КАЗАХСКИЙ НАЦИОНАЛЬНЫЙ УНИВЕРСИТЕТ ИМ. АЛЬ-ФАРАБИ

Чтение и перевод
Англоязычных текстов химической отрасли

Учебное пособие для студентов
Химических специальностей

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Алматы 2011

Содержание

Введение

Цель учебного пособия – языковая адаптация к англоязычной профессиональной коммуникации путем развития и совершенствования речи в процессе чтения, перевода, аудирования аутентичных текстов химической отрасли.

Цель обучающего – создать на уроке такую атмосферу англоязычной химической коммуникации, чтобы обучающийся смог шаг за шагом осознавать особенности, трудности, проблемы двуязычного общения, двуязычного обучения, двуязычной деятельности в своей профессиональной среде.

Цель обучающегося – расширить границы своих профессиональных знаний, войдя в англоязычную химическую коммуникацию с достойными навыками англоязычной культурной речи, а именно: двуязычная современная химическая терминология, наиболее распространенная общеупотребительная лексика двуязычной химической коммуникацию.

Материал учебного пособия дает возможность студентам в процессе обучения английскому языку получить специальные химические сведения на английском языке с учетом языковых и терминологических особенностей англоязычной химической коммуникации, с учетом особенностей процесса обучения химии в англоязычных странах. Материал учебного пособия включает специальные химические тексты, которые имеют прямое отношение к тематике химических исследований, проводимых на химическом факультете КазНУ им. аль-Фараби.

Структура учебного пособия – традиционная для любого учебного процесса. 15 уроков содержат не только специальные химические тексты, но и включают задания в виде упражнений и вопросов на закрепление лексического языкового материала, на закрепление терминологических словосочетаний и их адекватный перевод в системе контактирующих языков. Предлагаемые задания способствуют развитию устной речи, письменной языковой грамотности, развитию языкового химического мышления. Материал учебного пособия подобран так, что отвечает современному уровню развития английского языка, современной химической терминологической системе знаний. Содержание специальных текстов соответствует образовательным и научным задачам химии настоящего времени, связаны как с теоретической химией, так и с практической химией. В учебном пособии приведены специальные тексты разных химических информационных источников: учебная, справочная литература, журнальные статьи зарубежных изданий. Изучив и проработав 15 уроков этого пособия, студент сможет поднять свой уровень знаний по английскому языку от уровня Intermediate до Upper-intermediate.

Lesson 1

Part 1

Should and Would

In scientific literature authors often use such verbs as “should” and “would”. “Should” has the meaning of obligation while “would” means the repetition of actions. “Should” is translated as “должен”. The meaning of would is rendered into Russian with the word “обычно”. E.g.: This solution should be heated at 700 K. – Этот раствор нужно нагревать при температуре 700 К. This solution would be heated at 700 K. – Этот раствор обычно нагревают при температуре 700 К.

Vocabulary
benzene – бензол
value - значение
to get acquainted – ознакомиться
viscosity - вязкость
vapour – пар
humidity – влажность
solution – раствор

Practice

Translate the following sentences paying attention to the verbs «would» and «should»

1. The halobenzenes should form a number of compounds.
2. He would test the device before putting it into service.
3. One should take this catalyst, not the old one.
4. Microwave determination dipole moments should be of a considerable reliance.
5. The temperature of the solution should be controlled.
6. It should be emphasized that the double bonds in the benzene ring are of inert character.
7. Viscosity would be expected to increase with intermolecular forces.
8. Should the value of p for ammonium ion be chosen as four or one ?
9. Expansion of solution would account only for 0.5 % change.
10. It would be highly desirable to have quantitative data involving kinetically controlled reactions.
11. This device should be tested.
12. These reactions would take place at high temperatures.
13. To understand this phenomenon you should get acquainted with the previous works devoted to this theme.
14. You should be very careful when you work with these reagents.

15. The instrument using such an element would not respond to the relative humidity.
16. Air saturated with water vapour at the temperature of 58^o F would contain 0.01 pound of water vapour per pound of dry air.

Part 2

Exercises 1. Read, translate and retell the text.

Carbon

Carbon is a non-metallic element that belongs to group 14 (formerly IV B) of the periodic table. Atomic number (a.n) is 6, relative atomic mass (r.a.m) is 12.011, melting point (m.p.) is ~ 3550^o C, boiling point (b.p.) is ~ 4827^oC. Carbon has three main allotropic forms.

Diamond occurs naturally and can be produced synthetically. It is extremely hard. The hardness of diamond results from the covalent crystal structure in which each carbon atom is linked by covalent bonds to four others that are situated at the corners of tetrahedron.

Graphite is a soft black slippery substance. It occurs naturally and can be produced by Acheson process. In graphite carbon atoms are arranged in layers where each carbon atom is surrounded by three others. The layers are held together by weak van der Waals' forces. Graphite is a good conductor of heat and electricity. It has variety of uses including electrical contacts, high-temperature equipment and solid lubricants. Graphite mixed with clay is the 'lead' in pencils. The third crystalline allotrope is fullerite.

There are several amorphous forms of carbon: carbon black and charcoal. There are two stable isotopes of carbon (proton numbers 12 and 13) and four radioactive isotopes (10, 11, 14, 15). Carbon -14 is used in carbon dating.

Carbon occurs in all organic compounds. So carbon is fundamental to the structure of all living organisms. It is an essential element for plants and animals. It is ultimately derived from atmospheric carbon dioxide. It is assimilated by plants during photosynthesis.

Carbon forms a large number of compounds due to its unique ability to form stable covalent bonds with other carbon atoms and with hydrogen, oxygen, nitrogen and sulfur atoms.

Also there is a phenomenon in chemistry that is closely connected with carbon. It is carbon assimilation. Carbon assimilation is the incorporation of carbon from atmospheric carbon dioxide into organic molecules. This process occurs during photosynthesis.

Vocabulary

carbon - углерод
atomic number (a.n) - атомный номер
relative atomic mass (r.a.m) - относительная атомная масса

melting point (m.p) - температура плавления
boiling point (b.p) - температура кипения
allotropic forms -аллотропические формы
diamond - алмаз
naturally - в природе
to occur - встречаться
to belong to - принадлежать
hard - твердый
compound - соединение
bond - связь
covalent bond - ковалентная связь
extremely - весьма
to link – связывать
to form - образовывать
to be situated - находиться
tetrahedron - тетраэдр
to arrange - располагать
layer - слой
to surround - окружать
conductor - проводник
high-temperature equipment - оборудование, предназначенное для работы в условиях высокой температуры
solid lubricant - смазывающий материал твердой консистенции
graphite - графит
soft - мягкий
slippery - скользкий
unique - уникальный
allotrope - аллотроп
fullerite - фуллерит
amorphous - аморфный
carbon black - технический углерод, газовая сажа, углеродная сажа, копоть
charcoal - древесный уголь
carbon dating (radiocarbon dating) - датирование радиоуглеродом (углеродная метка)
sulphur - сера
carbon assimilation - ассимиляция углерода
to assimilate - ассимилироваться
nitrogen - азот
to produce - получать, производить (промышленным, производственным способом)
to prepare - приготовить, получить (лабораторным способом)
to obtain - получить, получать (в лабораторных условиях)
to have variety of uses - использоваться в различных сферах

Exercise 2. Answer the following questions.

1. What is carbon?
2. How many allotropic forms does carbon have?
3. How can graphite be produced?
4. How are atoms arranged in graphite?
5. Where is graphite used?

Exercise 3. Put questions to the bold-typed words.

1. **Diamond** occurs **naturally**.
2. **Graphite** is a good conductor of **electricity**.

3. The hardness results from the **structure**.
4. The third crystalline allotrope is **fullerite**.
5. **Graphite** can be produced by **Acheson** process.
6. **Carbon** occurs in **organic** compounds.
7. **The layers** are held together by weak **van der Waals' forces.**
8. **Diamond** is extremely hard.
9. There are several **amorphous** forms of carbon: **carbon black and charcoal.**
10. **Carbon** forms a large number of compounds **because of its unique ability to form covalent bonds.**
11. **Graphite** has variety of uses including electrical contacts, high-temperature equipment and solid lubricants.
12. Graphite is a **soft black slippery** substance.

Exercise 4. Give the equivalents for the following words and make up sentences with them:

Boiling point, melting point, to hold together, to have variety of uses, high-temperature equipment, solid lubricants, nitrogen, sulphur, charcoal, to occur, layer, to arrange, amorphous, carbon black, carbon dating.

Exercise 5. Match the beginnings of the sentences and the endings.

1. Carbon is a	a) naturally.
2. Graphite is used in	b) by weak van der Waals' forces.
3. All metals have	c) non-metallic element .
4. There are two	d) the production of solid lubricants.
5. All layers are held	e) a unique ability to form covalent bonds.
6. Diamond occurs	f) allows defining the age of an archeological object.
7. Carbon dating	g) amorphous forms of carbon.
8. Carbon is	h) is the 'lead' in pencils.
9. Graphite mixed with clay	i) an essential element for all living organisms.

Exercise 6. Give the explanation for the following words: carbon, boiling point, melting point, graphite, diamond, conductor, equipment, charcoal, carbon black, carbon dating, covalent bond, fullerite.

Exercise 7. Put the following sentences into Passive.

1. We used carbon dating to define the age of this archeological finding.
2. Recently, we have bought new high-temperature equipment.

3. Our workers usually use carbon black in many industrial processes.
4. We have obtained two amorphous forms of carbon.
5. I will investigate this substance tomorrow.
6. How often do you use charcoal in your research?
7. We use graphite in many spheres.
8. We haven't measured the boiling point yet.
9. How did you determine the mass of this substance ?
10. Recently we have studied the properties of graphite.
11. Our researchers are developing a new method for graphite production now.
12. To produce good solid lubricants we usually use graphite.

Exercise 8. Put the words into the right order.

