under the trade name protargol

a) colloid of sulphur
b) colloid of silver
c) colloid of antimony
d) colloid of gold

18.The element present in the hemoglobin of blood is

a) Fe
b) Cu
c) Na
d) Al

19.The element present in the hemocyanine is

a) Fe
b) Cu
c) Na
d) Al

20.The general electronic configuration of transition elements is

a) $(n-1)d^{1-5}$
b) $(n-1)d^{1-10}ns^2np^6$
c) $(n-1)d^{1-10}ns^2$
d) None

21.The d-block elements are called:

a) transition elements
b) typical elements
c) non-metalls
d) metalloids

22. What product of chemical reaction when Zn dissolves in an excess of aqueous solution of NaOH?

a) $Zn(OH)_2$
b) ZnO
c) $Na_2[Zn(OH)_4]$
d) Na_2ZnO_2

Dental materials, containing of s-, p- and d-block elements

Dental materials are specially fabricated materials, designed for use in dentistry. There are many different types of dental material, and their characteristics vary according to their intended purpose. Examples include temporary dressings, dental restorations (fillings, crowns, bridges), endodontic materials (used in root canal therapy), impression materials, prosthetic materials (dentures), dental implants, and many others.

Metals and alloys used in dentistry should have:

• high corrosion resistance in the oral cavity;

• high mechanical properties (strength, plasticity, elasticity, etc.);

• good technological properties (easily subjected to soldering, casting, welding, stamping, polishing, broaching);

• the necessary physical characteristics (color, low shrinkage, low melting point).

The alloys are divided into:

1. Mechanical mixtures, for example lead and antimony.
2. Solid solutions, for example, nickel and chromium, nickel and copper.
3. Chemical compounds, for example $AuHg_2$, Au_2Hg.

The chemical properties of metals and their alloys include:

1. Solubility.
2. Oxidability.
3. Corrosion resistance.

In dental practice, more than 500 different types of alloys are used:

• Alloys of noble metals based on gold.

• Alloys of noble metals containing 25-50% gold or platinum.

• Alloys of base metals.

• Alloys for metal-ceramic structures:

a) with a high gold content (more than 75%);

b) high content of noble metals (gold and platinum or gold and palladium more than 75%);

c) based on palladium (more than 50%);

d) based on base metals (cobalt, nickel, chromium, molybdenum).

Alloys of gold with silver and copper are used in stomatology for prosthetics.

An alloy of 916 samples, consisting of 91.6% of gold, 4.2% of copper and 4.2% of silver, is used to make bridges, crowns, facets, etc.

The alloy of 750 samples contains 75% of gold, 8.3% of silver and 16.7% of copper, and an alloy of 583 samples - 58.3% of gold, 13.7% of silver and 28% of copper.

Amalgams are mercury alloys with copper, silver, cadmium, are used in stomatology as a filling material. Amalgams easily soften when heated and harden at body temperature; they are not toxic, because they are not toxic. Mercury with metals forms intermetallic compounds.

Alloys based on iron (steel) contain additives:

1) manganese – increases strength, reduces the melting temperature of the alloy;

2) nickel – increases corrosion resistance, improves elastic properties, ductility ductility, however, the excessive nickel content makes the alloy toxic;

3) chrome – increases hardness, resistance to corrosion;

4) molybdenum – increases strength;

5) vanadium improves technological properties.

In the alloys of gold, copper, silver, platinum are added to increase the elasticity and hardness, cadmium – to reduce the melting point.

Filling materials are divided into groups:

1. Cements.

a) Zinc phosphate consists of solid and liquid phases.

The solid phase, powder, consists of 75-90% of ZnO, includes MgO, SiO_2, Bi_2O_3. The liquid phase consists of water, orthophosphoric acid, zinc, aluminum and magnesium phosphates.

b) Silicate cement.

The powder is finely ground glass: SiO_2, K_2O, NaF, Al_2O_3, pigments. The liquid is an aqueous solution of orthophosphoric acid, zinc and magnesium phosphates.

c) Silico-phosphate cement is mixture a) and b).

d) Zinc-eugenol cement;

e) Polycarboxylate cement.

The solid phase consists of zinc and magnesium oxides. The liquid phase consists of polyacrylic acid solution;

f) Polymeric cement, based on methyl methacrylate.

