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| МИНИСТЕРСТВО НАУКИ И ВЫСШЕГО ОБРАЗОВАНИЯ РОССИЙСКОЙ ФЕДЕРАЦИИ  федеральное государственное АВТОНОМНОЕ образовательное учреждение высшего образования  «Национальный исследовательский ядерный университет «МИФИ» |
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**Озерск**

Оглавление

[UNIT 1. CHEMISTRY: KEY TO PROGRESS AND ABUNDANCE 3](#_Toc96631942)

[1.1 Fields of chemistry 3](#_Toc96631943)

[UNIT 2. SYMBOLS, FORMULAS AND EQUATIONS 6](#_Toc96631944)

[2.1 Inorganic molecules and compounds 6](#_Toc96631945)

[2.2 Periodic law 7](#_Toc96631946)

[UNIT 3. RULES OF READING FORMULAS AND EQUATIONS 9](#_Toc96631947)

[UNIT 4. LABORATORY EQUIPMENT 11](#_Toc96631948)

[UNIT 5. DESCRIPTION OF CHEMICAL ELEMENTS 14](#_Toc96631949)

[UNIT 6. ANALYTICAL CHEMISTRY 15](#_Toc96631950)

[6.1 Methods of analysis 15](#_Toc96631951)

[6.2 Ion exchange methods in analytical chemistry 16](#_Toc96631952)

[6.3 Chromatography and ion exchange technique 17](#_Toc96631953)

[6.4 Chromatography techniques 17](#_Toc96631954)

[6.5 Paper chromatography, applications and procedure 17](#_Toc96631955)

[6.6 Gas analysis 18](#_Toc96631956)

[6.7 Some physical methods used in gas analysis 18](#_Toc96631957)

[6.8 Analysis of mixtures 18](#_Toc96631958)

[6.9 Extraction 19](#_Toc96631959)

[6.10 Precipitation 19](#_Toc96631960)

[6.11 Electrolysis 19](#_Toc96631961)

[6.12 Ion exchange 19](#_Toc96631962)

[UNIT 7. ORGANIC CHEMISTRY 20](#_Toc96631963)

[7.1 Carbon and compounds of carbon 20](#_Toc96631964)

[7.2 Carbon Dioxide 21](#_Toc96631965)

[7.3 Carbon Pollutants 21](#_Toc96631966)

[UNIT 8. FAMOUS CHEMISTS 22](#_Toc96631967)

[8.1 D.I. Mendeleyev 22](#_Toc96631968)

[8.2 Antoine Lavoisier 22](#_Toc96631969)

[8.3 Alfred Nobel 23](#_Toc96631970)

# 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 Mendeleyev, 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

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

accompanying - сопутствующие

energy changes – преобразование энергии

abundance - изобилие

overall volume of production – общий объем 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

manufacture - производство

textile fibres - текстильные волокна

contribution – вклад

aniline dyes – анилиновые красители

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

enable – давать возможность

## 1.1 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 is 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 deposition 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.

***VI. Translate the text with the dictionary and reproduce it:***

Analytical chemistry deals with the methods of separation. Synthetic chemistry deals with the methods by which complex bodies can be built from simplier substances.

Physical chemiststry deals with changes in state and with the motions of molecule. But at the present time the scientists don't maintain this definition.

The discovery of X-rays, an electron, and radioactivity marked a new era in all sciences in and in chemistry. It was a very important discovery in science. It plays an important part in the development of geology and physiology, in technology and in chemical engineering. Chemistry deals with medicine and agriculture as they are all concerned with the properties and change of chemical substances.

***VII. Read and entitle the text.***

The science of chemistry deals with substances. Chemistry is the investigation and discussion of the properties of substances. Common examples of substances are: water, sugar, salt, copper, iron and many others. Chemists study substances in order to learn as much as they can about their properties and about the reactions that change them into other substances. This knowledge is very important as it can make the world a better place to live in, it can make people happier, it can raise their standard of living.