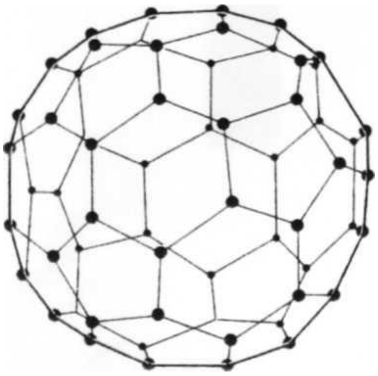
1. Is /conductor /a / electricity / heat / of / and / graphite / good.
2. Stable / two / there / isotopes / are.
3. Unique / to form / atoms / sulphur / carbon / forms / ability / a / number / large / compounds /of / because of / its / stable / bonds / covalent / with.
4. Results / covalent / hardness / from / structure / of / covalent / diamond / the /the.
5. Atom / is / to / other / linked / carbon / four / atoms/ each / situated / corners / tetrahedron / are / the / of / that / at.
6. Compounds / occurs / all / organic / in / carbon.
7. Can / produced / be / diamond/ synthetically.
8. Is / carbon / the / point / what / boiling / of ?
9. What / the / "charcoal" / your / of / term / understanding / is ?
10. Is / essential / for / animals / carbon / plants / for / an / element / and.
11. Is / graphite / in / solid / the / lubricants / used / production / of.

Texts for educational purposes

Buckminsterfullerene

Buckminsterfullerene is a form of carbon composed of clusters of 60 carbon atoms bonded together in a polyhedral structure composed of pentagons and hexagons. Originally it was identified in 1985 in the products obtained by firing a high-power laser at a graphite target. It can be made by an electric arc struck between graphite electrodes in an inert atmosphere. The molecule, C_{60}, was named after the US architect Richard Buckminster Fuller (1895-1983) because of the resemblance of the structure to the geodesic dome, which Fuller invented. The molecules are informally called buckyballs, more formally, the substance is called fullerene. The substance is a yellow crystalline solid (fullerite), which is soluble in benzene.

Various fullerene derivatives are known in which organic groups are attached to carbon atoms on the sphere. In addition, it is possible to produce novel enclosure compounds by trapping metal ions within the cage. Some of these have semiconducting properties. The electric-arc method of producing also leads to a smaller number of fullerenes such as C_{70}, which have less symmetrical molecular structures. It is also possible to produce forms of carbon in which the atoms are linked in a cylindrical, rather than spherical framework with a diameter of a few nanometers. They are known as buckytubes (or nanotubes).



Buckminster fullerene

Inorganic compounds of carbon

Carbon dioxide is a colourless odourless gas, CO_2, soluble in water, ethanol and acetone. Density (d.) is 1.977 g / dm ^{3} (0 ^oC); m.p. is -56.6 ^{o} C; b.p. is -78.5 ^{o} C. It occurs in the atmosphere (0.04% by volume), but has a short residence time in this phase. It is both consumed by plants during photosynthesis and produced by respiration and combustion. It is readily prepared in the laboratory by the action of dilute acids on metal carbonates or the action of heat on heavy-metal carbonates. Carbon dioxide is a by-product from the manufacture of lime and from fermentation processes. Carbon dioxide has a small liquid range. Liquid carbon dioxide is produced only at high pressures. The molecule CO_2 is linear with each oxygen making a double bond to carbon. Chemically, it is not reactive and will not support combustion. It dissolves in water to give carbonic acid.

Large quantities of solid carbon dioxide (dry ice) are used in processes requiring large-scale refrigeration. It is also used in fire extinguishers as a desirable alternative to water for most fires and as a constituent of medical gases as it promotes exhalation. It is also used in carbonated drinks.

The level of carbon dioxide in the atmosphere has increased by some 12% in the last 100 years, mainly because of extensive burning of fossil fuels and the destruction of large areas of rain forest. This has been postulated as the main cause of the average increase of 0.5°C in global temperatures over the same period, through the greenhouse effect. Steps are now being taken to prevent further increases in atmospheric CO_2 concentration and subsequent global warming.

Carbon monoxide is a colourless odourless gas, CO, sparingly soluble in water and soluble in ethanol and benzene. Density is 1.25 g dm^{-3} (0 ^{o} C); m.p. is -199^{o} C; b.p. is -191.5 ^{o} C. It is flammable and highly toxic. In the laboratory it can be made by the dehydration of methanoic acid (formic acid) using concentrated sulphuric acid. Industrially it is produced by the oxidation of natural gas (methane) or by the water-gas reaction. It is formed by the incomplete combustion of carbon and is present in car-exhaust gases.

It is a neutral oxide which burns in air to give carbon dioxide and is a good reducing agent, used in a number of metallurgical processes. It has the interesting chemical property of forming a range of transition metal carbonyls, e.g. $Ni(CO)_4$. Carbon monoxide is able to use vacant p-orbitals in bonding with metals. The stabilization of low oxidation states, including the zero state, is a consequence of this. This also accounts for its toxicity which is due to the binding of the CO to the iron in haemoglobin, thereby blocking the uptake of oxygen.

Carbonic acid is a dibasic acid, H_2CO_3, formed in solution when carbon dioxide is dissolved in water:

$CO_2(aq) + H_2O(1) = H_2CO_3(aq)$.

The acid is in equilibrium with dissolved carbon dioxide and also dissociates as follows:

$H_2 CO_3 = H^+ + HCO^-_3$

$K_d = 4.5 \times 10^{-7}$ mol dm^{-3}

$HCO_3^- = CO_3^{2-} + H^+$

$K_d = 4.8 \times 10^{-11}$ mol dm^{-3}.

The pure acid cannot be isolated, although it can be produced in ether solution at 30°C. Carbonic acid gives rise to two series of salts: the carbonates and the hydrogencarbonates.

Carbon disulphide (carbon bisulphide) is a colourless highly refractive liquid, CS_2, slightly soluble in water and soluble in ethanol and ether. Relative density (r.d.) is 1.261; m.p. is -110 ° C; b.p. is 46.3^{o} C. Pure carbon disulphide has an ethereal odour but the commercial product is contaminated with a variety of other sulphur compounds and has a very unpleasant smell. It was previously manufactured by heating a mixture of wood, sulphur and charcoal. Modern processes use natural gas and sulphur. Carbon disulphide is an excellent solvent for oils, waxes, rubber, sulphur and phosphorus, but its use is decreasing because of its high toxicity and its flammability. It is used for the preparation of xanthates in the manufacture of viscose yarns.

Carbide is any of various compounds of carbon with metals or other more electropositive elements. True carbides contain the ion C^{4-} as in $A1_4C_3$. These are saltlike compounds giving methane on hydrolysis. They were formerly called methanides. Compounds containing the ion C_2^{2-} are also saltlike and are known as dicarbides. They yield ethyne (acetylene) on hydrolysis. They were formerly called acetylides. The above types of compound are ionic but have partially covalent bond character, but boron and silicon form true covalent carbides, with giant molecular structures. In addition, the transition metals form a range of interstitial carbides in which the carbon atoms occupy interstitial positions in the metal lattice. These substances are generally hard materials with metallic conductivity. Some transition metals (e.g. Cr, Mn, Fe, Co and Ni) have atomic radii that are too small to allow individual carbon atoms in the interstitial holes. These form carbides in which the metal lattice is distorted and chains of carbon atoms exist (e.g. Cr_3C_2, Fe_3C, W_2C). Such compounds are intermediate in character between interstitial carbides and ionic carbides. They give mixtures of hydrocarbons on hydrolysis with water or acids.

Organic compounds of carbon

Carbonium ion (carbenium ion) is an organic ion with a positive charge on a carbon atom; i.e. it is an ion of the type R_3C^+. Carbonium ions are intermediates in certain types of organic reaction (e.g. Williamson's synthesis). Certain fairly stable carbonium ions can be formed (carbocations). Carbonium ions can be prepared from an alkyl fluoride and a superacid, such as antimony pentafluoride (SbF_5) at low temperature. Carbonium atoms always have a strong affinity for such nucleophiles as water.

Carbanion is an organic ion with a negative charge on a carbon atom; i.e. it is an ion of the type R_3C^- . Carbanions are intermediates in certain types of organic reaction (e.g. the aldol reaction).

Carbonyl group is the group >C=O, found in aldehydes, ketones, carboxylic acids, amides. Carboxyl group is the organic group -COOH, present in carboxylic acids.

Carbonyl compound is a compound containing the carbonyl group >C=O. Aldehydes, ketones and carboxylic acids are examples of organic carbonyl compounds. Inorganic carbonyls are complexes in which carbon monoxide has coordinated to a metal atom or ion, as in nickel carbonyl, $Ni(CO)_4$.Carbonyl chloride (phosgene) is a colourless gas, $COCl_2$, with an odour of freshly cut hay. It is used in organic chemistry as a chlorinating agent and was formerly used as a war gas.

Carboxylic acids are organic compounds containing the group -COOH (the carboxyl group; i.e. a carbonyl group attached to a hydroxyl group). In systematic chemical nomenclature carboxylic-acid names end in the suffix -oic, e.g. ethanoic acid, CH_3COOH. They are generally weak acids. Many long-chain carboxylic acids occur naturally as esters in fats and oils and are therefore also known as fatty acids. Methanoic acid (formic acid) is a colourless pungent liquid, HCOOH; r.d. is 1.2; m.p. is 8°C; b.p. is 101°C. It can be made by the action of concentrated sulphuric acid on the sodium salt (sodium methanoate) and occurs naturally in ants and stinging nettles. Methanoic acid is the simplest of the carboxylic acids.

Carbene is a species of the type R_2C:, in which the carbon atom has two electrons that do not form bonds. Methylene, $:CH_2$, is the simplest example. Carbenes are highly reactive and exist only as transient intermediates in certain organic reactions. They attack double bonds to give cyclopropane derivatives. They also cause insertion reactions, in which the carbene group is inserted between the carbon and hydrogen atoms of a C-H bond:

$C\text{-}H + :CR_2 \rightarrow C\text{-}CR_2\text{-}H$.

