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Методическое пособие

по развития лексических навыков в области профессионально-ориентированного общении на английском языке по специальности
«Аналитический контроль качества химических соединений»

Екатеринбург, 2009 г.

Пояснительная записка

Данное пособие предназначено для работы со студентами, обучающимися по специальности «Аналитический контроль качества химических соединений», и ставит своей целью подготовить их к чтению и переводу соответствующей технической литературы на английском языке, а также сформировать базовые навыки и умения для устного общения на языке по данной специальности.

Пособие содержит адаптированные и оригинальные тексты из иностранных журналов и научно-технической литературы, а также тексты, переведенные с русского на английский язык. Тематика текстов следующая: общая и неорганическая химия, правила чтения химических формул и уравнений, химическая посуда и оборудование химической лаборатории, описание химических элементов, аналитическая химия, известные химики. Содержание текстов соответствует программам специальных дисциплин, и по своей сложности данные тексты предназначены для студентов IV курса, имеющих базовые знания по дисциплине «Английский язык». В конце пособия предлагается итоговый тест на контроль уровня сформированности навыков по окончании курса.

Тексты снабжены упражнениями, рассчитанными на активизацию лексического и грамматического материала. Выбор упражнений и их последовательность обусловлены характером текстов. К текстам даются пояснения, облегчающие понимание и перевод отдельных мест, представляющих определенную языковую трудность.

Пособие может быть использовано для самостоятельной работы студентов.

Unit 1. CHEMISTRY: KEY TO PROGRESS AND ABUNDANCE

The science of chemistry includes a study of properties, composition, and structure of matter, the changes in structure and composition which matter undergoes, and the accompanying energy changes.

The Russian chemical industry now holds second place in the world in overall volume of production. Much credit for this is due to our scientists whose research has won worldwide recognition. The classical works by Mendeleev, Butlerov, Zelinsky, Zaitzev, Lebedev, Favorsky and many others not only served as a theoretical basis for the development of the chemical industry, but enabled our scientists to set up a number of modern branches of the chemical industry as well.

The close links between science and industry enabled the chemical industry to make great progress.

The Soviet Union was the first country to organize large-scale production of synthetic rubber.

Zelinsky's works formed the basis for the synthesizing of a large number of new chemical compounds. These compounds are now counted in thousands, and they are extremely important in the country's economy. Our scientists evolved an original method of extracting phenol and acetone simultaneously from benzene and propylene. Phenol and acetone are needed for the manufacture of plastics, textile fibres, organic glass and other chemical products.

Scientists are making a major contribution to the production of aniline dyes, and many new dyes have been evolved with their help.

The research of our scientists has revealed the physical and physico-chemical conditions necessary for the industrial production and processing of polymeric materials.

The theory of chain reactions is a major discovery of our time. The development of this theory is linked with the name of the Soviet scientist Semyonov, a Nobel Prize winner.

The successes achieved by chemistry and engineering have played an important part in our country's achievements in space.

VOCABULARY

chemistry - химия

science - наука

to include - включать

property - свойство

composition - состав

codas structure - структура, состояние

matter - материя

to undergo - подвергаться

accompanying - сопутствующие [

energy changes - преобразование энергии

abundance - изобилие

overall volume of production - общий объем

to set up - основывать

branch - отрасль

close links - тесная

large-scale production - производство в
больших масштабах

synthesizing - синтез

compound - соединение

to evolve - разрабатывать

simultaneously - одновременно

manufacture - производство

textile fibres - текстильные волокна

contribution - вклад

aniline dyes - анилиновые красители

продукции

much credit for this is due to our scientists

– в этом большая заслуга наших ученых

research – исследование

to win world-wide recognition – получить

всемирное признание

to serve – служить

theoretical basis – теоретическая основа

development – развитие

enable – давать возможность

to reveal - открывать, показывать

condition - условие

processing - обработка

chain reaction – цепная реакция

discovery - открытие

to achieve - достигать

to play an important part – играть важную роль

FIELDS OF CHEMISTRY

The field of chemistry is now a very large one. There are more than 30 different branches of chemistry. Some of the better known fields are inorganic chemistry, organic chemistry, physical chemistry, analytical chemistry, biological chemistry, pharmaceutical chemistry, nuclear chemistry, industrial chemistry, colloidal chemistry, and electrochemistry.

Inorganic chemistry. It was originally considered that the field of inorganic chemistry consists of the study of materials not derived from living organisms. However it now includes all substances other than the hydrocarbons and their derivatives.

Organic chemistry. At one time it was thought that all substances found in plants and animals could be made only by using part of a living plant or animal. The study of these substances, most of which contain carbon was therefore called organic chemistry. It is now known that this idea is quite wrong, for in 1828 F. Wohler made an "organic" substance using a simple laboratory process.

Organic chemistry now merely means the chemistry of carbon compounds.

Physical chemistry is concerned with those parts of chemistry which are closely linked with physics as, for instance, the behaviour of substances when a current of electricity is passed through them.

Electrochemistry is concerned with the relation between electrical energy and chemical change. Electrolysis is the process whereby electrical energy causes a chemical change in the conducting medium, which usually is a solution or a molten substance. The process is generally used as a method of depositing metals from a solution.

Magnetochemistry is the study of behaviour of a chemical substance in the presence of a magnetic field. A paramagnetic substance, i.e. one having unpaired electrons is drawn into a magnetic field. Diamagnetic substances, i.e. those having no unpaired electrons, are repelled by a magnetic field.