Chemists discovered many laws, investigated many important phenomena in life. They produced many artificial substances which have valuable properties. Chemistry has two main aspects: descriptive chemistry, the discovery of chemical facts, and theoretical chemistry, the formulation of theories. The broad field of chemistry may also be divided in other ways. An important division of chemistry is that into the branches of organic chemistry and inorganic chemistry.

***VIII. Read the text without the dictionary and retell it in Russian:***

Chemistry is a very large subject. It is the investigation and discussion of the properties of substances. If we ask — why do we study chemistry, the answer can be — it is through chemistry we obtain the knowledge of matter, its changes and transformations.

Everyone understands that science of chemistry plays an important part in the modern world.

Chemistry plays an important in the development of other sciences such as physics, biochemistry, geology and a lot of other fields of science.

# 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:

2H2O => 2H2 + O2 (statement: water decomposes to form hydrogen and oxygen)

**VOCABULARY**

symbol – символ

equation – уравнение

presently – в настоящее время

to derive – происходить

copper (Cu) – медь

sodium (Na) – натрий

to designate – обозначать

carbon dioxide CO2 – двуокись углерода

sulphuric acid H2SO4 – серная кислота

to indicate – указывать, означать

statement – формулировка

to decompose – разлагаться (на составные части)

## 2.1 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 – cepa

covalent – ковалентный

unlikе – различный

similar – подобный

hydrogen chloride – хлористый водопровод

electropositive – электроположительный

## 2.2 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 Mendeleyev 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 Mendeleyev'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 – сходство

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 Mendeleyev discover the periodic law?

7) How can the Periodic Law be simply stated?

8) What elements were discovered after Mendeleyev 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) Mendeleyev made his discovery in 1879.

8) There were several vacant spaces in Mendeleyev’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 \_ \_ \_ \_

2) \_ y \_ \_ \_ \_

3) \_ \_ sig \_ \_ \_ \_

4) \_ \_ com \_ \_ \_ \_

5) \_ \_ lya \_ \_ \_ \_ \_

6) \_ \_ \_ \_ \_ ar

7) \_ t \_ t \_

8) v \_ \_ \_ \_ t

9) ex \_ \_ \_ \_ \_

10) arr \_ \_ \_ \_ \_ \_ \_ \_

11) \_ \_ \_ \_ \_ \_ tion

12) m \_ss \_ \_ g

13) var \_ \_ \_ \_

14) \_ \_ \_ \_ fy

15) f \_ \_ \_ tion

***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 |

***V. Read and translate the text***

Man at last understood the elements well enough to make his own. First there were some elements still missing from the Periodic Table. The fact was they were practically missing from nature, too.

Scientists had to make these elements themselves. To make such elements meant first of all to carry on great experimental work. Many scientists worked hard at this problem. In 1919 Ernest Rutherford was the first to change nitrogen to oxygen by bombarding nitrogen atoms with alpha-particles.

To alter an element artificially is to add or subtract particles in its nucleus. The first completely new man-made isotope was created by Rutherford's method, its creators being Irene Curie and her husband Frederic Joliot. To do that they had to bombard aluminium with alpha-particles. This attack transformed some of the aluminium atoms into a highly radioactive substance. This substance was a new kind of phosphorus, its atomic weight being 30, instead of natural phosphorus 31.

It was no wonder that phosphorus 30 did not occur in nature, its half-life being only two and a half minutes. Thus the Joliot-Curies were the first to produce "artificial radioactivity".

The era of artificial transmutation began with the building of the first "atomsmasher", i.e. the cyclotron. By means of cyclotron and energetic particle accelerators developed later it became possible to open up the nucleus of any atom. It became possible to add particles to it, and even to create new ones.

The first element produced in this way was the missing number 43, it being named "technetium" meaning "artificial". The aim of the scientists was to discover other elements.