Alcohols are organic compounds that contain the -OH group. In systematic chemical nomenclature alcohol names end in the suffix -ol. Examples are methanol, CH_3OH, and ethanol, C_2H_5OH. Primary alcohols have two hydrogen atoms on the carbon joined to the -OH group (i.e. they contain the group $-CH_2-OH$). Secondary alcohols have one hydrogen on this carbon (the other two bonds being to carbon atoms, as in $(CH_3)_2CHOH$). Tertiary alcohols have no hydrogen on this carbon (as in$(CH_3)_3$ COH). The different types of alcohols may differ in the way they react chemically. For example, with potassium dichromate (VI) in sulphuric acid the following reactions occur:

primary alcohol → aldehyde → carboxylic acid
secondary alcohol→ ketone
tertiary alcohol - no reaction.

Other characteristics of alcohols are reaction with acids to give esters and dehydration to give alkenes or ethers. Alcohols that have two -OH groups in their molecules are diols (or dihydric alcohols), those with three are triols (or trihydric alcohols). Methanol (methyl alcohol) is a colourless liquid, CH_3OH; r.d. is 0.79; m.p. is -93.9°C; b.p. is 64.96°C. It is made by catalytic oxidation of methane (from natural gas) using air. Methanol is used as a solvent and as a raw material for making methanal (mainly for urea-formaldehyde resins). It was formerly made by the dry distillation of wood (hence the name wood alcohol).

Aldehydes are organic compounds that contain the group -CHO (the aldehyde group; i.e. a carbonyl group (C=O) with a hydrogen atom bound to the carbon atom). In systematic chemical nomenclature, aldehyde names end with the suffix -al. Examples of aldehydes are methanal (formaldehyde), HCOH, and ethanal (acetaldehyde), CH_3CHO. Aldehydes are formed by oxidation of primary alcohols. Further oxidation yields carboxylic acids. They are reducing agents and tests for aldehydes include Fehling's test and Tollens reagent. Aldehydes have certain characteristic addition and condensation reactions. With sodium hydrogensulphate (IV) they form addition compounds of the type $[RCOH(SO_3)H]^- Na^+$. Formerly these were known as bisulphite addition compounds**.** They also form addition compounds with hydrogen cyanide to give cyanohydrins and with alcohols to give acetals and undergo condensation reactions to yield oximes, hydrazones and semicarbazones. Aldehydes readily polymerize.

Methane is a colourless odourless gas, CH_4; m.p. is -182.5°C; b.p. is -164°C. Methane is the simplest hydrocarbon, being the first member of the alkane series. It is the main constituent of natural gas (-99%) and is an important raw material for producing other organic compounds. It can be converted into methanol by catalytic oxidation.

Benzene is a colourless liquid hydrocarbon, C_6H_6; r.d. is 0.88; m.p. is 5.5°C; b.p. is 80.1°C. It is now made from gasoline and from petroleum by catalytic reforming (formerly obtained from coal tar). Benzene is the archetypal aromatic compound. It has an unsaturated molecule, yet will not readily undergo addition reactions. On the other hand, it does undergo substitution reactions in which hydrogen atoms are replaced by other atoms or groups. This behaviour occurs because of delocalization of p-electrons over the benzene ring and all the C-C bonds in benzene are equivalent and intermediate in length between single and double bonds. It can be regarded as a resonance hybrid of Kekule and Dewar structures. In formulae it can be represented by a hexagon with a ring inside it.

Texts from scientific articles

Journal: Biomaterials

Mesoporous carbide-derived carbon with porosity tuned for efficient adsorption of cytokines

Abstract

Porous carbons can be used for the purification of various bio-fluids , including the cleansing blood of inflammatory mediators in conditions such as sepsis or auto-immune diseases. Here we show that the control of pore size in carbons is a key factor to achieving efficient removal of cytokines. In particular, the surface area accessible by the protein governs the rate and effectiveness of the adsorption process. We demonstrate that novel mesoporous carbon synthesized from ternary MAX-phase carbides can be optimized for efficient adsorption of large inflammatory proteins. The synthesized carbons, having tunable pore size with a large volume of slit-shaped mesopores, outperformed all other materials or method in terms of efficiency of TFN - α removal and the results are comparable only with highly specific antibody-antigen interactions.

Introduction.

Activated carbons (AC), known for over 3000 years, still remain the most powerful conventional adsorbents, mainly due to their highly developed porous structure and these experiments carbide derived carbons (CDCs) outperformed any other materials or method for the efficient removal of TFN - α and the results are comparable only to highly specific antibody-antigen interactions.

Adsorption of the smaller cytokine IL-6 by most of the studied carbons was noticeably higher, but demonstrated similar trends. Strictly microporous Adsorba 300^{o} C was clearly inefficient. However, CDCs prepared at 600 ^{o} C having a limited amount of mesopores (pores 2-50 nm), adsorbed 66-77 % of the cytokines initially present in the solution for 1 hr. The CDCs produced at 1200 ^{o} C demonstrated 97-98.5 % adsorption which is comparable with the CXV samples, capable of adsorbing ~99% . The CDCs prepared from Ti_2AlC at 800 ^{o} C having the most developed mesoporosity decreased IL-6 concentration by ~99.8 %; the remaining IL-6 was close to the detection limit of ELISA used.

Lesson 2

Part 1

Attributive chains (AC)

Attributive chains are compound phrases which consist of two or more nouns connecting logically with each other where the preposition «of» is absent. E.g.:
the reaction of catalysis - catalysis reaction
the solution of benzene - benzene solution.

As all compound phrases are formed in scientific literature with the help of genitive case (родительный падеж), most authors prefer to use attributive chains. To avoid the frequent repetition of the preposition «of» authors omit this preposition by transferring the word which must be after the preposition «of» at the beginning of a phrase. Let’s consider this process on the following example. At first we will translate all the words:

Горение жидкости ацетилена:
горение - combustion
жидкость - liquid
ацетилен - acetylene.

Now let’s translate this phrase using the preposition «of»: горение жидкости ацетилена - the combustion of the liquid of acetylene. Here we can see two prepositions «of». Such kind of phrase is not good for English style. To get rid (избавиться) of the excessive (чрезмерный) use of the preposition «of» we should put the word «acetylene» at the beginning. The word «acetylene» will be the first. Then after the word «acetylene» we must put the word «liquid». It will be the second word. And finally the word «combustion» will be the last one in this phrase. As a result we have the following word combination: acetylene liquid combustion.

Now let’s consider the translation of AC from English into Russian on the following example: magnesium oxide melting point.

At first of all we will translate all the words in this phrase:
magnesium - магний
oxide - оксид
melting point - температура плавления.

When we translate from English into Russian we should start our translation from the last word. The first word will be **melting point** - температура плавления, the second word will be **oxide** - оксид and the last word will be **magnesium** - магний and finally we will have the following phrase: температура плавления оксида магния.

Vocabulary:

to proceed - проходить, протекать
toluene - толуол
well - скважина
commercial - производственный
hydrocarbon - углеводород
data - данные
reduction - восстановление

Practice

Translate the following sentences paying attention to the translation of the compound phrases:

1. We have obtained catalysis original data.
2. Silicon oxidation technique was successfully tested by researches last year.
3. Heavy hydrocarbon fuel has been added into this device.
4. Last time toluene reduction proceeded very slowly.
5. Commercial well drilling has opened a new era in petrochemistry.
6. Hydrogen oxide is the lightest compound in chemistry.
7. Benzene is a strong solvent.
8. Last year we developed a new combustion technique.
9. Toluene oxidation process has taken place at 40 K.
10. A new toluene production procedure was developed two years ago.
11. The detection method developed by Lovelock is widely-used by us.
12. Present - day theories attempt to explain this phenomenon.
13. Benzene structure analysis has been carried out by us.
14. The researchers couldn’t determine the soot yield.
15. Unfortunately, we haven’t obtained the analysis data yet.
16. We have used terbium oxide to obtain this substance.

Part 2

Exercise 1. Read, translate and retell the text.

Alkali Metals

Alkali metals are the elements of group 1 (formerly IA) of the periodic table: lithium (Li), sodium (Na), potassium (K), rubidium (Rb), cesium (Cs) and francium (Fr). All have a characteristic electron configuration that is a noble gas structure with one outer s-electron. They are typical metals (in the chemical sense) and readily lose their outer electron to form stable M ions with noble-gas configurations. All are highly reactive, with the reactivity (i.e. metallic character) that increases down the group. There is a decrease in ionization energy from lithium to cesium. The second ionization energies are much higher and divalent ions are not formed. Other properties also change down the group. Thus, there is an increase in atomic and ionic radius, an increase in density and a decrease in melting and boiling points. The standard electrode potentials are low and negative, although they do not show a regular trend because they depend both on ionization energy (which decreases down the group) and the hydration energy of the ions (which increases). All the elements react with water (lithium slowly; the others violently) and tarnish rapidly in air. They can all be made to react with chlorine, bromine, sulphur and hydrogen. The hydroxides of the alkali metals are strongly alkaline (hence the name) and do not decompose on heating. The salts are generally soluble. The carbonates do not decompose on heating, except at very high temperatures. The nitrates (except for lithium) decompose to give the nitrite and oxygen:

$$2MNO_3(s) \rightarrow 2MNO_2(s) + O_2(g).$$

Lithium nitrate decomposes to the oxide. In fact lithium shows a number of dissimilarities to the other members of group 1 and in many ways it resembles magnesium. Lithium is widely-used in batteries and also as a potential tritium source for fusion research. On heating it reacts with nitrogen and oxygen. In general, the stability of the salts of oxo acids increases down the group (i.e. with increasing size of the M^4 ion). This trend occurs because the smaller cations (at the top of the group) tend to polarize the oxo anions more effectively than the larger cations at the bottom of the group.