2. Amalgams.

Amalgams are metal systems, one of the component of which is mercury. When the metal is wetted with mercury, their diffusion takes place. And also formed chemical compounds such as $AuHg_2$, Au_2Hg, Ag_2Hg_3, Cu_3Hg_4, etc. Amalgams are plastic, harden at 37°C, they practically do not shrink, they are stable in the oral cavity, they ensure a long service life of the seal.

3. Polymeric materials.

Polymeric materials include polyacrylates, polymethacrylates, polymethyl methacrylates.

Final test: «Properties of s-, p-, and d-block elements»

TEST 1

1. **General properties of s-block elements:**
   a) general electronic configuration
   b) ionisation energy
   c) atomic radii
2. **Biological role of sodium and potassium and their application in medicine.**

3. **Calculate a concentration of solutions and daily dose of a drug.**

a) Potassium acetate salt is applied as a diuretic remedy at edemas, bounded with infringement of a circulation, thus 30g CH_3COOK dissolve in 200 ml of water. Calculate a percent by mass of these solution and daily dose of a drug, if it is accepted by 5 times per day on 1 restaurant to a spoon (20g).

b) The energy expenditures of an organism at parenteral power supply of the patients in a postoperative period coat with intravenous introduction 1,5 l per day of a solution for hiperalimentation: a glucose 400g/l, KCl - 5,0 g/l, NaCl - 2,1g/l, $CaCl_2$ - 1,0 g/l, KH_2PO_4 - 0,2 g/l. Define a percent by mass (%) of potassium chloride in this solution. What quantity (mmol) of ions Ca^{2+} will be injected to the patient? (density is equal 1,2 g/ml).

4. **Out of the following elements which one do you expect to be most reactive chemically?**
   a) Magnesium
   b) Calcium
   c) Strontium
   d) Barium
5. **Melting point is lowest for**
   a) Be
   b) Mg
   c) Ca
   d) Sr
6. **Which of the following configurations corresponds to alkaline earth metals?**
   a) [Ar] $4s^2$
   b) [Ne] $3s^2 3p^2$
   c) [Ar] $3d^{10} 4s^1$
   d) [Ar] $3d^{10} 4s^2$

7. The most abundant alkali metal in nature is

a) Na
b) Li
c) K
d) Cs

8. The trace metal present in insulin is

a) Zn
b) Mn
c) Fe
d) Co

9. Complex ion is formed by

a) Ag
b) Au
c) Cu
d) All of these

10. Which of the silver salt is used in medicine?

a) AgF
b) AgCl
c) AgBr
d) $AgNO_3$

11. Cu gives following gas when heated with conc. H_2SO_4

a) O_2
b) H_2S
c) SO_2
d) SO_3

12. Which element is most abundant on earth′s crust?

a) Ca
b) C
c) Si
d) O

13. When Al is added to KOH solution

a) no action takes place
b) oxygen is evolved
c) water is produced
d) hydrogen is evolved

14. Aluminium belongs to:

a) s-block elements
b) p-block elements
c) d- block elements
d) f- block elements

15.Which of the following metal exhibits similarities in properties to aluminium?

a) Ba
b) Be
c) Ca
d) Sr

16.Which of the following is most acidic?

a) Na_2O
b) MgO
c) Al_2O_3
d) CaO

17.A considerable part of harmful ultraviolet radiation of sun does not reach earth′s surface. This is because high above the earth′s atmosphere there is a layer of

a) CO_2
b) H_2
c) O_3
d) NH_3

19. Characteristic oxidation state of calcium in an organism is:

a) 0
b) +1
c) +2
d) -2?

20. The barium hydroxide is formed:

a) at decomposing a hydrocarbonate of barium
b) at adding dilute solutions of barium chloride and potassium hydroxide
c) at interaction of barium oxide with water
d) at adding solutions of sodium hydroxide of and barium carbonate
e) the correct answer is not present

21. With the increase in atomic weights melting point of the aldalimetals

a) increase
b) remains constant
c) do not show definite trend
d) decrease

22. With reference to concept of ionization energy wiech one of the following is in correct order

a) Li > K > Cs
b) B > Li > K
c) Cs > Li > K
d) Cs < Li < K

23. A black sulphide is formed by the action of H_2S on

a) sodium chloride

b) aluminium chloride

c) tin chloride

d) zinc chloride

24. Which one of the following is basic?

a) CO_2

b) SiO_2

c) SO_2

d) Na_2O

25. Write down the following reactions

a) hydrolysis of Al^{3+} ions

b) interaction of NH_4^+ with Nessler′s reasent

c) formation of lead iodide

d) interaction of barium chloride with oxalic acid

TEST 2

1. General properties of s-block elements:

a) reducting power

b) oxidation state

c) melting and boiling point

2. Biological role of calcium and magnesium and application of their compounds in medicine

4. Calculate the mass and concentrations of solutions

a) Calculate the molarity of 0.9% NaCl solution. (ρ = 1 g/ml). 0.9% solution of sodium chloride is applied to intravenous injections at the large hemorrhages.