Biochemistry. Just as the physical chemist works on the boundaries between physics and chemistry, so the biochemist works on the boundaries between biology and chemistry. Much of the work of the biochemist is

concerned with foodstuffs and, medicines. The medicines known as antibiotics, of which penicillin is an early example, were prepared by biochemists.

VOCABULARY

field – область, отрасль

nuclear chemistry – ядерная химия

It was ... considered (thought) – предполагали, считали

to consist - состоять из

to derive – происходить от

to include – включать, содержать в себе

hydrocarbon – углеводород

substance - вещество

to contain – содержать

for instance - например

behaviour - поведение

current of electricity – электрический ток

relation – соотношение, зависимость

whereby – посредством которого

to cause – вызывать

conducting medium – проводящая среда

solution - раствор

molten - расплавленный

method of deposition metals – метод осаждения металлов

to draw (drew, drawn) – тянуть

to repel - отталкиваться

boundary - граница

EXERCISES

I. Give English equivalents for these words.

отрасль

развитие

исследование

условие

выделение

открытие

состав

свойство

наука

производство

одновременно

достигать

II. Answer the questions.

- 1) Which branch of chemistry deals with the study of materials not derived from living organisms?
- 2) Which branch of chemistry studies the behaviour of a chemical substance in the presence of a magnetic field?
- 3) What is the study of substances containing carbon called?
- 4) What other branches of chemistry do you know?
- 5) By whom were antibiotics prepared?

III. Fill in the gaps with suitable words given below.

- 1) Diamagnetic substances are ... by a magnetic field.
- 2) Much of the work of the biochemist is concerned with . . . and medicines.
- 3) ... is the process whereby electrical energy causes a chemical change in the conducting medium.
- 4) Electrolysis is generally used as a method of deposition of metals from
- 5) The theory of ... reactions is a major discovery of our time.
- 6) The close links between the science and industry ... the chemical industry to make great progress.
- 7) Zelinsky's works formed the basis for the synthesizing of a large number of new chemical
- 8) Scientists are making a major contribution to ... of aniline dyes.

9) There are more than 30 different . . . of chemistry.

10) Diamagnetic substances have no ... electrons.

Production, repelled, unpaired, solution, foodstuffs, compounds, enabled, branches, electrolysis, chain.

IV. Make up sentences out of these words.

1) And, phenol, an original method, acetone, our scientists, simultaneously, benzene, and, evolved, from, extracting, propylene, of.

2) Substance, field, the study, in the presence, behaviour, chemical, magnetochemistry, of, of, is, a, of, a, magnetic.

3) World-wide, this, to, scientists, recognition, much, due, research, credit, our, is, whose, won, has.

4) Other, needed, manufacture, textile fibers, plastics, acetone, and, are, organic glass, for, the, products, of, and, chemical, phenol.

5) Physics, chemistry, parts, linked, which, concerned, are, closely, with, with, physical, chemistry, is, those, of.

V. Translate into English.

1) Наши ученые разработали новый метод обработки металлов.

2) Биохимики внесли большой вклад в производство антибиотиков.

3) Электрохимия связана с изучением отношений между электрической энергией и химическими изменениями.

4) Русские ученые основали большое количество современных отраслей химической промышленности.

5) Они не знают состава этого соединения.

6) Советский союз был первым государством, которое организовало крупномасштабное производство синтетического каучука.

7) Этот ученый определил физические и физико-химические условия необходимые для промышленного производства и обработки полимерных материалов.

Unit 2. SYMBOLS, FORMULAS AND EQUATIONS

Each of the 105 presently known chemical elements is given a symbol which usually is derived from the name of the element. The symbol of oxygen is O, of hydrogen is H, of helium He, of copper Cu, of sodium Na, of plutonium Pu. Groups of symbols called formulas are used to designate compounds. The formula for water is H₂O, for carbon dioxide CO₂, for sulphuric acid H₂SO₄. These symbols and formulas are used to indicate chemical fractions. For example:

$2\text{H}_2\text{O} \rightarrow 2\text{H}_2 + \text{O}_2$ (statement: water decomposes to form hydrogen and oxygen)

VOCABULARY

symbol - символ

equation – уравнение

carbon dioxide CO₂ – двуокись углерода

presently - в настоящее время
to derive – происходить
copper (Cu) - медь
sodium (Na) – натрий
to designate – обозначать

sulphuric acid H₂SO₄ – серная кислота
to indicate – указывать, означать
statement – формулировка
to decompose – разлагаться (на составные части)

INORGANIC MOLECULES AND COMPOUNDS

Simple diatomic molecules of a single element are designated by the symbol for the element with a subscript 2, indicating that it contains 2 atoms. Thus the hydrogen molecule is H₂; the nitrogen molecule, N₂; and the oxygen molecule, O₂. Polyatomic molecules of a single element are designated by the symbol for the element with a numerical subscript corresponding to the number of atoms in the molecule. Examples are the phosphorus molecule, P₄, and the sulphur molecule, S₈.

Diatomic covalent molecules, containing unlike elements are given similar designation. The formula for hydrogen chloride is HCl. The more electropositive element is always designated first in the formula.

For polyatomic covalent molecules containing unlike elements, numerical subscriptions are used to designate number of atoms of each element present in the molecule, for example, water, H₂O. Again, as in diatomic molecules, more electropositive element is placed first in the formula.