Vocabulary

alkali metals - щелочные металлы
lithium - литий
potassium - калий
rubidium - рубидий
cesium - цезий
francium - франций
noble gas - благородный газ
ionization - ионизация
reactive - реакционно-способный, химически активный
reactivity - реакционная способность
dissimilarity - различие
divalent ion - двухвалентный ион
to tarnish - вызывать потускнение
standard electrode potentials - стандартные электродные потенциалы
chlorine - хлор
bromine - бром
to decompose - разлагаться
to resemble - быть похожим
magnesium - магний
heating - нагревание
cation - катион
anion - анион
to polarize – поляризовать(-ся)
nitric acid - азотная кислота

Exercise 2. Answer the following questions.

1. What elements belong to alkali metals?
2. Why do alkali metals readily lose their outer electron?
3. What substances do alkali metals react with and where do they tarnish?
4. Why don't alkali metals show a regular trend?
5. What substance does lithium nitrate decompose to?

Exercise 3. Put questions to the bold-typed words.

1. **Alkali metals** can all be made to react with **chlorine.**
2. **Lithium (Li)** is an alkali metal**.**
3. **The standard electrode** potentials are low and negative**.**
4. **Salts** are generally soluble.
5. **The nitrates (**except for lithium) **decompose** to give **the nitrite**.
6. The **carbonates** do not decompose on **heating.**
7. There is a decrease in ionization energy **from lithium to cesium.**
8. In fact **lithium** shows a number of dissimilarities to the other members of group 1.
9. **The smaller cations** tend to polarize the **oxo anions**.
10. **The second** ionization energies are much higher.
11. Ionization energy **decreases** from lithium to cesium.
12. **Other properties** also change **down the group.**

Exercise 4. Give the equivalents for the following words and make up sentences with them: alkali metals, lithium, sodium, potassium, rubidium, cesium, francium, noble gas, ionization, reactive, to decompose, to resemble, magnesium, heating, carbonate, cation anion, to polarize.

Exercise 5. Match the following words with the correct definitions.

1. Nitric acid is a) poisonous and harmful to people and animals.
2. Natural gas is b) a colourless acid that can destroy substances and used to make explosives.
3. Oil pollution is c) gas consisting of methane and other hydrocarbon gases that are found underground and used for heating and cooking.
4. Sulfuric acid is d) a strong acid that has no color and can harm flesh. Chemical formula is H_2SO_4.
5. Toxic means e) a pollution caused by oil.
6. Boiling point is f) a point at which liquid boils.
7. Phenol is g) a poisonous white chemical compound. When dissolved in water it is used as an antiseptic.
8. Sodium is h) a process for producing ions.
9. Ionization is i) a soft, silvery-white metal that is found naturally only in compounds, such as salt.

Exercise 6.

a) Fill the gaps with an appropriate word and translate the text: bonds, molecule, energy, bond, to form, electrons, covalent, valence, configuration, atoms, to give, gas.

Chemical bond

Chemical bond is a strong force of attraction that connects atoms in a … or crystal. Usually chemical bonds have …. that is equal to 10000 kJmol $^{-1}$. There are two types of chemical … . The first type is ionic … . Transfer of electrons … ionic bond. For instance, calcium atom has electron configuration of [Ar] 4s^{2}. It has two electrons in outer shell. The electron … of chlorine atom is [Ne] 3s^{2}3p^{5} with seven outer electrons. If calcium atom transfers two …. to chlorine atom it becomes Ca^{2+} ion with stable configuration of inert … . … electrons form covalent bond. … bond is a bond where one of the atoms supplies two electrons. For instance, hydrogen … have one outer electron. In hydrogen molecule H_2 each atom … one electron to the bond. So, hydrogen atom controls two electrons. In water molecule H_2O oxygen atom with six outer electrons controls an extra two electrons which hydrogen atoms supply. Similarly, hydrogen atoms gain control of an extra electron from oxygen.

Notes to the text:

chemical bond – химическая связь
force - сила
attraction - притяжение
electron transfer – перенос электронов
to be equal to - равняться
outer - внешний
shell - оболочка
for instance -например
inert gas - инертный газ
to gain control of - получать контроль над
to supply - давать, обеспечивать

b) Grammar and spelling quiz: find and correct the mistakes in the following sentences:

1. Are alkali metals elements to an group 1 (formerly IA) with pireodec tabl: lithum (Li), sadium (Na), potasium (K), rubium (Rb), cesiem (Cs) and franceum (Fr).
2. Decomposes nitrate lithim wth the oxide.
3. All is high reactive.
4. Are the salts soluble gebneraly.
5. Nitrates decomoposes to give thee oxide.
6. In fact lithum show a number of dissimilarities.

c) Chemical quiz: Are these sentences true or false?:

1. Na is a non-metal.
2. Alkaline-earth metals and alkali metals are similar.
3. Graphite is a metal.
4. The boiling point of carbon is 43 ^{o} C.
5. Chemical bond is a connection between two chemical elements.

6. Hydrogen atoms controls one molecule.

Exercise 7. Put the prepositions into the gaps, some prepositions can be used 2-3 times: down, with, of, in, on, at, to, of.

1. All the elements react … water (lithium slowly; the others violently) and tarnish rapidly … air.
2. They can all be made to react … chlorine, bromine, sulphur, and hydrogen.
3. The hydroxides … the alkali metals are strongly alkaline and do not decompose … heating.
4. The carbonates decompose … high temperatures.
5. The energy …..chemical bond is equal … 10000 kJ/mol.
6. The stability of the salts of oxo acids increases … the group.
7. This phenomenon can be observed only … high pressure.
8. One can see an increase … atomic and ionic radius.
9. The standard electrode potentials depend … ionization energy.
10. The larger cations … the bottom … the group tend to polarize less effectively than smaller ones.
11. … fact lithium shows a number … dissimilarities … the other members of group 1.

Exercise 8.

a) Describe any alkali element on the following plan:

1. boiling point;
2. melting point;
3. atomic number;
4. relative density;
5. valence;
6. Is it a metal or non-metal ?;
7. What group does it belong to?;
8. colour;
9. odour;
10. Where is it used?;
11. What substances does it react with?;
12. What chemical compounds does it have?.

b) Choose any two alkali elements and compare them on the following plan using comparative and superlative degree:

1. melting point;
2. boiling point;
3. relative density;
4. atomic and ionic radius;
5. relative atomic mass

Texts for educational purposes

Clay and its minerals

Clay is a fine-grained deposit consisting chiefly of clay minerals. It is characteristically plastic and virtually impermeable when wet and cracks when it dries out. In geology the size of the constituent particles is usually taken to be less than 1/256 mm. In soil science clay is regarded as a soil with particles less than 0.002 mm in size.

Clay minerals are very small particles, chiefly hydrous silicates of aluminium, sometimes with magnesium and/or iron substituting for all or part of the aluminium, that are the major constituents of clay materials. The particles are essentially crystalline (either platy or fibrous) with a layered structure, but may be amorphous or metalloidal. The clay minerals are responsible for the plastic properties of clay; the particles have the property of being able to hold water. The chief groups of clay minerals are: $Al_4Si_4O_{10}(OH)_8$, the chief constituent of kaolin; halloysite, kaolinite, $Al_4Si_4(OH)_8O_{I0}.4H_2O$; illite, $KAl_4(SiAl)_8\ O_{18}.2H_2O$; montmorillonite, $(Na,Ca)_{0.33}(Al,Mg)_2Si_4O_{10}(OH)_2.nH_2O$, formed chiefly through alteration of volcanic ash; and vermiculite, $(Mg,Fe,Al)_3(Al,Si)_4O_{10}(OH)_2.4H_2O$, used as an insulating material and potting soil.

Potassium and its compounds

Potassium is a soft silvery metallic element belonging to group 1 (formerly IA) of the periodic table**;** a.n. is 19; r.a.m. is 39.098; r.d. is 0.86; m.p. is 63.7°C; b.p. is 774°C. The element occurs in seawater and in a number of minerals, such as sylvite (KC1), carnallite ($KCl.MgCl_2.6H_2O$), and kainite ($MgSO_4.KC1_2.6H_2O$). It is obtained by electrolysis. The metal has few uses but potassium salts are used for a wide range of applications. Potassium is an essential element for living organisms. The potassium ion, K^+, is the most abundant cation in plant tissues, being absorbed through the roots and being used in such processes as protein synthesis. In animals the passage of potassium and sodium ions across the nerve-cell membrane is responsible for the changes of electrical potential that accompany the transmission of impulses. Chemically, it is highly reactive, resembling sodium in its behaviour and compounds. It also forms an orange-coloured superoxide, KO_2, which contains the O_2^- ion. Potassium was discovered by Sir Humphry Davy in 1807.

Potassium bromide is a white or colourless crystalline solid, KBr, slightly hygroscopic and soluble in water and very slightly soluble in ethanol. Its shape is cubic; r.d. is 2.75; m.p. is 734°C; b.p. is 1435°C. Potassium bromide may be prepared by the action of bromine on hot potassium hydroxide solution or by the action of iron (III) bromide or hydrogen bromide on potassium carbonate solution. It is used widely in the photographic industry and is also used as a sedative. Because of its range of transparency to infrared radiation, KBr is used both as a matrix for solid samples and as a prism material in infrared spectroscopy.

Potassium carbonate (pearl ash; potash) is a translucent (granular) or white (powder) deliquescent solid known in the anhydrous and hydrated forms. K_2CO_3 (monoclinic; r.d. is 2.4; m.p. is 891°C) decomposes without boiling. $2K_2CO_3.3H_2O$ (monoclinic; r.d. is 2.04) dehydrates to $K_2CO_3.H_2O$ above 100°C and to K_2CO_3 above 130^o C. It is prepared by the Engel-Precht process in which potassium chloride and magnesium oxide react with carbon dioxide to give the compound Engel's salt, $MgCO_3.KHCo_3.4H_2O$. It decomposes in solution to give the hydrogencarbonate, which can then be calcined to K_2CO_3. Potassium carbonate is soluble in water (insoluble in alcohol) with significant hydrolysis to produce basic solutions. Industrial uses include glasses and glazes, the manufacture of soft soaps. It is used also in laboratory as a drying agent.