b) Hydroxide of aluminum is applied at heightened gastric acidity, peptic ulcer of a stomach and duodenal intestine. The drug neutralizes a hydrochloric acid: 1 g neutralize about 250 ml 0.1M solution HCl. Calculate, what quantity HCl is neutralized 50g $Al(OH)_3$, received as 4% of a suspension.

4. Which of the following statements is correct with respect to the property of elements with increase in atomic number in the carbon family (group IVA or 14)?

a) Their metal character decreases
b) The stability of +2 oxidation state increases
c) Their ionization energy increases
d) Their atomic size decreases

5. A considerable part of harmful ultraviolet radiation of sun does not reach earth′s surface. This is because high above the earth′s atmosphere there is a layer of

a) CO_2
b) H_2
c) O_3
d) NH_3

6. The gas is commonly used in anaesthesia:

a) Methane
a) Nitrous oxide
b) Nitrogen
c) Hydrogen peroxide

7. Living in the atmosphere of CO is dangerous because it

a) reduced organic matter of tissues
b) dries up the blood
c) combines with O_2 present inside to form CO_2
d) combines with hemoglobin and makes it incapable to absorb oxygen

8. Pick out the metal ion present in Vitamin B_{12}

a) Ca
b) Co
c) Fe
d) Mg

9. The general electronic configuration of transition elements is

a) $(n-1)d^{1-5}$
b) $(n-1)d^{1-10}ns^2np^6$
c) $(n-1)d^{1-10}ns^2$
d) None

10. The oxide reacts both with HCl and NaOH separately

a) CO_2
b) CaO
c) N_2O_5
d) ZnO

11. Which of the following is the main constituent of teeth and bones

a) $CaCO_3$
b) CaF_2
c) $CaSO_4$
d) $Ca_3(PO_4)_2$

12. Magnesium is present in

a) chlorophyll
b) hemoglobin
c) vitamin C
d) vitamin B_{12}

13. Element found in plant systems, which forms an important constituent of photosynthesis is

a) iron
b) copper
c) magnesium
d) sodium

14. Alkaline earth metals are

a) reducing agent
b) oxidizing agent
c) amphoteric
d) acidic

15. Which one of the following is most abundant in the earth′s crust?

a) B
b) Al
c) Ga
d) In

16. Ammonia reacts with Nessler′s reagent to give

a) deep blue precipitate
b) white precipitate
c) green precipitate
d) dark orange precipitate

17. Ozone is:

a) compound of oxygen
b) allotrope of oxygen
c) isotope of oxygen
d) mixture of atomic

18. How the reaction of interaction lithium with water proceeds?

a) is quiet, without ignition
b) roughly, with ignition
c) in explosion

19. The calcium hydroxide is formed:

a) at decomposing potassium carbonate

b) at adding delute solution of calcium chloride to delute solution of potassium hydroxide

c) at interaction of oxide of calcium with water

d) at adding of sodium hydroxide solution to calcium carbonate

e)the correct answer is not present

20. In what is $Mg(OH)_2$ dissolved?

a) NaOH

b) NH_4Cl

c) HCl

21. What are substances formed at interaction of copper with concentrated sulfuric acid?

a) $CuSO_4$

b) CuO

c) H_2

d) SO_2

22. Determine a product of reaction of interaction H_3BO_3 and NaOH:

a) B_2O_3

b) B_2H_6

c) Na_3BO_3

d) $Na_2B_4O_7$

e) Na_3B

23. What compaund of ПА of group elements is used in medical practice for manufacturing plaster bandages at fractures of bones?