VOCABULARY

molecule - молекула
diatomic - двухатомный
single – единичный
subscript – подстрочный индекс
polyatomic - многоатомный
numerical – числовой
corresponding - соответствующий

sulphur – сера
covalent - ковалентный
unlike – различный
similar – подобный
hydrogen chloride - хлористый водород
electropositive - электроположительный

PERIODIC LAW

One of the cornerstones of modern chemical theory is the Periodic Law. It can be simply stated as follows: The properties of the elements are a periodic function of the nuclear charges of their atoms.

In 1869 Mendeleev arrived at the conclusion that by the arrangement of the elements in order of increasing atomic weight the similarity and periodicity of properties of various, valence groups of the elements were clearly delineated.

There were several vacant spaces in Mendeleev's table which led him to predict the existence of six undiscovered elements, (scandium, gallium, germanium, polonium etc). His confidence in the new classification was clearly expressed in the predictions which he made of the chemical properties of these

missing elements. And within fifteen years gallium, scandium and germanium were discovered.

Although this table has been modified hundreds of times, it has withstood the onslaught of all new facts. Isotopes, rare gases, atomic numbers, and electron configurations have only strengthened the idea of the periodicity of the properties of the elements.

VOCABULARY

Periodic Law – периодический закон

cornerstone – краеугольный камень

to state – формулировать

as follows – следующим образом

nuclear charge – ядерный заряд

to arrive at a conclusion – прийти к заключению

arrangement – расположение

in order of increasing atomic weight – в порядке возрастания атомного веса

similarity ['simi,lærɪtɪ] сход-

valence group – валентная группа

to delineate - очерчивать

vacant space – свободное место

to predict - предсказывать

existence - существование

confidence - уверенность

to express – выражать

prediction - предсказание

missing - отсутствующий

within – в течение

to modify - видоизменять

to withstand – выдерживать

onslaught – появление

isotope – изотоп

rare gases – редкие газы

electron configuration – электронная конфигурация

to strengthen - укреплять

EXERCISES

I. Answer the questions.

- 1) How many chemical elements are there now?
- 2) What is the symbol of Manganese?
- 3) What is a symbol usually derived from?
- 4) What does a subscript show?
- 5) What element is always designated first in the formula?
- 6) When did Mendeleev discover the periodic law?
- 7) How can the Periodic Law be simply stated?
- 8) What elements were discovered after Mendeleev modified the table?
- 9) Give some examples of polyatomic molecules of single elements.
- 10) What are simple diatomic molecules of a single element designated by?

II. True or false?

- 1) Symbols and formulas are used to indicate chemical reactions.
- 2) Groups of symbols are called equations.
- 3) Groups of symbols are called formulas.
- 4) There are 102 chemical elements now.
- 5) The more electropositive element is always designated last in the formula.
- 6) Subscriptions are used to designate the number of atoms of each element present in the molecule.
- 7) Mendeleev made his discovery in 1879.
- 8) There were several vacant spaces in Mendeleev's table which led him to predict the existence of six undiscovered elements.
- 9) The table wasn't modified.

10) Properties of the elements are periodic functions of the nuclear charges of their atoms.

III. Identify the words, each dash stands for one letter only.

- | | |
|----------------------|--------------------|
| 1) d _ _ _ _ | 9) ex _ _ _ _ _ |
| 2) _ y _ _ _ _ | 10) arr _ _ _ _ _ |
| 3) _ _ sig _ _ _ _ | 11) _ _ _ _ _ tion |
| 4) _ _ com _ _ _ _ | 12) m _ ss _ _ g |
| 5) _ _ lya _ _ _ _ _ | 13) var _ _ _ _ |
| 6) _ _ _ _ _ ar | 14) _ _ _ _ fy |
| 7) _ t _ t _ | 15) f _ _ _ tion |
| 8) v _ _ _ _ t | |

III. Translate the words from exercise III and make up your own sentences with them.

IV. Find special words and terms in the cross-word puzzle.

H	Y	D	R	O	G	E	N	P	O
R	E	A	C	P	E	L	E	N	L
E	M	C	T	E	C	T	G	E	Y
L	E	O	I	R	O	R	Y	M	A
E	H	P	O	I	H	E	X	U	T
C	T	P	N	O	Y	D	O	I	O
H	Y	E	R	D	T	I	E	L	M
E	T	I	C	I	R	X	N	C	I
M	P	R	O	P	E	O	I	D	E
I	C	A	L	V	A	L	E	N	C

Unit 3. Rules of reading formulas and equations.

Обозначение и название важнейших химических элементов (к таблице Менделеева)

Al — aluminium алюминий	Li — lithium литий
Ag — argentum серебро	Mg — magnesium магний
Ar — argon аргон	Mn — manganese марганец
As — arsenic мышьяк	Mo — molybdenum молибден
Au — aurum = gold золото	N — nitrogen азот
B — boron бор	Na — natrium = sodium натрий
Ba — barium барий	Ne — neon неон
Be — berillium бериллий	Ni — nickel никель
Bi — bismuth висмут	O — oxygen кислород
Br — bromine бром	P — phosphorus фосфор
C — carbon углерод	Pb — plumbum = lead свинец
Ca — calcium кальций	Pt — platinum платина
Ce — cerium церий	Ra — radium радий
Cd — cadmium кадмий	Rb — rubidium рубидий
Cl — chlorine хлор	S — sulphur сера
Co — cobalt кобальт	Sb — antimony сурьма
Cr — chromium хром	Se — selenium селен
Cs — caesium цезий	Si — silicon кремний
Cu — copper медь	Sn — stannum = tin олово
F — fluorine фтор	Sr — strontium стронций
Fe — ferrum = iron железо	Te — tellurium теллур
Ge — germanium германий	Th — thorium торий
H — hydrogen водород	Ti — titanium титан
He — helium гелий	U — uranium уран
Hg — hydrargyrum = mercury ртуть	W — wolfram = tungsten вольфрам
I — iodine йод	Zn — zinc цинк
Ir — iridium иридий	Zr — zirconium цирконий
K — kalium = potassium калий	

Правила чтения химических формул

Буквы латинского алфавита, обозначающие название элементов, читаются согласно английским названиям букв алфавита.