Potassium chlorate is a colourless crystalline compound, $KCIO_3$, which is soluble in water and moderately soluble in ethanol; monoclinic; r.d. is 2.32; m.p. is 356°C. It decomposes above 400°C giving off oxygen. The industrial route to potassium chlorate involves the fractional crystallization of a solution of potassium chloride and sodium chlorate but it may also be prepared by electrolysis of hot concentrated solutions of potassium chloride. It is a powerful oxidizing agent finding applications in weedkillers and disinfectants. Due to its ability to produce oxygen it is used in explosives, pyrotechnics and matches.

Potassium chloride is a white crystalline solid, KC1, which is soluble in water and very slightly soluble in ethanol; its shape is cubic; r.d. is 1.98; m.p. is 772°C. It sublimes at 1500°C. Potassium chloride occurs naturally as the mineral sylvite (KC1) and as carnallite ($KCl.MgCl_2.6H_2O$). It is produced industrially by fractional crystallization of these deposits or of solutions from lake brines. It has the interesting property of being more soluble than sodium chloride in hot water but less soluble in cold. It is used as a fertilizer, in photography and as a source of other potassium salts such as the chlorate and the hydroxide. It has low toxicity.

Potassium chromate is a bright yellow crystalline solid, K_2CrO_4, soluble in water and insoluble in alcohol. Its shape is rhombic; r.d. is 2.73; m.p. is 968.3°C. It decomposes without boiling. It is produced industrially by roasting powdered chromite ore with potassium hydroxide and limestone and by leaching the resulting cinder with hot potassium sulphate solution. Potassium chromate is used in leather finishing as a textile mordant and in enamels and pigments. In the laboratory it is used as an analytical reagent and as an indicator. Like other chromium (III) compounds it is toxic when ingested or inhaled.

Potassium chromium sulphate (chrome alum) is a violet or ruby-red crystalline solid, $K_2SO_4.Cr_2(SO_4)_3.24H_2O$, that is soluble in water and insoluble in ethanol. Its shape is cubic or octahedral; r.d. is 1.826; m.p. is 89°C. It loses $10H_2O$ at 100°C, $12H_2O$ at 400°C. Six water molecules surround each of the chromium (III) ions and the remaining ones are hydrogen bonded to the sulphate ions. Like all alums, the compound may be prepared by mixing equimolar quantities of the constituent sulphates.

Potassium dichromate (potassium bichromate) is an orange-red crystalline solid, K_2Cr_207, soluble in water and insoluble in alcohol. It is monoclinic or triclinic; r.d. is 2.68. Monoclinic changes to triclinic at 241.6°C; m.p. is 396°C. It decomposes above 500°C. It is prepared by acidification of crude potassium chromate solution (the addition of a base to solutions of potassium dichromate reverses this process). The compound is used industrially as an oxidizing agent in the chemical industry and in dyestuffs manufacture, in electroplating, pyrotechnics, glass manufacture, glues, tanning, photography and lithography and in ceramic products. Laboratory uses include application as an analytical reagent and as an oxidizing agent. Potassium dichromate is toxic and considered a fire risk on account of its oxidizing properties.

Potassium hydrogencarbonate (potassium bicarbonate) is a white crystalline solid, $KHCO_3$, soluble in water and insoluble in ethanol; r.d. 2.17. It decomposes at about 120°C. It occurs naturally as calcinite and is prepared by passing carbon dioxide into saturated potassium carbonate solution. It is used in baking, soft-drinks manufacture and in CO_2 fire extinguishers. Because of its buffering capacity it is added to some detergents and also used as a laboratory reagent.

Potassium hydrogentartrate (cream of tartar) is a white crystalline acid salt, $HOOC(CHOH)_2COOK$. It is obtained from deposits on wine vats (argol) and used in baking powders.

Potassium hydroxide (caustic potash; lye) is a white deliquescent solid, KOH, often sold as pellets, flakes, or sticks, soluble in water and in ethanol and very slightly soluble in ether. Its shape is rhombic; r.d. is 2.044; m.p. is 360.4°C; b.p. is 1320°C. It is prepared industrially by the electrolysis of concentrated potassium chloride solution but it can also be made by heating potassium carbonate or sulphate with slaked lime, $Ca(OH)_2$. It closely resembles sodium hydroxide but is more soluble and is therefore preferred as an absorber for carbon dioxide and sulphur dioxide. It is also used in the manufacture of soft soap, other potassium salts and in Ni-Fe and alkaline storage cells. Potassium hydroxide is extremely corrosive to body tissues and especially damaging to the eyes.

Potassium iodate is a white crystalline solid, KIO_3, soluble in water and insoluble in ethanol. It is monoclinic; r.d. is 3.9: m.p. is 560°C. It may be prepared by the reaction of iodine with hot concentrated potassium hydroxide or by careful electrolysis of potassium iodide solution. It is an oxidizing agent and is used as an analytical reagent. Some potassium iodate is used as a food additive.

Potassium iodide is a white crystalline solid, KI, with a strong bitter taste, soluble in water, ethanol, and acetone. Its shape is cubic; r.d. is 3.13; m.p. is 681°C; b.p. is 1330°C. It may be prepared by the reaction of iodine with hot potassium hydroxide solution followed by separation from the iodate (which is also formed) by fractional crystallization. In solution it has the interesting property of dissolving iodine to form the triiodide ion I_3^-, which is brown. Potassium iodide is widely used as an analytical reagent, in photography and also as an additive to table salt to prevent goitre and other disorders due to iodine deficiency.

Potassium manganate (VII) (potassium permanganate) is a compound, $KMnO_4$, forming purple crystals with a metallic sheen, soluble in water (intense purple solution), acetone and methanol but it is decomposed by ethanol; r.d. is 2.70. Decomposition is slightly above 100°C and is complete at 240°C. The compound is prepared by fusing manganese (IV) oxide with potassium hydroxide to form the manganate and electrolysing the manganate solution using iron electrodes at about 60°C. An alternative route employs production of sodium manganate by a similar fusion process, oxidation with chlorine and sulphuric acid, then treatment with potassium chloride to crystallize the required product.

Potassium manganate (VII) is widely used as an oxidizing agent and as a disinfectant in a variety of applications and as an analytical reagent.

Potassium monoxide is a grey crystalline solid, K_2O. Its shape is cubic; r.d. is 2.32. Decomposition occurs at 350°C. It may be prepared by the oxidation of potassium metal with potassium nitrate. It reacts with ethanol to form potassium ethoxide (KOC_2H_5) and with liquid ammonia to form potassium hydroxide and potassamide (KNH_2).

Potassium nitrate (saltpetre) is a colourless rhombohedral or trigonal solid, KNO_3, soluble in water, insoluble in alcohol; r.d. is 2.109. Transition to trigonal forms at 129°C; m.p. is 334°C. It decomposes at 400°C. It occurs naturally as nitre and may be prepared by the reaction of sodium nitrate with potassium chloride followed by fractional crystallization. It is a powerful oxidizing agent (releases oxygen on heating) and is used in gunpowder and fertilizers.

Potassium nitrite is a white or slightly yellow deliquescent solid, KNO_2, soluble in water and insoluble in ethanol; r.d. is 1.91; m.p. is 440°C. It may explode at 600°C. Potassium nitrite is prepared by the reduction of potassium nitrate. It reacts with cold dilute mineral acids to give nitrous acid and is also able to behave as a reducing agent (if oxidized to the nitrate) or as an oxidizing agent (if reduced to nitrogen). It is used in organic synthesis because of its part in diazotization and in detecting the presence of the amino groups in organic compounds.

Potassium sulphate is a white crystalline powder, K_2SO_4, soluble in water and insoluble in ethanol. Its shape is rhombic or hexagonal; r.d. is 2.66; m.p. is 1069°C. It occurs naturally as schonite (Strassfurt deposits) and in lake brines from which it is separated by fractional crystallization. It has also been produced by the Hargreaves process which involves the oxidation of potassium chloride with sulphuric acid. In the laboratory it may be obtained by the reaction of either potassium hydroxide or potassium carbonate with sulphuric acid. Potassium sulphate is used in cements, in glass manufacture, as a food additive and as a fertilizer (source of K^+) for chloride-sensitive plants, such as tobacco and citrus.

Lesson 3

Part 1

Ways of the Translation of Passive Voice

There are a few ways of the translation of the passive voice. They are the following:

1. passive voice can be translated by passive voice itself, e.g.: These data are presented in Fig. 2. - Эти данные представлены на рисунке 2.
2. Passive voice can be translated into Russian by the verbs with endings -ся, -сь. E.g.: Solubility of hydroxides is characterized by solubility constant. - Растворимость гидроксидов характеризуется константой растворимости. The beauty of this method was recognized by many scientists. - Преимущество этого метода признавалось многими учеными.
3. Passive voice can be translated as a verb in active voice, e.g.: The properties of iron were taken into account in the measurement of its relative density - Свойства железа учли при измерении его относительной плотности.
4. Passive voice of compound verbal complexes that include modal verbs is translated as infinitive, e.g.: Tin can be reduced under high pressure. - Олово можно восстановить при высоком давлении. These conditions should be maintained. - Необходимо поддерживать эти условия.

Translation of the construction: under + noun

There are some constructions in English like “under +noun”. In scientific literature the preposition “under” in this constructions is translated as “при”: under pressure - при давлении, under temperature - при температуре, but there are cases where it can be translated in a different way. They can be translated as a participle. In English they are often placed after a noun but in translation into Russian they are placed before the noun. E.g.: The properties under examination are very important - Рассматриваемые свойства очень важны.