a) $MgSO_4$

b) $CaCO_3$

c) $CaSO_4 \cdot 2H_2O$

d) $CaCl_2$

24. Write down the following chemical reactions in molecular and ionic forms:

a) hydrolysis of Cu^{2+} ion

b) interaction of NH_4^+ with KOH

c) formation of iron(III) thiocyanide

d) interaction of Sn^{2+} with S^{2-}

TEST 3

1. General properties of p-block elements:

a) general electronic configuration

b) ionization energy

c) electronegativity

2. Biological role of iron and cobalt and application of their compounds in medicine.

3. Calculate the mass and concentrations of solutions

a) What amount HCl (in g), included in the composition of a gastric juice, is possible to neutralize 80 g 0,5% $NaHCO_3$, accepted inside at a hyperoxemia of a gastric juice.

b) A 2% solution $NaHCO_3$ is used at laryngitises for gargles. Calculate, what amount (in g) $NaHCO_3$ and H_2O is necessary for taking for preparation 200 g 2% solution of this salt.

4. Which of the following alkaline earth metal hydroxide is the least soluble?

a) $Be(OH)_2$

b) $Mg(OH)_2$

c) $Ca(OH)_2$

d) $Ba(OH)_2$

5. Which of the following properties is more applicable to alkaline earth metals compared with alkali metals:

a) large ionic size

b) lower ionization energy

c) less basic hydroxides

d) lower electronegativities

6. CO_2 is obtained by heating

a) Na_2CO_3

b) K_2CO_3

c) $NaHCO_3$

d) none of the above

7. In what is $CaCO_3$ dissolved?

a) H_2O

b) NaOH

c) CH_3COOH

d) HCl

8. What metal is oxidased on air easier?

a) aluminium
b) magnesium
c) sodium
d) beryllium

9. Ionic equation $Ba^{2+} + CO_3^{2-} \rightarrow BaCO_3$ corresponds interaction between:

a) $BaSiO_3$ and solution Na_2CO_3
b) Solution $Ba(OH)_2$ and CO_2
c) BaO and CO_2
d) Solution $Ba(NO_3)_2$ and solution K_2CO_3

10. Characteristic oxidation state of magnesium in an organism is:

a) –2
b) +2
c) +1
d) 0

11. Which one of the following is used as anaesthetic?

a) NH_3
b) N_2O
c) NO
d) NO_2

12. $AlCl_3$ on hydrolysis gives:

a) $Al_2O_3 \cdot H_2O$
b) $Al(OH)_3$
c) Al_2O_3
d) $AlCl_3 \cdot 6H_2O$

13. Sodium has … as compared to potassium

a) less electronegativity
b) lower melting point
c) more ionization energy
d) larger atomic radius

14. The most abundant alkali metal in nature is

a) Na
b) Li
c) K
d) Cs

15. Which is most basic in nature

a) RbOH
b) KOH
c) LiOH
d) NaOH

16. What compaund of IIA group elements is used in medical practice at a poisoning with acids?

a) MgO
b) $CaCl_2$
c) $CaCO_3$
d) $MgSO_4$

17. Which one of the following statements regarding the alkali and the alkaline earth metals is false

a) they are reactive metals
b) they belong to s-block elements
c) they form hydroxides which are basic in character
d) they form carbonates which decomposes on heating

18. Which of the following is used as purgative

a) calomel
b) corrosive sublimate
c) zinc chloride
d) philosopher′s wool

19. The element present in the hemocyanine is

a) Fe
b) Cu
c) Na
d) Al

20. Which of the following reacts with hemoglobin of blood to give carboxyhemoglobin?

a) CO
b) CO_2
c) HCOOH
d) CH_3COOH

21. Which of the following statements is correct with respect to the property of elements with increase in atomic number in the carbon family (group IVA or 14)?

a) Their metal character decreases
b) The stability of +2 oxidation state increases
c) Their ionization energy increases
d) Their atomic size decreases

22. Which is most acidic?

a) Na_2O
b) MgO
c) CaO
d) Al_2O_3

23. Amphoteric oxide is/are

a) Al_2O_3
b) Ga_2O_3
c) Tl_2O_3
d) CO_2

24. Write down the following chemical reactions in molecular and ionic forms:

a) formation of $BaSO_4$
b) hydrolysis of Sn^{2+}
c) interaction of Pb^{2+} with S^{2-}
d) interaction of $CuSO_4$ with KI

TEST 4

1. General properties of d-block elements:

a) electronic configuration
b) atomic radii
c) ionization energy

2. Biological role of cobalt and iron and application if their compounds in medicine.

3. Calculate the mass and concentrations of solutions

a) A 0,25% a solution of zinc sulfas is applied as antiseptic and astringent for a gargle at laryngitis. Determine, what mass (in g) of water is necessary for adding to 200 g 1% of a solution $ZnSO_4$ to receive 0,25% a solution.

b) A 2% solution $NaHCO_3$ is used at laryngitises for gargles. Calculate, what amount (in g) $NaHCO_3$ and H_2O is necessary for taking for preparation 200 g 2% solution of this salt.