Знак + читается plus, and, together, with, react with.

Знак — обозначает одну связь или единицу родства и не читается.

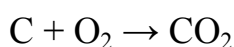
Знак = читается give, form или produce.

Знак → читается give, pass over to lead to.

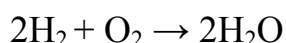
Знак ↔ читается forms and is formed from.

Цифра перед названием элемента обозначает число молекул.

Примеры:

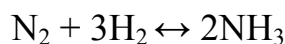


1 atom of carbon reacts with 1 two-atom molecule of oxygen and produces 1 molecule of carbon dioxide.



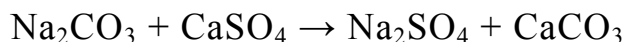
Two molecules of H₂ plus O₂ give two molecules of H₂O.

или Two two-atom molecules of hydrogen react with 1 two-atom molecule of oxygen and produce two molecules of water.



N₂ plus three molecules of H₂ form and are formed from two molecules of NH₃

или 1 two-atom molecule of nitrogen plus three two-atom molecules of hydrogen form and are formed from two molecules of ammonia.



Na₂CO₃ plus CaSO₄ form Na₂SO₄ plus CaCO₃

или The sodium (Na) and the calcium (Ca) switch places. The sodium combines with the sulphate radical (SO₄), forming sodium sulphate (Na₂SO₄) which dissolves in water. The calcium combines with the carbonate radical (CO₃), forming calcium carbonate (CaCO₃). Calcium carbonate does not dissolve in water, and so settles to the bottom of the solution.

Task: - write any 20 formulas and read them

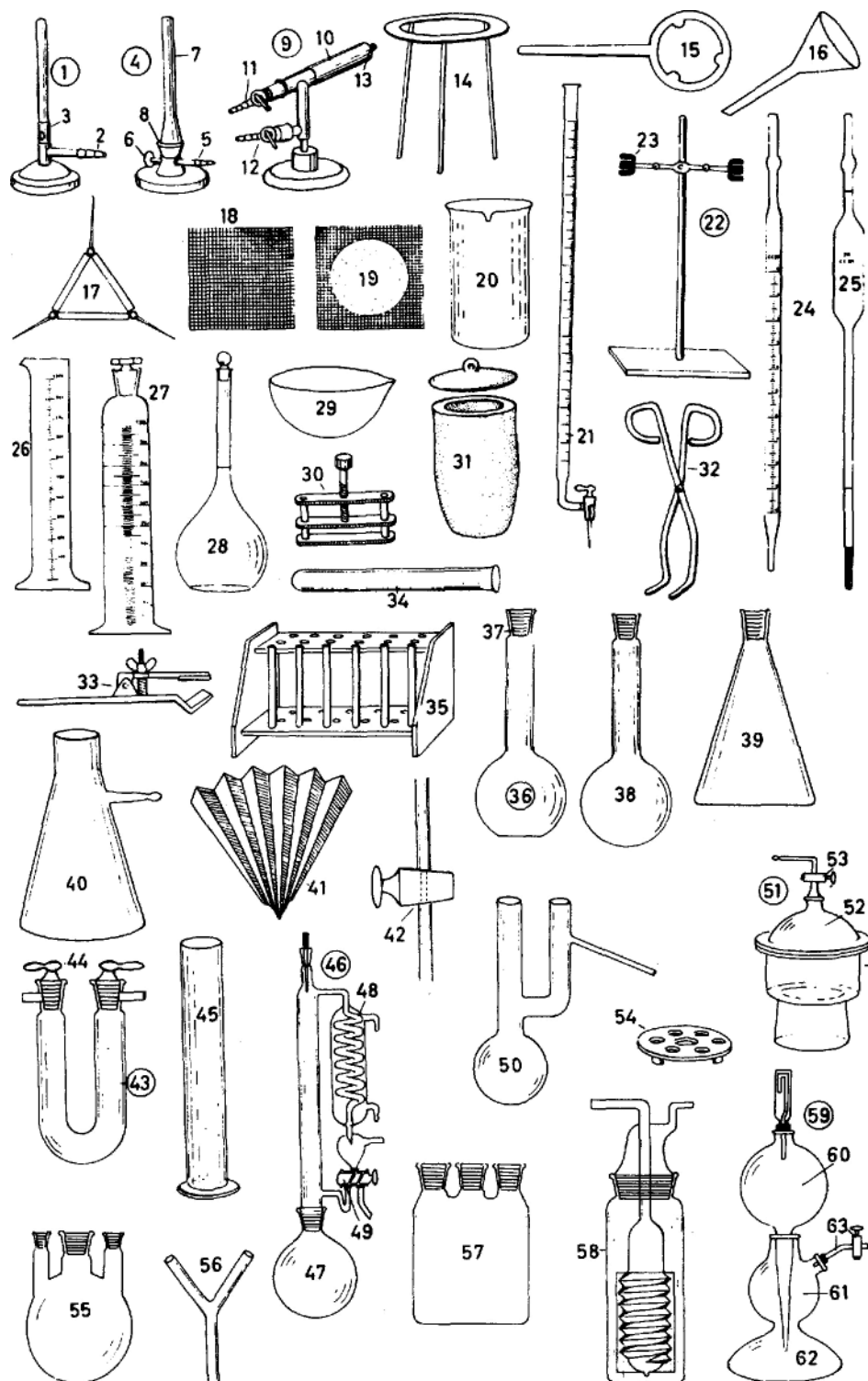
- write any 5 equations and read them

Unit 4. Laboratory equipment.