In 1939 a new element was found. It behaved like an alkalimetal, therefore it was to be 87 the missing number of the alkali-metal family. It was called "francium". It was detected in nature. Later that element was produced artificially by an accelerator, and only then did chemists obtain enough of it. For that reason francium is to be considered as a manmade element.

Later scientists discovered traces of an element in neutron-bombarded uranium.

They called it "neptunium". Radioactive neptunium gave rise to another element — number 94.

In 1955 chemists could produce a few atoms of element 101, which was named "mendelevium" in honour of D. I. Mendeleyev. The isolation of element number 102 occurred in 1963, it being named "nobelium", as part of the work was done at the Nobel Institute in Stockholm.

***a) Entitle the text***

***b) Divide the text into logical parts.***

***c) Make the plan of the text***

***d) Formulate the main idea of each part.***

***f) Give the summary of the text***

# UNIT 3. RULES OF READING FORMULAS AND EQUATIONS

Список наиболлее важных химических элементов (к таблице Менделеева)

|  |  |  |  |
| --- | --- | --- | --- |
| 1. Al  2. Ag  3. Ar  4. As  5. Au  6. B  7. Ba  8. Be  9. Bi  10. Br  11. C  12. Ca  13. Ce  14. Cd  15. Cl  16. Co  17. Cr  18. Cs  19. Cu  20. F  21. Fe  22. Ge  23. H  24. He  25. Hg  26. J  27. Ir  28. K  29. Li  30. Mg  31. Mn  32. Mo  33. N  34. Na  35. Ne  36. Ni  37. O  38. P  39. Pb  40. Pt  41. Ra  42. Rb  43. S  44. Sb  45. Se  46. Si  47. Sn  48. Sr  49. Te  50. Th  51. Ti  52. U  53. W  54. Zn  55. Zr | aluminium  argentums  argon  arsenic  aurum = gold  boron  barium  berillium  bismuth  bromine  carbon  calcium  cerium  cadmium  chlorine  cobalt  chromium  caesium  copper  fluorine  ferrum = iron  germanium  hydrogen  helium  hydrargyrum = mercury  iodine  iridium  kalium = potassium  lithium  magnesium  mangnese  molybdenum  nitrogen  natrium = sodium  neon  nickel  oxygen  phosphorus  plumbum= lead  platinum  radium  rubidium  sulphur  antimony  selenium  silicon  stannum = tin  strontium  tellurium  thorium  titanium  uranium  wolfram = tungsten  zinc  zirconium | [ˎæləʹmɪnɪəm]  [a:ʹʤentəm]  [ʹa:ɡɒn]  [ʹa:snɪk]  [ʹɔ:rəm] = [ɡɔuld]  [ʹbɔrɒn]  [ʹbeərɪəm]  [bəʹrɪlɪəm]  [ʹbɪzməθ]  [ʹbrɔumɪn]  [ʹka:bən]  [ʹkælsɪəm]  [ʹsɪərɪəm]  [ʹkædmɪəm]  [ʹklɔ:rɪn]  [ʹkɔubɔ:lt]  [ʹkrɔumɪəm]  [ʹsɪ:zɪəm]  [ʹkɔpə]  [ʹfluərɪ:n]  [ʹferəm] = [ʹaɪən]  [ʹʤɜ:meɪnɪəm]  [ʹhaɪdrəʤən]  [ʹhɪ:lɪəm]  [ʹhaɪdrəʤərəm] = [ʹmɜ:kjurɪ]  [ʹaɪədɪn]  [ɪʹrɪdɪəm]  [ʹkælɪəm] = [pəʹtæsɪəm] [ʹlɪθɪəm]  [mæɡʹnɪ:zɪəm]  [ʹmæŋɡənɪ:z]  [məʹlɪbdənəm ]  [ʹnaɪtrəʤən]  [ʹneɪtrɪəm] = [ʹsɔudɪəm]  [ʹnɪ:ɔn]  [ʹnɪkl]  [ʹɔksɪʤən]  [ʹfɔsfərəs]  [ʹplʌmbəm] = [led]  [ʹplætɪnəm]  [ʹreɪdɪəm]  [ruʹbɪdɪəm]  [ʹsʌlfə]  [ʹæntɪmənɪ]  [sɪʹlɪ:nɪəm]  [ʹsɪlɪkən]  [ʹstænəm] = [tɪn]  [ʹstrɔntɪəm]  [teʹluərɪəm]  [ʹθɔ:rɪəm]  [taɪʹteɪnɪəm]  [juʹreɪnɪəm]  [ʹwulfrəm] = [ʹtʌŋstən]  [ʹzɪnk]  [zɜ:ʹkɔunɪəm] | алюминий  серебро  аргон  мышьяк  золото  бор  барий  бериллий  висмут  бром  углерод  кальций  церий  кадмий  хлор  кобальт  хром  цезий  медь  фтор  железо  германий  водород  гелий  ртуть  йод  иридий  калий  литий  магний  марганец  молибден  азот  натрий  неон  никель  кислород  фосфор  свинец  платина  радий  рубидий  cepa  сурьма  селен  кремний  олово  стронций  теллур  торий  титан  уран  вольфрам  цинк  цирконий |