4. Iodine deficiency in diet is known to cause

a) Beri-Beri
b) Goitre
c) Rickets
d) Night blindness

5. Which one of the following elements occurs free in nature?

a) N
b) P
c) As
d) Sb

6. Living in the atmosphere of CO is dangerous because it

a) reduced organic matter of tissues
b) dries up the blood
c) combines with O_2 present inside to form CO_2
d) combines with hemoglobin and makes it incapable to absorb oxygen

7. The general electronic configuration of p-block elements is

a) ns^1 to ns^2
b) ns^2 to np^6
c) ns^2np^1 to ns^2np^5
d) $(n-1)d^{1-10}\ ns^{0-2}$

8. Cobalt is present in

a) chlorophyll
b) hemoglobin
c) vitamin C
d) vitamin B_{12}

9. Which of the following is the main constituent of teeth and bones

a) $CaCO_3$
b) CaF_2
c) $CaSO_4$
d) $Ca_3(PO_4)_2$

10. Which one of the following has highest ionization energy?

a) O
b) S
c) Se
d) Te

11. In what is $CaCO_3$ dissolved?

a) H_2O
b) NaOH
c) CH_3COOH
d) HCl

12. What metal is oxidased on air easier?

a) aluminium
b) magnesium
c) sodium
d) beryllium

13. What alkali metal shows the greatest tendency to formation of covalent bonds?

a) Li
b) Na
c) K
d) Rb

14. Ionic equation $Ba^{2+} + CO_3^{2-} \rightarrow BaCO_3$ corresponds interaction between:

a) $BaSiO_3$ and solution Na_2CO_3
b) Solution $Ba(OH)_2$ and CO_2
c) BaO and CO_2
d) Solution Ba $(NO_3)_2$ and solution K_2CO_3

15. What elements are macroelements?

a) C
b) N
c) Br
d) Ca

16. Characteristic oxidation state of magnesium in an organism is:

a) –2
b) +2
c) +1
d) 0

17. Which one of the following statements regarding the alkali and the alkaline earth metals is false

a) they are reactive metals
b) b) they belong to s-block elements
c) they form hydroxides which are basic in character
d) they form carbonates which decomposes on heating

18. What compaund of IA group elements is used in medicine at treatment of mental diseases?

a) NaCl
b) Li_2CO_3
c) Na_2SO_4
d) KI

19. What compaund of IIA group elements is used in medical practice at a poisoning with acids?

a) MgO
b) $CaCl_2$
c) $CaCO_3$
d) $MgSO_4$

20. What compaund of sodium is used in medicine at a hyperoxemia of a gastric juice?

a) $Na_2SO_4 \cdot 10H_2O$

b) NaCl

c) $NaHCO_3$

d) NaBr

21. The hydroxide of a sodium is formed:

a) at interaction of sodium chloridum with calcium hydroxide

b) at interaction of a sodium with water

c) at interaction of sodium nitratum with water

d) at interaction of sodium oxide with water

e) at decomposing soda

22. What oxide of chrome shows most basic properties:

a) Cr_2O_3

b) CrO

c) CrO_3

23. Chlorine is mixed with drinking water so that:

a) bacteria are killed

b) dirt is removed

c) water is cleaned

d) suspension is removed

24. Write down the following reactions

a) formation of CaC_2O_4

b) hydrolysis of Ni^{2+}

c) interaction of $Al(OH)_3$ with excess of NaOH

d) formation of $BaSO_4$

PRACTICAL PROBLEMS

1. Potassium acetate salt is applied as a diuretic remedy at edemas, bounded with infringement of a circulation, thus 30g CH_3COOK dissolve in 200 ml of water. Define a mass share of these solution and daily dose of a drug, if it is accepted by 5 times per day on 1 restaurant to a spoon (20g).