I. Match the word with its definition.

- | | |
|------------------------|--|
| 1) funnel | |
| 2) beaker | a) a tool that consists of two movable bars joined at one end, used to pick up an object |
| 3) microscope | b) a scientific instrument that makes extremely small things look larger |
| 4) slides | c) a short stick with a heavy round end |
| 5) electric balance | d) the science that is concerned with studying the structure of substances and the way they change |
| 6) tongs | e) a round piece of rubber or wood used to close the top of a container |
| 7) mortar | f) a round pipe made of rubber for liquids to go through |
| 8) pestle | g) a substance used in chemistry or produced by chemistry |
| 9) tripod | h) a tube used for pouring liquids or powders into a container with a narrow opening |
| 10) rubber tubing | i) an electric instrument for weighing things |
| 11) gas tap | j) a natural process in which the atoms of chemicals mix and arrange themselves differently to form new substances |
| 12) matches | k) a glass container used for measuring liquid |
| 13) measuring cylinder | l) a thin glass tube for sucking up exact amounts of liquid, used especially in chemistry |
| 14) test tube | m) a small glass container that is shaped like a tube and is used in chemistry |
| 15) test tube rack | n) a piece of clothing that is worn over your clothes in laboratory to protect them |
| 16) pipette | o) a scientist who has a special knowledge in chemistry |
| 17) conical flask | p) a glass cup with straight sides that is used in chemistry for measuring and heating liquids |
| 18) bung/stopper | q) small pieces of thin glass used for holding something when you look at it under a microscope |
| 19) lab coat | r) a hard bowl in which substances are crushed into powder or very small pieces with a pestle |
| 20) chemical | s) a special type of bottle mat you use to keep liquids |
| 21) chemical reaction | t) a special shelf for tubes |
| 22) chemist | u) a support with three legs, used for a camera, telescope etc. |
| 23) chemistry | v) small wooden sticks, used, to light a fire |
| | w) a piece of equipment for controlling the flow of gas from a pipe or container |

II. Learn the words and special term from the list.



- 1) **1-63 laboratory apparatus (laboratory equipment)** лабораторное оборудование
- 2) **Bunsen burner** горелка Бунзена
- 3) **gas inlet (gas inlet pipe)** подвод газа (газовая подводящая труба)
- 4) **air regulator** регулятор подвода воздуха
- 5) **Teclu burner** горелка Теклю
- 6) **pipe union** присоединение газовой трубы
- 7) **gas regulator** регулятор поступления газа
- 8) **stem** трубка горелки
- 9) **air regulator** регулятор поступления воздуха
- 10) **bench torch** настольная горелка
- 11) **oxygen inlet** подвод кислорода
- 12) **hydrogen inlet** подвод водорода
- 13) **oxygen jet** струя кислорода
- 14) **tripod** треножник, тренога
- 15) **ring (retort ring)** кольцо для реторты
- 16) **funnel** воронка
- 17) **pipe clay triangle** трубчатый глиняный треугольник
- 18) **wire gauze** проволочная сетка
- 19) **wire gauze with asbestos centre (Am. center)** проволочная сетка с асбестовым центром
- 20) **beaker** стакан
- 21) **burette (for delivering measured quantities of liquid)** бюретка (для выпуска измеренных объемов жидкости)
- 22) **burette stand** штатив для бюреток
- 23) **burette clamp** зажим для бюреток
- 24) **graduated pipette** градуированная пипетка
- 25) **pipette** пипетка
- 26) **measuring cylinder (measuring glass)** мерный цилиндр (измерительный стакан)
- 27) **measuring flask** мерная колба
- 28) **volumetric flask** мерная колба
- 29) **evaporating dish (evaporating basin), made of porcelain** выпарная чашка, выполненная из фарфора
- 30) **tube clamp (tube clip, pinchcock)** зажим для трубок
- 31) **clay crucible with lid** глиняный тигель с крышкой
- 32) **crucible tongs** тигельные щипцы
- 33) **clamp** струбцина
- 34) **test tube** пробирка
- 35) **test tube rack** штатив для пробирок
- 36) **flat-bottomed flask** плоскодонная колба
- 37) **ground glass neck** горлышко с притертой стеклянной пробкой
- 38) **long-necked round-bottomed flask** длинногорлая круглодонная колба
- 39) **Erlenmeyer flask (conical flask)** колба Эрленмайера (коническая колба)
- 40) **filter flask** колба для фильтрования под вакуумом
- 41) **fluted filter** гофрированный фильтр
- 42) **one-way tap** одноходовый кран
- 43) **calcium chloride tube** трубка с хлоридом кальция
- 44) **stopper with tap** пробка с краном
- 45) **cylinder** цилиндр
- 46) **distillation apparatus (distilling apparatus)** перегонный аппарат
- 47) **distillation flask (distilling flask)** перегонная колба
- 48) **condenser** конденсатор
- 49) **return tap, a two-way tap** возвратный кран, двухходовой кран
- 50) **distillation flask (distilling flask, Claisen flask)** перегонная колба (вакуум-перегонная колба, колба Кляйзена)
- 51) **desiccator** эксикатор (сушилка)
- 52) **lid with fitted tube** крышка с вставленной трубкой
- 53) **tap** кран
- 54) **desiccator insert made of porcelain** фарфоровый вкладыш в эксикаторе
- 55) **three-necked flask** трехгорлая колба
- 56) **connecting piece (Y-tube)** соединительная (Y-образная) трубка
- 57) **three-necked bottle** трехгорлая склянка
- 58) **gas-washing bottle** склянка
- 59) **gas generator (Kipp's apparatus, Am. Kipp generator)** генератор газа (аппарат Кипа, генератор Кипа)
- 60) **overflow container** переточный сосуд
- 61) **container for the solid** сосуд для засыпки реагента
- 62) **acid container** сосуд для кислоты
- 63) **gas outlet** трубка для выпуска газа