Here are some examples of these constructions:

under consideration - рассматриваемый
under examination - рассматриваемый
under review - рассматриваемый
under investigation - исследуемый
under study - исследуемый, изучаемый
under observation - наблюдаемый
under test - испытуемый, испытываемый
under way - осуществляемый в данное время.

Vocabulary

vinylacetylene - винилацетилен
rate of reaction - скорость реакции
trisacharide - трисахарид
isomaltose - изомальтоза
independent synthesis - встречный синтез

hydrolyse - гидролизовываться, гидролизовать
impurity - примесь

Practice

Translate the following sentences paying attention to the passive voice and constructions: “under +noun”.

1. At this point the material under examination is fed.
2. Hydrogen has been substituted by oxygen.
3. The values have little relevance to the problem under investigation.
4. Vinylacetylene under pressure with or without catalysis is polymerized.
5. The results have been affected by the presence of impurities.
6. The amine is isolated from reaction.
7. The rate of reaction is symbolized by XV.
8. The trisacharide under examination has been contaminated with isomaltose.
9. The reaction was accompanied by the violent evolution of heat.
10. Conclusive proof for dioxin structure was obtained through independent synthesis last time.
11. These results under review have been verified by us a few times.
12. The polarization of these lines under consideration can be predicted using this mechanism.
13. A new technique under consideration has been developed by us.
14. The oxidation of this substance has been carried out by us.
15. The research of the new properties of iron compounds are being carried out by them.
16. Compound II under study can be hydrolyzed to yield free amine.
17. The reaction under study can be accompanied by resin formation.
18. This apparatus is made up of the following parts.
19. The properties of these compounds were defined by us last year.
20. This method will be reported by us tomorrow.
21. This reaction has been hindered by the presence of impurities.

Part 2

Exercise 1. Read and translate the text. Make the summary of the text.

Alkaline-Earth Metals

Alkaline-earth metals are the elements of group *2* (formerly IIA) of the periodic table: beryllium (Be), magnesium (Mg), calcium (Ca), strontium (Sr), and barium (Ba). The elements are sometimes referred to as the 'alkaline earths', although strictly the 'earths' are the oxides of the elements. All have a characteristic electron configuration that is a noble-gas structure with two outer s-electrons. They are typical metals (in the chemical sense) and readily lose both outer electrons to form stable M^{2+} ions; i.e. they are strong reducing agents. All are reactive, with the reactivity increasing down the group. There is a decrease in both first and second ionization energies down the group. Although there is a significant difference between the first and second ionization energies of each element, compounds containing univalent ions are not known. This is because the divalent ions have a smaller size and larger charge, leading to higher hydration energies (in solution) or lattice energies (in solids). Consequently, the overall energy change favours the formation of divalent compounds. The third ionization energies are much higher than the second ionization energies, and trivalent compounds (containing M^{3+}) are unknown.

Beryllium, the first member of the group, has anomalous properties because of the small size of the ion: its atomic radius (0.112 nm) is much less than that of magnesium (0.16 nm). From magnesium to radium there is a fairly regular increase in atomic and ionic radius. Other regular changes take place in moving down the group from magnesium. Thus, the density, melting and boiling points increase. Beryllium, on the other hand, has higher boiling and melting points than calcium and its density lies between those of calcium and strontium. The standard electrode potentials are negative and show a regular small decrease from magnesium to barium. In some ways beryllium resembles aluminium.

All the metals are rather less reactive than the alkali metals. They react with water and oxygen (beryllium and magnesium form a protective surface film) and can be made to react with chlorine, bromine, sulphur, and hydrogen. The oxides and hydroxides of the metals show the increasing ionic character in moving down the group. Beryllium hydroxide is amphoteric. Magnesium hydroxide is a very slightly soluble in water and weakly basic, calcium hydroxide is sparingly soluble and distinctly basic. Strontium and barium hydroxides are quite soluble and basic. The hydroxides decompose on heating to give the oxide and water:

$$M(OH)_2(s) \rightarrow MO(s) + H_2O(g).$$

The carbonates also decompose on heating to the oxide and carbon dioxide:

$$MCO_3(s) \rightarrow MO(s) + CO_2(g).$$

The nitrates decompose to give the oxide:

$$2M(NO_3)_2(s) \rightarrow 2MO(s) + 4NO_2(g) + O_2(g).$$

As with the alkali metals, the stability of the salts of oxo acids increases down the group. In general, the salts of the alkaline-earth elements are soluble if the anion has a single charge (e.g. nitrates, chlorides). Most salts with a doubly charged anion (e.g. carbonates, sulphates) are insoluble. The solubilities of salts of a particular acid tend to decrease down the group.

Vocabulary

alkaline-earth metals - щелочноземельные металлы
beryllium - бериллий
calcium - кальций
strontium - стронций
barium - барий
to refer to - относиться, ссылаться
univalent - одновалентный

size - размер
charge - заряд
single charge - единичный заряд
to favour - благоприятствовать
lattice energy - энергия кристаллической решетки
radium - радий
amphoteric - амфотерный
surface film - поверхностная пленка
solubility - растворимость

Exercise 2. Answer the following questions.

1. What elements belong to alkaline-earth metals?
2. What is your understanding of the term “alkaline - earth”?
3. What element does beryllium resemble?
4. When can one observe a fairly regular increase in atomic and ionic radius?
5. What does the overall energy change favour?

Exercise 3. Put questions to the bold-typed words.

1. **Beryllium** has **anomalous properties.**
2. Beryllium has a **high** melting point.
3. **The hydroxides** decompose on **heating** to give **the oxide**.
4. **The oxides of the metals** show the **increasing ionic character.**
5. Beryllium has higher boiling and melting points than **calcium**.
6. The **standard** electrode potentials show a regular small decrease **from magnesium to barium.**
7. **Regular** changes take place **down the group**.
8. Alkaline-earth metals **react with water and oxygen**.
9. One can observe **a decrease** in **first** and **second** ionization energies down the group.
10. Compounds contain **univalent ions**.
11. All **alkaline-earth** metals have a characteristic electron configuration.
12. There are **three** electrons in the **outer** shell**.**

Exercise 4. Give the equivalents for the following words and make up sentences with them: univalent, compound, lattice energy, sparingly soluble, solution, amphoteric, to favour, charge, size, single charge, to refer to, surface film, solubility, reducing agent, regular.

Exercise 5.

a) Match the beginnings of the sentences with the endings.

1. Beryllium has
2. Alkaline –earth metals react with
3. Calcium
4. Ba hydroxide is
5. Alkaline - earth metals’ properties increase
6. Solubilities of salts can decompose
7. The boiling point of Be is

a) down the group.
b) anomalous properties.
c) high.
d) a very soluble.
e) is useful for children.
g) on heating.
f) water.

8. The overall change — h) 0.112 nm.
9. The atomic radius of Be is — g) favours the formation of divalent compounds.

b) Grammar and spelling quiz: find and correct the mistakes:

1. Be have anomalous propertyes.
2. The atomic radius (0.112 nm) of Be are more less that those of magnesium (0.16 nm).
3. To general, the is soluble salts of the alkali-earthy elements if the anion had an single charge.
4. These elements reats to water.
5. We is studying the compounds contain univalent ions.
6. An standard electrode potentials a regular decrease in magnesium to barium show.

c) Chemical quiz: Are these sentences true or false?:

1. Carbon is a non-metal.
2. Na is an alkaline-earth metal.
3. The oxides and hydroxides of the alkaline-earth metals show the decreasing atomic character in moving down the group.
4. The hydroxides of the alkali metals are weakly alkaline.

d) Finish the sentences:

1. Alkaline - earth metals are …
2. Beryllium resembles …
3. Alkaline-earth metals react with …
4. The third ionization energies are much …

Exercise 6. Give the explanations for the following words: ion, solution, property, reducing agent, oxide, amphoteric, alkaline-earth.

Exercise 7. Make the following sentences negative and interrogative.

1. The overall energy change favours the formation of divalent compounds.
2. The stability of the salts of oxo acids increases down the group.
3. Other regular changes take place in moving down the group from magnesium.
4. The oxides and hydroxides of the metals show the increasing ionic character in moving down the group.
5. Be density lies between those of calcium and strontium.
6. The elements are sometimes referred to as the alkaline earths.
7. The solubilities of the salts of a particular acid tend to decrease down the group.
8. Alkaline-earth metals have many uses.
9. The standard electrode potentials show a regular trend.

Exercise 8. Project work:

a) Describe any alkaline-earth metal on the following plan:

1. boiling point;
2. melting point;
3. atomic number;
4. relative density;
5. valence;
6. Is it a metal or non-metal?;
7. What group does it belong to?;
8. colour;
9. odour
10. Where is it used ?;
11. What substances does it react with ?;
12. What chemical compounds does it have ?.

b) Choose any two alkali elements and compare them on the following plan using comparative and superlative degrees:

6. melting point;
7. boiling point;
8. relative density;
9. atomic and ionic radius;
10. relative atomic mass.

Texts for educational purposes

Calcium and its compounds

Basalt is a fine-grained basic igneous rock. It is composed chiefly of calcium-rich plagioclase feldspar and pyroxene; other minerals present may be olivine, magnetite, and apatite. Basalt is the commonest type of lava.

Calcium is a soft grey metallic element belonging to group 2 (formerly 11 A) of the periodic table: a.n. is 20; r.a.m. is 40.08; r.d. is 1.54; m.p. is 839°C; b.p. is 1484°C. Calcium compounds are common in the Earth's crust, e.g. limestone and marble ($CaCO_3$), gypsum ($CaSO_4.2H_2O$) and fluorite (CaF_2). The element is extracted by electrolysis of fused calcium chloride and is used as a getter in vacuum systems and a deoxidizer in producing nonferrous alloys. It is also used as a reducing agent in the extraction of such metals as thorium, zirconium, and uranium.