2. The energy expenditures of an organism at parenteral power supply of the patients in a postoperative period coat with intravenous introduction 1,5 l per day of a solution for hiperalimentation: a glucose 400g/l, KCl – 5.0 g/l, NaCl – 2.1 g/l, $CaCl_2$ – 1.0 g/l, KH_2PO_4 – 0.2 g/l. Define a mass share (%) of potassium chloride in this solution. What quantity (mmol) of ions Ca^{2+} will be injected to the patient? (density is equal to 1.2 g/ml).

3. What value pH (= 7, > 7, < 7) have the solutions: a) of sodium chloride and calcium chloride; б) of a carbonate and hydrocarbonate. Prove the answer by the ionic equations of reactions.

4. Sodium chloride is found in plasma and tissue fluids in the body at a concentration of about 0.9%. It is the most important inorganic component that supports the osmotic pressure of blood plasma and extracellular fluid. Calculate the molar and molar concentration of this solution. (density is equal to 1g/cm^3).

5. Calcium chloride $CaCl_2$ has received wide application as antiallergic and antiedematous drugs. Antiallergic property of calcium is caused by that it depresses a permeability of walls of capillaries. Calculate mass of $CaCl_2 \cdot 6H_2O$ and water that need for preparation 250 ml 4% solution (density is equal to 1g/cm^3).

6. Hydrogen peroxide H_2O_2 – 3% the solution is applied as a disinfectant (disinfectant properties are based on oxidizing properties of H_2O_2). What volume of water should be added to 5 ml of 30% hydrogen peroxide solution to obtain a 3% solution. (density is equal to 1g/cm^3).

7. Write down the equations of reactions, with which help it is possible to detect ions, K+, Na+, Ca^{2+}, Mg^{2+}, Ba^{2+}, NH_4^+. What properties of received compounds allow to detect these ions?

8. Make the equation of oxidation-reduction reaction with participation of hydrogen peroxide.

9. Write the electrons formulas of s-elements atoms (ions), define a possible oxidation state, compare nuclear parameters and reducibility of metals on a position of s-elements in Periodic table.

10. Hydroxide of aluminum is applied at heightened gastric acidity, peptic ulcer of a stomach and duodenal intestine. The drug neutralizes a hydrochloric acid: 1 g neutralize about 250 ml 0,1M solution HCl. Calculate, what quantity HCl is neutralized 50g $Al(OH)_3$, received as 4% of a suspension.

11. The sodium nitrite is used in medicine as an antispasmodic. Describe analytical effects, which will watch at adding to this substance: a) dilute sulfuric acid? b) potassium permanganate in acidic medium. Write the equations of reactions.

12. The content of copper ions in the blood plasma is 85-134 μg. Calculate the content of copper ions in blood plasma in mol/l. (density is equal to 1.03 g/cm^3).

13. In medical practice, 5-10% alcohol solutions of iodine are used to treat wounds, abrasions, and the operating field. What volume of 10% alcohol solution of iodine can be prepared from 10 g of crystalline iodine? (density is equal to 0.95 g/cm^3).

14. Lugol's solution, used in medical practice for lubricating the mucous membrane of the mouth and throat, contains 1 g of iodine and 2 g of potassium iodide in 17 ml of water. Calculate the percent by mass of iodine and potassium iodide in Lugol's solution.

15. The 2% solution of $NaHCO_3$ used to rinse the throat. Calculate the volume of carbon (IV) monoxide (N.T.P.), which can be released by the reaction 10 grams of sodium hydrogen carbonate with an excess of hydrochloric acid. How many grams of $NaHCO_3$ should be dissolved in a glass of water (200 ml) to rinse your throat?

16. Determine the mass (g) of each of the substances taken for the preparation of 500 g of a 5% alcohol solution of iodine. To mitigate the effect of this solution should contain 1% glycerin.

17. What mass of salt and water should I take to prepare 500 g of 0.9% NaCl solution? Such a solution is called isotonic and is used in medical practice.

18. Calculate the mass of the solution with a 20% of sodium chloride solution to be added to water with a volume of 80 ml to obtain an isotonic solution.

19. In surgery 3, 5 or 10% solutions of sodium chloride are used externally. Calculate the volume of water to be added to 50 g of a 20% solution of sodium chloride to obtain NaCl solutions: a) 3%; b) 5%; c) 10%.

20. In human gastric juice, the percent by mass of acid is on average 0.05%. How much mole of HCI is contained in 500 ml of gastric juice? The density of gastric juice is 1.005 g/ml.