**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:

* **C + O2 > CO2**

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

* **2H2 + O2 > 2H2O**

a) Two molecules of H two plus O two give two molecules of H two O.

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

* **N2 + 3H2 - 2NH3**

a) N two plus three molecules of H two form and are formed from two molecules of NH three

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

* **Na2CO3 + CaSO4 > Na2SO4 + CaCO3**

a) Na two CO three plus CaSO four form Na two SO four plus CaCO three

b) The sodium (Na) and the calcium (Ca) switch

c) The sodium combines with the sulphate radical (SO4), forming sodium sulphate (Na2SO4) which dissolves in water.

d) The calcium сombines with the carbonate radical (CO3), forming calcium carbonate (CaCO3).

e) Calcium carbonate does not dissolve in water, and so settles to the bottom of the solution.

Знаки + или - стоящие в левом верхнем углу, обозначают положительную и отрицательную валентность иона.

|  |  |  |  |
| --- | --- | --- | --- |
| **Пример:** | H+ | — | a) hydrogen ion  b) univalent positive hydrogen ion |
|  | Сu++ | — | divalent positive cuprum ion |
|  | Al+++ | — | trivalent positive cuprum ion |
|  | Cl – | — | a) negative chlorine ion  b) negative univalent chlorine ion |

**Task: - write any 20 formulas and read them**

**- write any 5 equations and read them**

# UNIT 4. LABORATORY EQUIPMENT

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 форфора

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 (вакуумперегонная 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

**II. Learn the words and special terms from the list.**

****

**I. Match the word with its definition.**

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

**V. Describe the functions of each piece of equipment.**

**VI. Read and translate the text**

**LABORATORY**

A) All the laboratories of inorganic chemistry are almost alike. These are large rooms where both students and research-workers carry out their experimental work. Modern laboratories of inorganic as well as organic and analytical chemistry are provided with gas and running water. Every laboratory is to be provided with a ventilating hood for the escape of both harmful and unpleasant vapours and odours. Every laboratory has to be lit up very well.

There are many laboratory benches with a great number of drawers in every laboratory. Different apparatus devices as well as materials are to be kept in them. Besides we can see many shelves and cases for containers with chemicals.

On every laboratory bench one can see test-tubes, flasks, beakers, funnels, evaporating dishes, weighing bottles. All this glassware should be kept in good order.

Various burners serve for producing flames. Bunsen burner is to be mentioned among them. Different crucibles are to be employed when heating of solution and igniting of materials are to be carried out. Crucibles are usually made of quartz, porcelain and iron. In addition to these crucibles, there are platinum crucibles in some laboratories, but they are used very seldom.