Calcium is an essential element for living organisms, being required for normal growth and development. In animals it is an important constituent of bones and teeth and is present in the blood, being required for muscle contraction and other metabolic processes. In plants it is a constituent (in the form of calcium pectate) of the middle lamella.

Calcium carbonate is a white solid, $CaCO_3$, which is only sparingly soluble in water. Calcium carbonate decomposes on heating to give calcium oxide (quicklime) and carbon dioxide. It occurs naturally as the minerals calcite (its shape is rhombohedral; r.d. is 2.71) and aragonite (its shape is rhombic; r.d. is 2.93). Rocks containing calcium carbonate dissolve slowly in acidified rainwater (containing dissolved CO_2) to cause temporary hardness. In the laboratory calcium carbonate is precipitated from limewater by carbon dioxide. Calcium carbonate is used in making lime (calcium oxide) and is the main raw material for the Solvay process.

Calcium chloride is a white deliquescent compound, $CaCl_2$, which is soluble in water; r.d. is 2.15; m.p. is 782°C; b.p. is >1600°C. There are a number of hydrated forms, including the monohydrate, $CaCl_2.H_2O$, the dihydrate, $CaCl_2.2H_2O$ (r.d. is 0.84) and the hexahydrate, $CaCl_2.6H_2O$ (trigonal; r.d. is 1.71). The hexahydrate loses $4H_2O$ at 30°C and the remaining $2H_2O$ at 200°C. Large quantities of it are formed as a byproduct of the Solvay process and it can be prepared by dissolving calcium carbonate or calcium oxide in hydrochloric acid. Crystals of the anhydrous salt can only be obtained if the hydrated salt is heated in a stream of hydrogen chloride. Solid calcium chloride is used in mines and on roads to reduce dust problems, whilst the molten salt is the electrolyte in the extraction of calcium. An aqueous solution of calcium chloride is used in refrigeration plants.

Calcium fluoride is a white crystalline solid, CaF_2; r.d. is 3.2; m.p. is 1360°C; b.p. is 2500°C. It occurs naturally as the mineral fluorite (or fluorspar) and is the main source of fluorine. The calcium fluoride structure (fluorite structure) is a crystal structure in which the calcium ions are each surrounded by eight fluoride ions arranged at the corners of a cube. Each fluoride ion is surrounded by four calcium ions at the corners of a tetrahedron.

Calcium hydrogencarbonate (calcium bicarbonate) is a compound $Ca(HCO_3)_2$, that is stable only in solution and is formed when water containing carbon dioxide dissolves calcium carbonate.

It is the cause of temporary hardness in water because calcium ions react with soap to give scum. Calcium hydrogencarbonate is unstable when heated and decomposes to give solid calcium carbonate. This explains why temporary hardness is removed by boiling and the formation of scale in kettles and boilers.

Calcium hydroxide is a white solid, $Ca(OH)_2$, which dissolves sparingly in water; its shape is hexagonal; r.d. is 2.24. It is manufactured by adding water to calcium oxide, a process that evolves much heat and is known as slaking. It is used as a cheap alkali to neutralize the acidity in certain soils and in the manufacture of mortar, whitewash, bleaching powder and glass.

Calcium oxide is a white solid compound, CaO, formed by heating calcium in oxygen or by the thermal decomposition of calcium carbonate. Its shape is cubic; r.d. is 3.35; m.p. is 2580°C; b.p. is 2850^o C. On a large scale, calcium carbonate in the form of limestone is heated in a tall tower (lime kiln) to a temperature above 550°C:

$CaCO_3(s) = CaO(s) + CO_2(g)$.

Although the reaction is reversible, the carbon dioxide is carried away by the upward current through the kiln and all the limestone decomposes. Calcium oxide is used to make calcium hydroxide, as a cheap alkali for treating acid soil and in extractive metallurgy to produce a slag with the impurities (especially sand) present in metal ores.

Calcium phosphate (V) is a white insoluble powder, $Ca_3(PO_4)_2$; r.d. is 3.14. It is found naturally in the mineral apatite, $Ca_5(PO_4)_3(OH, F, Cl)$ and as rock phosphate. It is also the main constituent of animal bones. Calcium phosphate can be prepared by mixing solutions containing calcium ions and hydrogenphosphate ions in the presence of an alkali. It is used extensively as a fertilizer. The compound was formerly called calcium orthophosphate.

Calcium sulphate is a white solid compound, $CaSO_4$: r.d. is 2.96; 1450°C It occurs naturally as the mineral anhydrite, which has a rhombic structure, transforming to a monoclinic form at 200°C. More commonly, it is found as the dihydrate, gypsum, $CaSO_4.2H_2O$ (monoclinic; r.d. is 2.32). When heated, gypsum loses water at 128°C to give the hemihydrate, $2CaSO_4.H_2O$, better known as plaster of Paris. Calcium sulphate is sparingly-soluble in water and is a cause of permanent hardness of water. It is used in the manufacture of certain paints, ceramics and paper. The naturally occurring forms are used in the manufacture of sulphuric (V1) acid.

Solution and solvation

Solution is a homogeneous mixture of a liquid (the solvent) with a gas or solid (the solute). In a solution, the molecules of the solute are discrete and mixed with the molecules of solvent. There is usually some interaction between the solvent and solute molecules **.** Two liquids that can mix on the molecular level are said to be miscible. In this case, the solvent is the major component and the solute the minor component.

Hydrolysis is a chemical reaction of a compound with water. For instance, salts of weak acids or bases hydrolyse in aqueous solution, as in

$NaCH_3COO + H_2O = Na^+ + OH^- + CH_3COOH$

The reverse reaction of esterification is another example.

Solvation is the interaction of ions of a solute (the substance dissolved in a solvent in forming a solution) with the molecules of solvent. For instance, when sodium chloride is dissolved in water the sodium ions attract polar water molecules, with the negative oxygen atoms pointing towards the positive Na^+ ion. Solvation of transition-metal ions can also occur by formation of coordinate bonds, as in the hexaquocopper (II) ion $(Cu(H_2O)_6]^{2+}$. Solvation is the process that causes ionic solids to dissolve, because the energy released compensates for the energy necessary to break down the crystal lattice. It occurs only with polar solvents. Solvation in which the solvent is water is called hydration. Solvay process **(**ammonia-soda process**)** is an industrial method of making sodium carbonate from calcium carbonate and sodium chloride. The calcium carbonate is first heated to give calcium oxide and carbon dioxide, which is bubbled into a solution of sodium chloride in ammonia. Sodium hydrogencarbonate is precipitated.

The sodium hydrogencarbonate is heated to give sodium carbonate and carbon dioxide. The ammonium chloride is heated with calcium oxide (from the first stage) to regenerate the ammonia. The process was patented in 1861 by the Belgian chemist Ernest Solvay (1838-1922).

Lesson 4

Part 1

How to Translate “to follow” and its derivatives

“To follow” has a few meanings - следовать за, следить за, использовать, прослеживаться. “Following” - следующий за, использующий (-ся), после. “Followed by” - за которым следует, с последующим. E.g.: We followed this method. - Мы следовали этому методу. Following the experiment the end product was tested. - После эксперимента конечный продукт был протестирован.

Vocabulary

curve - кривая
formation - образование
procedure - методика
interdiffusion - взаимная диффузия
X-ray - рентгеновский луч

Practice

Translate the following sentences paying attention to the verb “to follow”.

1. This usage is not followed in carbohydrate chemistry.
2. Then followed the discovery of a new compound.
3. The reaction is followed by temperature rise.
4. The condensation is followed by a rapid epoxide formation.
5. This apparatus was followed by us to determine the concentration of the acid.
6. One of the procedures described in Part 1 has been followed here.
7. Identical procedures are followed in preparing this solution.
8. The opening of the epoxide ring is not followed by the displacement of bromine by oxygen.
9. It is to be noted that according to the classical ideas the reaction under consideration would be expected to follow the complete path of potential energy curve.
10. To reach the results we followed this method.
11. Following the measurements we were able to determine the mass of the substance.
12. This issue is considered in Chapter 9 followed by Chapter 10.
13. Molecular layers of different substances may be deposited above one another, and their interdiffusion might be followed with the help of X-ray.
14. The reactions were too rapid to be followed by other method.

Part 2

Exercise 1. Read and translate the text. Make the summary of the text.

Bismuth

Bismuth is a white crystalline metal with a pinkish tinge belonging to group 15 (formerly VB) of the periodic table; a.n. is 83; r.a.m. is 208.98; relative density (r.d.) is 9.78; m.p. is 271.3°C; b.p. is 1560°C. The most important ores are bismuthinite (Bi_2S_3) and bismite (Bi_2O_3). Peru, Japan, Mexico, Bolivia and Canada are major producers. The metal is extracted by carbon reduction of its oxide. Bismuth is the most diamagnetic of all metals and its thermal conductivity is lower than the thermal conductivity of any metal except mercury. The metal has a high electrical resistance and a high Hall effect when placed in magnetic fields. It is used to make low-melting-point casting alloys with tin and cadmium. These alloys expand on solidification to give clear replication of intricate features. It is also used to make thermally activated safety devices for fire-detection and sprinkler systems. More recent applications include its use as a catalyst for making acrylic fibres, as a constituent of malleable iron, as a carrier of uranium-235 fuel in nuclear reactors and as a specialized thermocouple material. Bismuth compounds (when lead-free) are used for cosmetics and medical preparations. It is attacked by oxidizing acids, steam (at high temperatures) and by moist halogens. It burns in air with a blue flame to produce yellow oxide fumes. C. G. Junine first demonstrated that it was different from lead in 1753.