21. Ammonia water is an aqueous solution of ammonia. For preparation ammonia water 112 liters of ammonia (N.T.P.) were dissolved in 300 g of water. Calculate the percent by mass of ammonia in the resulting solution.

22. A solution of calcium chloride is used in medicine as a hemostatic and antiallergic agent. Determine the mass of calcium cations entering the body by ingesting a tablespoon of a solution (15 ml). 100 ml of solution containing 5 grams of calcium chloride hexahydrate. What is the percent by mass and molar concentration of the solution, if for preparation of solution 90 g calcium chloride was dissolved in water with volume of 800 ml?

23. Aluminum-potassium alum is used in medical practice extraneously for lotions. How many grams of alum should be added to 1000 g of a 5% solution of potassium sulfate, so that the percent by mass of the solution doubles? What will happen if the resulting solution is affected by an excess of potassium sulphide?

24. In medical practice 0.9% NaCl solution is used as isotonic. Calculate the mass of Na^+ cations and Cl^- anions in 100 ml of isotonic solution, if density of solution is equal to 1.005 g/ml.

25. Diluted aqueous solutions of aluminum-potassium alum ($KA1(SO_4)_2 \cdot 12H_2O$) have hemostatic and anti-inflammatory effects. Calculate: a) the number of moles of water in 4.74 g aluminum-potassium alum; b) the number of moles and the number of oxygen and hydrogen atoms in 18.88 g of aluminum-potassium alum.

26. Percent by mass of zinc, which is part of the cobra venom (a valuable medicine drug) is 0.5%. How many zinc atoms would a cobra need to produce 1 drop (30 mg) of poison?

27. Chlorine is used to disinfect water. Calculate the mass of chlorine required to chlorinate 500 g of water, if chlorination consumes 0.002 mg of chlorine per liter of water. Explain the chemical and biological nature of chlorination.

28. Calculate the mass of silver consumed when obtaining silver nitrate, if in the reaction of silver with nitric acid, 4.48 liters of nitric oxide (IV) is released, and the gas loss is 20%.

29. When poisoning with lapis, the stomach is washed with a 2% solution of sodium chloride. Calculate the mass of AgCI, which is obtained by the reaction of 0.1 g of silver nitrate with an excess of sodium chloride.

30. The composition of sedatives (validol, corvalol, valochardin) include isovaleric acid C_4H_9COOH. Calculate mass of isovaleric acid reacts with 50 ml of 0.1 M sodium hydroxide solution.

31. When boiling with water, aspirin breaks down into salicylic and acetic acids. Calculate the number of molecules of salicylic acid and its molar concentration in the solution that you are converting after dissolving one tablet of aspirin in 100 ml of water and then boiling. The mass of a tablet is 0,5 g.

32. The lead acetate tetrahydrate (II) $Pb(CH_3COO)_2 \cdot 3H_2O$ is a part of solution that has cooling and antimicrobial action. Calculate: a) the mass of water in 1 mole of this salt; b) the number and number of oxygen and hydrogen atoms in the same amount of salt.

33. When heated and exposed to light, hydrogen peroxide solutions decompose. Therefore, H_2O_2 solutions are stored in dark glass bottles in a cool place. Calculate the volume of oxygen (N.T.P.), which will be released when 100 ml of a 3% solution of H_2O_2 is added. The density of the solution is assumed to be 1 g / ml.

34. A solution of H_2O_2 is used to rinse the throat, mouth cavity. To prepare a solution of H_2O_2, it is convenient to use a complex compound of H_2O_2 with urea is $(NH_2)_2CO \cdot H_2O_2$. Calculate the percent by mass of hydrogen peroxide in complex.

35. With the bites of ants, when touched with nettles on the skin, a burning sensation arises due to the action of formic acid. What mass of formic acid can be neutralized with 10 ml of a 2% solution of NaHCO3, if density is 1.013 g/ml?

Учебное издание

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Редактор: Е.А. Гусакова
Технический редактор: И.А. Борисов
Компьютерная верстка: Е.А. Гусакова

Подписано в печать _____ . Формат бумаги 64х84 $^{1}/_{16}$.
Бумага типографская №2. Ризография. Усл. печ.л. ____.
Уч.-изд. л. ___. Тираж ___ экз. Заказ № _____.

Издатель и полиграфическое исполнение
УО « Витебский государственный медицинский университет»
ЛП 02330/453 от 30.12.2013г.
Пр. Фрунзе,27, 210602, г. Витебск.