V. Describe the functions of each piece of equipment.

to destroy разрушать
to oxidize окислять, окисдировать
component составная часть, компонент
ranks in reactivity about with oxygen по своей реактивности почти не уступает кислороду

EXERCISES

I. Answer the questions.

- 1) In what state is chlorine found in nature?
- 2) At what temperature does chlorine liquefy?
- 3) Is chlorine easily soluble in water?
- 4) What action does chlorine exert in water?
- 5) What is the reactivity of chlorine?
- 6) What products are obtained when sodium chloride or potassium chloride solutions are subjected to electrolysis?
- 7) By what method is chlorine generally produced?
- 8) What products are produced if fused sodium chloride is used ?

II. Make up a description of any element you like.

Unit 6. ANALYTICAL CHEMISTRY

METHODS OF ANALYSIS

The analysis of a complex material usually involves four steps, sampling, dissolving the sample, separating mutually interfering substances, and determining the constituents of interest. The first step, sampling can be a significant problem, particularly in industrial applications.

Sampling is complete when the subdivision is small enough to permit analysis.

The second step is the dissolving of a sample. If we know the nature of the sample we use a suitable reagent.

I/Gravimetric methods involve a weighing operation as the final measurement.

Gravimetric analysis have been developed for almost everything from A(luminium) to Z(irconium).

Gravimetric procedures may be done in various ways: by precipitating, by dissolving, by removing as a volatile compound^.

Volumetric methods involve measurement of that volume of a solution of known concentration which reacts with a known amount of the sample. Such a solution is called a standard solution.

Volumetric techniques are now applicable to most of the elements and to many specific inorganic and organic compounds. They are widely used in all phases of chemistry, in medicine, and in many allied sciences.

Physico-chemical methods depend upon the measurement of physical properties other than mass and volume. Such methods are important when the simpler methods of analysis are inadequate.

METHODS OF SEPARATION

Methods of separating a solid and a liquid are built around two processes, filtration and centrifugation.

Filtration is the process of passing the suspension of solid and liquified through a porous barrier which will trap the solid. The barrier may be filter paper, sintered glass, asbestos matting, glass wool and others.

Centrifugation is mechanized setting (or floating) and depends upon the difference between the densities of the solid and the solution. Gravitational setting is usually inadequate. A centrifuge can be used to enhance the gravitational force moving the particles. Most centrifuges operate at hundreds of revolutions per minute. Extremely difficult separations require speeds of tens of thousands of revolutions per minute.

NOTES AND COMMENTARY

are built around two processes – базируются на двух процессах
the process of passing ... through – процесс пропускания ... через

mechanized setting - механическое осаждение

depends upon – зависит

revolutions per minute – обороты в минуту

ION EXCHANGE METHODS IN ANALYTICAL CHEMISTRY

Ion exchange is now one of the recognized processes of chemical engineering. It has been applied to the separation processes of quantitative analysis.

General Principles. By **ion exchange** we mean the exchange of ions of like sign between a solution and a solid insoluble body in contact with it. For such an exchange to be possible, the solid must contain ions of its own. The solid (called the **ion exchanger**) must have an open, permeable molecular structure, so that ions and solvent molecules can move freely in and out. Many substances, both natural and artificial, have ion exchanging properties.

In analytical work we are primarily interested in the synthetic organic exchangers. These have a high capacity for holding ions and they are not broken down by acids or alkalies, they have a relatively simple composition.

NOTES AND COMMENTARY

by "ion exchange" we mean - под ионным обменом мы подразумеваем
of like sign - одноименные по знаку
for such exchange to be possible – чтобы осуществить этот обмен

of its own - свои собственные
can move freely in and out - могут свободно входить и выходить

CHROMATOGRAPHY AND ION EXCHANGE TECHNIQUE

Chromatography is a method of chemical analysis based upon the selective absorption and partial fractionation of various substances by certain suitable materials. The method is simple and requires a minimum of special equipment. The technique consists of pouring a solution through a column containing a suitable adsorbing material. A selective developing agent is then passed through the column and the different substances in the solution are spread down the column into layers visibly separated from one another, provided the substances are colored. In the case of colorless substances, the layers of the different substances may be located by the use of ultra-violet light or by chemical tests.

This method was first described by the Russian botanist Tswett, in 1906. Tswett was engaged in the extraction and purification of plant pigments.

Methods of chromatography have been applied to the separation of the rare earths and a number of procedures, based on chromatography techniques, have been developed for the separation of the inorganic cations and anions.