B) Every laboratory should be equipped with different kinds of apparatus. Everything in the laboratory is to have its definite place.

Experiments in the Laboratory. Many experiments can be carried out in the laboratory of inorganic chemistry. Thus, if we want to obtain hydrogen chloride (HCL) which is often referred to as a hydrochloric acid gas, it is necessary to pour some sulphuric acid through a tube over the crystal of sodium chloride, in a flask. The fiask is to be heated. On warming the fiask, the hydrogen chloride is expelled as a colourless gas with a suffocating odour. It produces heavy clouds of white fumes when it comes in contact with the moist air of the room. It is soluble and it cannot be collected over water as are oxygen and hydrogen. It is much heavier than the air and may be passed through a glass tube to the bottle. If we dissolve some of the gas in water, the solution has a sour taste, reddens blue litmus, reacts with zinc, etc.: it is hydrochloric acid. When all the sodium chloride originally present in the flask has been transformed, the reaction is complete. The flask then contains a salt called sodium acid sulphate (NaHSO4) together, with unchanged excess of sulphuric acid.

Nitric acid may be prepared by the reaction of concentrated sulphuric acid with sodium nitrate. In the laboratory method, a mixture of sodium nitrate and concentrated sulphuric acid is heated in a glass retort. Nitric acid is boiled out of the mixture and is condensed: NaNO3 + H2SO4 = HNO3+ NaHSO4

**Answer the following questions:**

1. What do we call a laboratory'?

2. In what laboratories can the students carry out their experiments?

3. What is every laboratory provided with?

4. Why is every laboratory provided with a ventilating hood?

5. What can you see on the shelves'?

6. What glassware is there on every laboratory bench?

7. What are burners used for?

8. What are crucibles used for?

9. What are crucibles made of?

10. What is it necessary to do if we want to obtain hydrogen chloride? (describe the experiment)

11. How can nitric acid be prepared in the laboratory?

# UNIT 5. DESCRIPTION OF CHEMICAL ELEMENTS

**CHLORINE**

Chlorine is an element with atomic number 17, atomic weight 35.5 (thirty five point five). It is a gas at ordinary temperatures and is never found free in nature. It is found in nature combined with other elements. At normal temperatures, chlorine is a diatomic gas (Cl2), greenish-yellow in colour and about 2 1/2 (two and a half) times as heavy as air. It liquefies at atmospheric pressure at -34.1° C (minus thirty four point one degrees Centigrade) to a yellowish liquid approximately 1 1/2 (one and a half) times as heavy as water. The liquid freezes at -100.98° C (minus one hundred point nine eight degrees Centigrade). Chlorine is soluble in water and indirectly exerts bleaching and bactericidal action by reacting with water to form hypochlorous acid.

Cl2 + H2O ↔ HCl + HClO → HCl + (O)

Chlorine Water Hydrochloric Hypochloric

acid acid

The hypochlorous acid is unstable, giving up oxygen to form more HC1. The oxygen attacks and destroys bacteria; it also oxidizes coloured organic substances, forming colourless or less-coloured components.

As one of the most active elements, chlorine ranks in reactivity about with oxygen. It combines directly and readily with hydrogen and most non-metals except nitrogen, carbon and oxygen; it also unites with all the familiar metals except gold and platinum.

Participating in a number of important organic reactions, in some cases chlorine appears in the final product, as in insecticides (DDT) or in the plastic, polyvinil chloride.

Chlorine is generally produced by electrolysis of water solutions of sodium chloride in electrolytic cells. When sodium chloride or potassium chloride solutions are subjected to electrolysis, there are three products; caustic soda or caustic potash, chlorine and hydrogen. If fused sodium chloride is used, there are two products: chlorine, and metallic sodium.