NOTES AND COMMENTARY

are spread down ... into layers - оседают пластинами

provided - при условии, что
was engaged in - занимался

CHROMATOGRAPHY TECHNIQUES

The techniques of carrying out a chromatographic investigation are very simple. The basic apparatus is the adsorption column. The adsorption column may be constructed of soft glass or in special cases of quartz. The diameter and length of the column are determined by the quantity of material to be absorbed.

No universal adsorbent has been found. A good adsorbent should satisfy the following criteria: it should hold relatively large quantities of the materials to be resolved; the resolved materials must be eluted from the adsorbent by polar solvents; the size of the particles of adsorbent should be such as will allow rapid and uniform percolation; the adsorbents must not react with either the materials to be resolved nor the materials to be used as solvent or color

developer; the adsorbent should not be porous and should, if possible, be colorless.

The chromatograph is made as follows: a solution of the material to be adsorbed is poured into the adsorption column and allowed to percolate through the adsorbent. The column is washed with additional portions of the original solvent from which *the* compound was adsorbed. The sides of the column are washed with small portions of the solvent and then larger quantities are added to the column. The passage of the solvent through the column causes the adsorbed materials to move at different rates and thus produce the chromatogram.

NOTES AND COMMENTARY

should be such as will allow - должен бы
быть таким, чтобы позволить

rapid and uniform percolation - быстрое и
равномерное просачивание

PAPER CHROMATOGRAPHY, APPLICATIONS AND PROCEDURE

In paper chromatography-the absorption column is replaced by strips of paper. The absorbent or ion exchanger is precipitated into the pores of the paper. One end of the prepared paper is dipped into distilled water and allowed to stand until the water has climbed about a centimeter along the paper. It is then removed and dipped into a solution of the materials to be separated. After the unknown solution has climbed about 2 cm, the paper is removed from the unknown solution and returned to the distilled water. After the water has climbed to about 12 to 16 cm, the strip is removed and dried between filter paper. Brushing the dried paper strip with the proper developing agent will produce bands similar to those produced in the adsorption column.

Numerous studies have been made of the paper-strip method for separating cations, anions and metal complexes. The procedure is similar to that of column chromatography.

The paper-strip method has the advantage that the developing reagent does not pass through the adsorbent as it is required in column chromatography. The strip method requires a minimum of test solution, about 0.1 mm, several developers may be applied to the same strip.

The paper-strip method has been applied to quantitative determination of the inorganic cations and to many organic materials.

GAS ANALYSIS

Special techniques are usually employed in the analysis of the gases. Since the analysis of a gas, or gas mixture usually involves the measurement of a volume and only very rarely the weighing of a sample, the results are most frequently reported in per cent by volume rather than per cent by weight.

It must be remembered that the volume of a gas is greatly dependent upon both the temperature and the pressure and it is necessary to adjust each measurement to standard conditions of temperature and pressure. It is obvious then that these conditions must remain constant over the course of the analysis.

NOTES AND COMMENTARY

the results are ... reported in per cent by volume rather than per cent by weight - результаты даются в процентах относительно объема, а не относительно веса
over the course of the analysis - в течение всего процесса анализа

SOME PHYSICAL METHODS USED IN GAS ANALYSIS

The relative proportions of various components of gas mixtures can be determined by merely measuring some physical constants of the mixture: the density, the viscosity, the thermal conductivity, heat of combustion, ionization potential.

Condensation methods are often applicable in the separation of complex mixtures of gases. This method has been applied to the gases of the argon group and of natural gas mixtures.

The application of the methods of mass spectrometry to gas analysis has been extensive. The use of a mass spectrometer in analysis enables one to determine the components of mixtures of hydrocarbons, fuel gases, rare gases, etc.

Thermal conductivity applied to gas analysis is rapid, simple to carry out and adaptable to continuous operation and process control.

Some attempts to apply the methods of emission and absorption spectroscopy to gas analysis have been made.

Other miscellaneous methods include magnetic susceptibility, microwave analysis, acoustical method based on the principle that the velocity of sound in a gas is a function of the molecular weight of the gas, interferometric methods, diffusion methods and others.

NOTES AND COMMENTARY

enables one - обеспечивает
simple to carry out - прост в производстве
based on - основан на

ANALYSIS OF MIXTURES

Many problems of quantitative chemistry are more complex than determining the amount of a pure substance or the composition of an aqueous solution of a pure compound. Often the problem arises simply because the compound or solution has an unknown or complex composition.

There are three fundamental schemes than can be used in the problem at hand.

1. Phase separation: The metal ion, A, can be determined without interference from B if we separate A from B. We do this by preparing a two-phase system such that all of A is in one phase and all of B is in the other phase.

2. Selective determination: The metal ion, A, can be determined in the presence of B if we can find a determination which is selective toward A, ignoring B.

3. Combined determination: The two metal ions, A and B, can be determined together. This type of measurement combined with another independent measurement gives the amount of each ion.

NOTES AND COMMENTARY

are more complex than - более сложны чем the problem at hand - рассматриваемая проблема

EXTRACTION

Liquid-liquid phase separations are possible when a metal forms a compound soluble in two immiscible liquids. The distribution of the compound between the two liquids can be considered to be a solubility contest. Practical considerations dictate that one of the liquids must be water. Among the liquids other contestants are: carbon tetrachloride, chloroform, carbon disulfide, ethers, paraffin hydrocarbons, and aromatic hydrocarbons. Alcohols cannot be added to this list.

Most inorganic compounds just are not interested in the organic solvents which are immiscible with water. Sometimes, however, a complexing agent can be found which will coach an inorganic substance into an organic solution. Cupric, lead, zinc, silver, mercuric, and cadmium salts, for example, will dissolve, in either chloroform or carbon tetrachloride if it contains some dithizone.