**VOCABULARY**

1. is never found free in nature - не встречается в свободном состоянии в природе
2. 2 1/2 times as heavy as air - в 2.5 раза тяжелее воздуха
3. to liquefy - переходить в жидкое состояние
4. to freeze (froze, frozen) - замерзать, затвердевать
5. soluble - растворимый
6. to exert - оказывать
7. bleaching and bactericidal action -отбеливающее и бактерицидное действие
8. hypochlorous acid - хлорноватистая кислота
9. unstable - неустойчивый
10. to destroy - разрушать
11. to oxidize - окислять, оксидировать
12. component - составная часть
13. ranks in reactivity about with oxygen - по своей реактивности почти не уступает кислороду
14. to combine - соединяться
15. insecticide - средство для истребления насекомых
16. sodium chloride - поваренная соль, хлористый натрий
17. electrolytic cell - электролитическая ванна
18. potassium chloride - хлористый калий
19. caustic soda - едкий натр
20. caustic potash - едкое кали
21. fused = molten - расплавленный

**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

## 6.1 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 to the text**

1. are built around two processes – базируются на двух процессах
2. mechanized setting – механическое осаждение
3. the process of passing … through – процесс пропускания … через
4. depends upon – зависит от
5. revolutions per minute – обороты в минуту

## 6.2 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**

1. by "ion exchange" we mean - под ионным обменом мы подразумеваем

2. of like sign - одноименные по знаку

3. for such exchange to be possible – чтобы осуществить этот обмен

4. of it own - свои собственные

5. can move freely in and out - могут свободно входить и выходить

## 6.3 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 purifictaion 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 to the text**

1. are spread down … into layers - оседают пластами

2. provided - при условии, что

3. was engaged in - занимался

## 6.4 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 аnd 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 to the text**

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

rapid and uniform percolation - быстрое и равномерное просачивание

## 6.5 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.

## 6.6 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 to the text**

1. 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

2. over the course of the analysis - в течение всего процесса анализа

## 6.7 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, micro-wave 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, inferometric methods, diffusion methods and others.

**Notes to the text**

1. enables one - обеспечивает

2. simple to carry out - прост в производстве

3. based on - основан на

## 6.8 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 front 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 to the text**

1. the problem at hand - рассматриваемая проблема

2. are more complex than - более сложны чем

## 6.9 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.

## 6.10 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 easilly.

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.

## 6.11 Electrolysis

Another type of solid-liquid phase separation is furnished by electrolytic techniques. Two electrodes are placed in the solution of interest, and a current is passed through the solution at a voltage sufficient to reduce some but not all of the metals present. If the current and concentrations are adjusted properly, the metals which are reduced will plate out on the electrode in a pure metallic deposit which can be dried and weighed directly.

**Notes to the text**

the solution of interest - исследуемый раствор

will plate out - отлагается

to reduce some but not all - для частичного удаления

## 6.12 Ion exchange

Another procedure utilizing the elution technique is the ion exchange separation. This time the solid (which is called the substrate) is a salt or compound with salt-forming capacity, something like a sulfonic acid group. When a solution containing metal ions is passed through such an acid substrate, the ions can replace the protons, forming salts. Further elution repeats many times the cycle of ion exchange, replacement of a proton by a salt ion, followed by replacement of the metal ion by proton. As in chromatography, the repetitious procedure magnifies small differences in saltforming capacity and permits separations which are extremely difficult by any other method.

Ion exchange substrates fall into two groups: cation exchangers and anion exchangers. Acidic functional groups areeffective as cation exchangers. These groups include sulfonic acids,— SO3H; carboxylic acid,— COOH; phenols or alcohols,— OH; and mercaptans,— SH. These interact only with cations and by an exchange reaction of the following sort:

— SO3H + M+ = — SO2M + H+.

Most anion exchangers are amines, depending upon one of the functional groups — NH2, — NHR, and NR2. These groups form ammonium type salts, and the anion can be displaced:

— NH2 • HC1 + X = — NH2 • HX + Cl.

1. saltforming capacity - способность солеобразования

2. something like - нечто вроде

3. by any other method - любым другим методом

4. fall into two groups - разделяются на две разные группы

# UNIT 7. ORGANIC CHEMISTRY

## 7.1 Carbon and compounds of carbon

Organic chemistry is an extremely interesting field of natural science and of great technological significance. The overwhelming majority of chemists prove to be engaged in producing organic compounds; several millions being known so far.

In view of their obvious success in the manufacture of synthetic compounds, the chemists are greatly interested in this field of science.

The name organic chemistry, which was originally used to refer to the chemistry of substances that occur in living organisms, is now used for the chemistry of the compounds of carbon. The chemistry of carbon was greatly advanced about a century ago through the development of a general structure theory, this theory being a chemical theory, induced from chemical facts.

In recent years it has received added verification through the determination of exact structures of molecules and crystals by physical methods, especially X-ray diffraction, electron diffraction, and the analysis of the spectra of substances.

During the first half of the 19th century many organic compounds were found to have been obtained from plants and animals and also to have been made in the laboratory.

They were analyzed for their constituent elements, an their properties were carefully studied. Efforts were made to find some correlation between the chemical composition and the properties of the substances.

**Elementary Carbon.** Carbon occurs in nature in its elementary state in two allotropic forms namely diamond, this being the hardest substance known, and graphite, a soft, black crystalline substance used as a lubricant. Having investigated all the substances thoroughly the scientists found charcoal, coke, and carbon black; to be microcrystalline or amorphous (noncrystalline) forms of carbon. Carbon burns to form gases: carbon monoxide CO, and carbon dioxide CO2, the former being produced when there is a deficiency of oxygen or the flame temperature is very high.

This investigation followed by others resulted in new discoveries in the field of carbon. It has been found out that carbon monoxide is a colourless, odourless gas with small solubility in water. It is poisonous, because of its ability to combine with the hemoglobin in the blood in the same way that oxygen does, and thus to prevent the hemolobin from combining with oxygen in the lungs and carrying it to the tissues.

It should be noted that the exhaust as from automobile engines contains some carbon.

Nevertheless carbon monoxide is a valuable industrial gas, for use as a fuel and as a reducing agent.

## 7.2 Carbon Dioxide

Carbon dioxide is a colourless, odourless gas with a weakly acid taste, due to the formation of some carbonic acid when it is dissolved in water. It appears to be about 50'/o heavier than air. It is easily soluble in water, one liter of water at 0°C dissolving 1,713 ml of the gas under 1 atm pressure. When crystalline carbon dioxide is heated from a very low temperature its vapour pressure reaches 1 atm at 79' at which temperature it vaporizes without melting. If pressure were increased to 2.5 atm the crystalline substance would melt to a liquid at 56.6'. Under ordinary pressure, then, the solid substance could be changed directly to a gas.

Carbon dioxide is known to combine with water to form carbonic acid H2CO3 , it being a weak acid.

If you studied all the properties more thoroughly you would see that carbon dioxide is used for the manufacture of sodium carbonate, sodium hydrogen carbonate, and carbonated water and for many other uses. From this short review it's clear that chemistry of carbon and its compounds is a very important field of chemistry and should be studied carefully.

## 7.3 Carbon Pollutants

Carbon monoxide and carbon dioxide are both very important atmospheric contaminants. Human activities are responsible for the introduction of increasing quantities of these gases to the atmosphere. Carbon monoxide is particularly important because of its potent mammalian toxicity, while carbon dioxide is most significant because of its ability to regulate global temperature. Neither gas is tought to cause direct damage to vegetation at ambient concentrations presently monitored.