PRECIPITATION

The most generally useful technique for accomplishing a phase separation is the solid-liquid separation, obtained in a precipitation.

To have wide applicability a precipitant should form compounds with many metal ions, and these compounds should have a wide range of solubility. To obtain proper conditions, the concentration of the precipitant should be controlled easily.

What sort of precipitant is most desirable depends upon many variables: how many samples must be determined, what constituents are present, what reagents are at hand, what time is available, what accuracy is desired, etc.

Unit 7. Famous chemists.

- Task:** 1) read the texts
2) answer the questions
3) make up a report about any famous chemist you like

Antoine Lavoisier.

Antoine Laurent Lavoisier is a French chemist, was the founder of modern chemistry.

Lavoisier carefully measured the weights of substances involved in chemical reactions. In 1772 he began a series of experiments that demonstrated the nature of combustion. He concluded that combustion results from the union of a flammable material with a newly discovered gas, which he called oxygen. Lavoisier published his findings in his *Elementary Treatise on Chemistry* (1789).

With French astronomer and mathematician Pierre Simon Laplace, Lavoisier conducted experiments on respiration in animals. Their studies demonstrated a similarity between common chemical reactions and the processes that occur in living organisms. These experiments provided the foundation for the science now known as biochemistry. Lavoisier also helped to develop a system for naming chemical substances based on their composition. This system is still in use.

Lavoisier was born in Paris. He received an excellent education and developed an interest in all branches of science, especially chemistry. He was elected to the French Academy of Sciences in 1768.

Lavoisier was arrested in 1793 by the leaders of the French Revolution. Many years earlier, he had become a partner in a firm that collected a number of taxes for the government. In spite of his achievements, Lavoisier was found guilty of conspiracy with the enemies of France because of his involvement in tax collection. He was executed by guillotine.

Questions

- 1) What famous scientist did Lavoisier work with?
- 2) What experiments did they conduct?
- 3) The foundation of what science did their experiments provide?
- 4) Why was he arrested?
- 5) What series of experiments did Lavoisier begin in 1772?

Alfred Nobel.

Alfred Bernard Nobel, a Swedish chemist, invented dynamite and founded the Nobel Prizes. As a young man, Nobel experimented with nitroglycerin in his father's factory. He hoped to make this dangerous substance into a safe and useful explosive. He prepared a nitroglycerin explosive, but so many accidents occurred when it was put on the market that for a number of years many people considered Nobel almost a public enemy.

Finally in 1867 Nobel combined niter with an absorbent substance. This explosive could be handled and shipped safely. Nobel named it dynamite. Within a few years he became one of the world's richest men. He set up factories throughout

the world and bought the large Bofors armament plant in Sweden. He worked on synthetic rubber, artificial silk and many other products.

Nobel was never in good health. In later years he became increasingly ill and nervous. He suffered from a feeling of guilt at having created a substance that caused so much death and injury. He hated the thought that dynamite could be used in war when he had invented it for peace. Nobel set up a fund of about 9 million U.S. dollars. The interest from the fund was to be used to award annual prizes, one of which was for the most effective work in promoting international peace.

Alfred Nobel was born on October, 21, 1833 in Stockholm. He was the son of an inventor. He was educated in St. Petersburg, Russia, and later studied engineering in the United States.

Questions

- 1) Who was Nobel's father?
- 2) What was Nobel's chief invention?
- 3) Why did people consider him a public enemy for a number of years?
- 4) What kind of Prizes did he set up?
- 5) What was the interest from these fund?

Final test.

I. Match the words.

- | | |
|---------------|-----------------|
| 1) Solvent | a) частица |
| 2) depositing | b) двуокись |
| 3) alkali | c) заряд |
| 4) particle | d) растворитель |
| 5) mercury | e) растворимый |
| 6) dioxide | f) осаждение |
| 7) dyestuff | g) уравнение |
| 8) soluble | h) краситель |
| 9) charge | i) ртуть |
| 10) equation | j) щелочь |

II. Fill in the gaps with suitable words given below.

- 1) Natural gas is an ... gas that occurs in the earth's crust.
- 2) ... is a process used to make raw rubber useful.
- 3) Iron is always present as an ... in commercial aluminium and its alloys.
- 4) Radioactivity is the ... , exhibited by certain types of matter, of emitting energy spontaneously.
- 5) A measure of the strength of the electrolyte is its ability ... an electric current.
- 6) When chemical substances have the same molecular weight but different properties, they are called
- 7) Natural rubber is an elastic substance found as milky dispersion in many species of... .
- 8) Cellulose is a naturally occurring
- 9) ... is the linking of small molecules (monomers) to make large molecules.
- 10)... is a chemical substance which contains plant food.

Polymerization, to conduct, vulcanization, isomers, inflammable, property, plants, impurity, a fertilizer, carbohydrate.

III. Make up sentences out of these words and translate the sentences into Russian.

- 1) Enough, analysis, when, is, is, the, sampling, complete, permit, subdivision, small, to.
- 2) The, main, production, use, energy, fuel, of, of, is, in, atomic, uranium, a, as, the.
- 3) Dealing, electrolytic, theory, solution, is, a, with, of, in, theory, compounds, dissociation, behavior.
- 4) Solution, method, metals, is, depositing, from, of, a, electrolysis.
- 5) Composition, of, depend, only, quantitative, not, their, substances, properties, on, qualitative, and.

IV. Make up 5 sentences of your own with the words from task I.

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