Carbon monoxide has not been shown to produce acute effects on plants at concentrations below 100 p.p.m. for exposures from one to three weeks. The threshold of carbon dioxide toxicity to plants is in such excess of ambient conditions as to be completely unimportant. The hypothesis that the increasing concentration of carbon dioxide in the atmosphere might result in elevated global temperatures, however, has enormous implications for the health of forest ecosystems.

**I. Answer the following questions:**

1. What is organic chemistry. 2. Why are the scientists interested in the field of organic chemistry. 3. What does the name organic chemistry refer to? 4. When was the chemistry of carbon advanced'? 5. What phenomenon was found during the first half of the 19th century. 6. Where does carbon occur? 7. In that form does carbon occur in nature? 8. What gases does carbon form during its burning? 9. What properties of ca-bon monoxide do you know? 10. What properties of carbon dioxide do you know'? 11. What does carbon dioxide form combining with water? 12. What are very important atmospheric contaminants?

**II. Retell the text according to the following plan:**

1. Organic chemistry.

2. The chemistry of carbon.

3. Elementary carbon,

4. The properties of carbon.

5. Carbon monoxide.

6. Carbon dioxide.

7. Carbon pollutants.

# UNIT 8. FAMOUS CHEMISTS

## 8.1 D.I. Mendeleyev

D. I. Mendeleyev, the great Russian chemist, was born in Siberia on February 8, 1834. When seven years old he went to gymnasium in Tobolsk. He studied very hard, he especially liked mathematics, physics and history. At the age of 16 he entered the Pedagogical Institute in St. Petersburg, physico-mathematical department. He graduated from the Institute in 1855 and began to teach chemistry at the Technological Institute and then at the University In 1865 Mendeleyev was granted the Doctor of Science degree for the thesis on the combination of alcohol with water.

This work was both of great theoretical and practical significance. Soon after that D.I. Mendeleyev was appointed Professor of General Chemistry of St. Petersburg University. Despite lectures and supervision of the laboratory, D. I. Mendeleyev carried on great research work.

Mendeleyev's greatest discovery was the Period Law. The Periodic Law suggested by Mendeleyev stated that the properties of the elements were a periodic function of their atomic masses. He presented this work to the Russian Chemical Society.

Mendeleyev's Periodic Law opened a new era in the history of chemistry.

Mendeleyev was interested in many branches of science, indeed there is hardly any field of science that was not enriched by his contribution. His numerous works dealt with many subjects: properties of liquids, theories of solutions, the development of the gas law, the use of oil and many others, D. I. Mendeleyev was a great patriot. He did everything for the development and progress of his country.

D. I. Mendeleyev continued his research work to the very last day of his life. He died in 1907.

The world is thankful to Mendeleyev for his great contribution to the world science.

At present there is hardly anybody who doesn't know this Russian scientist and his Periodic Law. D I Mendeleyev did very much for his country, for the development of the world science.

**I. Answer the following questions:**

1. When was D. I. Mendeleyev born? 2. Where was he born'? 3. When did he go to gymnasium'? 4. What subjects did he like'? 5. What Institute did he enter? 6. Where did he work after the graduation from the Institute? 7. When was he granted the Doctor of Science degree? 8. What was he granted this degree for? 9. What was Mendeleyev's greatest discovery'? 10. What did he present to the Russian Chemical Society? 11. What other problems was Mendeleyev interested in? 12. What subjects did his numerous works deal with? 13. When did he die?

**II. Retell the text according to the following plan:**

1. D. I. Mendeleyev's childhood.

2. The gymnasium and the Pedagogical Institute.

3. D. I. Mendeleyev's work at the Technological Institute and at the Uniiversity.

4. His research work.

5. D. I. Mendeleyev's greatest discovery.

6. D. I. Mendeleyev's greatest contribution in science.

7. D. I. Mendeleyev is a great chemist and patriot.

**III. Task: 1) read the texts**

**2) answer the questions**

**3) make up a report about any famous chemist you like**

## 8.2 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?

## 8.3 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 this fund?