Vocabulary

bismuth - висмут
pinkish - розоватый
tinge - оттенок
ore - руда
relative density (r.d.) - относительная плотность
bismuthinite - висмутин (бисмутинит, висмутовый блеск)
bismite - бисмит (висмутовая охра)
to extract - получать, извлекать
thermal conductivity - теплопроводимость
mercury - ртуть
electrical resistance - электрическое сопротивление
alloy - сплав
low-melting-point casting alloys - легкоплавкие сплавы
tin - олово
to expand - увеличивать(-ся), расширять(-ся)
solidification - затвердевание, застывание
sprinkler system - противопожарная система
device - прибор
safety - безопасность

detection - обнаружение
acrylic fibers - акриловые волокна
malleable iron - ковкий чугун
carrier - носитель

uranium - уран
fuel - топливо
nuclear reactor - ядерный реактор
thermocouple material - материал, использованный для изготовления термопары (материал термопары)
lead-free - не содержащий тетраэтилсвинца (неэтилированный)
oxidizing acid - кислота - окислитель, окисляющая кислота
steam - пар
moist - влажный
halogen - галоген
to burn - гореть
fume - дым, пар

Exercise 2. Answer the following questions.

1. In what countries are bismuthinite (Bi_2S_3) and bismite (Bi_2O_3) produced?
2. What are the main characteristics of bismuth?
3. What are the uses of bismuth?
4. Where does bismuth burn?
5. What scientist demonstrated the difference of bismuth from lead in 1753?

Exercise 3. Put questions to the bold-typed words.

1. Bismuth is a white crystalline metal with a pinkish tinge belonging to **group 15 (formerly VB)** of the periodic table.
2. **Bismuth** is extracted by **carbon reduction of its oxide**.
3. Bismuth compounds **(when lead-free**) are used for **cosmetics and medical preparations.**
4. **Bismuth** burns in air **with a blue flame** to produce **yellow oxide fumes**.
5. Bismuth has **a high electrical resistance and a high Hall effect when placed in magnetic fields.**
6. Relative density of **bismuth** is **9.78**.
7. Melting point of bismuth is **271.3°C.**
8. **Peru, Japan, Mexico, Bolivia, and Canada** are major producers of these minerals.
9. These alloys expand **on solidification**
10. The alloys expend **to give clear replication of intricate features.**
11. Bismuth is a **diamagnetic** metal.

Exercise 4 . Put the following words in the gaps: bismuth, oxidizing acids, to produce, melting point, to be used for, to demonstrate, bismite, flame, reduction, lead-free, sprinkler systems, cadmium.

1. Nowadays … has many applications.
2. Bismuth is usually attacked by... .
3. These ores are mainly … in Canada, Peru.
4. … of this metal is very low.

5. Bismuth … medical preparations.
6. Yesterday he … all the advantages of the obtained substance.
7. … is a rare mineral.
8. We used … to obtain this substance.
9. Only … compounds can be used in cosmetics production.
10. Our engineers have developed a new type of … which works more effectively during fire.
11. … is used in batteries and nuclear reactors.
12. … was growing higher and higher.

Exercise 5. Match the beginnings of the sentences with the endings.

1. Bismuth is	a) a specialized thermocouple material.
2. Carbon burns in	b)make low-melting-point casting alloys.
3. Bismuth is used as	c) are extracted in Peru.
4. Sulphur has a	d) tin and iron.
5. It is used to	e) high electrical resistance.
6. The minerals of bismuth	f) a diamagnetic metal.
7. This alloy contains	g) air.
8. C. G. Junine first demonstrated	h) very low.
9. Its thermal conductivity is	i) the difference of Bi from Pb.

Exercise 6. Work with synonyms**:** Match the first column with the second column:

device	to employ
to detect	to identify
to extract	to put
feature	apparatus
to place	peculiarity
to use	to obtain
to give	to donate

Exercise 7. Put the following sentences into Passive.

1. We often use bismuth in our experiments.
2. Yesterday we could define the melting point of this element.
3. Recently we have extracted a new element from urine ores.
4. Now we are developing a new type of sprinkler system which will be much better than the previous one.
5. Today many owners of petrol stations prefer to use lead –free petrol.
6. We have just extracted bismuth by carbon reduction.
7. Last year the researchers of our institute invented a new type of fire-detection system.
8. At first we measured the diameter of the dome.
9. Mexico produces large quantities of bismuth every year.
10. The researchers from Peru were the first who investigated this problem.
11. How did you obtain these results ?

12. We use bismuth as a catalysts to make acrylic fibres.

Exercise 8.

a) Grammar and spelling quiz: find and correct the mistakes.

1. Bismuth used id make low-melting-point casting aloys.
2. This aloys from solidificataon gived cler replicataon with intricate features expands.
3. The metal extracts by carbon reduction of her oxide.
4. What you knows to alkaline-earth metals ?
5. Alakaly metals reacting in water.
6. What is an difference among lead and bismuth ?
7. Junin were the first which discovered ths difference.
8. We want describing the properties of this element.

b) Chemical quiz: Are these sentences true or false ?

1. Bismuth is an acid.
2. Beryllium is an alkali metal.
3. Bismuth compounds (when lead-free) are used for cosmetics and medical preparations.
4. Bismuth has a high electrical resistance and a high Hall effect when placed in magnetic field.
5. Bismuth is used to make low-melting-point casting alloys with hydrogen and oxygen.
6. Graphite is used to make electrical contacts.
7. Diamond is used to produce solid lubricants.
8. Carbon is an essential element for all living organisms.

c) Compare bismuth with iron and tin on the following scheme, using comparative and superlative degrees:

e.g. The boiling point of iron is higher than that of bismuth.

1. Melting point;
2. Boiling point;
3. Relative atomic mass;
4. Which of these metals is more ductile?;
5. Which of these elements is widely-used?;

d) Make the following sentences interrogative and negative:

1. These alloys expand on solidification to give clear replication of intricate features.
2. The metal is extracted by carbon reduction of its oxide.
3. Bismuth compounds (when lead-free) are used for cosmetics and medical preparations.
4. The metal has a high electrical resistance.

Texts for educational purposes

Lead and its compounds

Lead is a heavy dull grey soft ductile metallic element belonging to group 14 (formerly IVB) of the periodic table. The main ore is the sulphide galena (PbS); other minor sources include anglesite ($PbSO_4$), cerussite ($PbCO_3$) and litharge (PbO). The metal is extracted by roasting the ore to give the oxide, followed by the reduction with carbon. Silver is also recovered from the ores. Lead has a variety of uses including building construction, lead-plate accumulators, bullets, and shot, and is a constituent of such alloys as solder, pewter, bearing metals, type metals, and fusible alloys. Chemically, it forms compounds with the +2 and +4 oxidation states, the lead(II) state being the more stable.

Lead-acid accumulator is an accumulator in which the electrodes are made of lead and the electrolyte consists of dilute sulphuric (V1) acid. The electrodes are usually cast from a lead alloy containing 7-12% of antimony (to give increased hardness and corrosion resistance) and a small amount of tin (for better casting properties). The electrodes are coated with a paste of lead (II) oxide (PbO) and finely divided lead; after insertion into the electrolyte a forming current is passed through the cell to convert the PbO on the negative plate into a sponge of finely divided lead. On the positive plate the PbO is converted to lead (IV) oxide (PbO_2). The equation for the overall reaction during discharge is:

$$PbO_2 + 2H_2SO_4 + Pb \rightarrow 2PbSO_4 + 2H_2O.$$

The reaction is reversed during charging. Each cell gives an e.m.f. of about 2 volts and in motor vehicles a 12-volt battery of six cells is usually used. The lead-acid battery produces 80-120 kJ per kilogram.

Lead (ll) carbonate is a white solid, $PbCO_3$, insoluble in water; rhombic; r.d. is 6.6. It occurs as the mineral cerussite, which is isomorphous with aragonite and may be prepared in the laboratory by the addition of cold ammonium carbonate solution to a cold solution of a lead (II) salt (acetate or nitrate). It decomposes at 315°C to lead (II) oxide and carbon dioxide.

Lead (ll) carbonate hydroxide (white lead; basic lead carbonate) is a powder, $2PbCO_3.Pb(OH)_2$, insoluble in water, slightly soluble in aqueous carbonate solutions; r.d. is 6.14. It decomposes at 400^CC. Lead (II) carbonate hydroxide occurs as the mineral *hydroxycerussite* (of variable composition). It was previously manufactured from lead in processes using spent tanning bark or horse manure, which released carbon dioxide. It is currently made by electrolysis of mixed solutions (e.g. ammonium nitrate, nitric acid, sulphuric (V1) acid and acetic acid) using lead anodes. For the highest grade product the lead must be exceptionally pure (known in the trade as corroding lead) as small amounts of metallic impurity impart grey or pink discolorations. The material was used widely in paints both for art work and for commerce, but it has the disadvantage of reacting with hydrogen sulphide in industrial atmospheres and production of black lead sulphide. The poisonous nature of lead compounds has also contributed to the declining importance of this material

Oxidation-reduction reactions (redox)

Originally, oxidation was simply regarded as a chemical reaction with oxygen. The reverse process - loss of oxygen -was called reduction**.** Reaction with hydrogen also came to be regarded as reduction. Later, a more general idea of oxidation and reduction was developed in which oxidation was loss of electrons and reduction was gain of electrons. This wider definition covered the original one. For example, in the reaction:

$4Na\ (s) + O_2\ (g) \rightarrow 2Na_2O\ (s).$

The sodium atoms lose electrons to give Na^+ ions and are oxidized. At the same time, the oxygen atoms gain electrons and are reduced. These definitions of oxidation and reduction also apply to reactions that do not involve oxygen. For instance in reaction:

$2Na\ (s) + Cl_2\ (g) \rightarrow 2NaCl\ (s).$

The sodium is oxidized and the chlorine reduced. Oxidation and reduction also occurs at the electrodes in cells.

This definition of oxidation and reduction applies only to reactions in which electron transfer occurs - i.e. to reactions involving ions. It can be extended to reactions between covalent compounds by using the concept of oxidation number (or state). This is a measure of the electron control that an atom has in a compound compared to the atom in the pure element. An oxidation number consists of two parts:

1. its sign, which indicates whether the control has increased (negative) or decreased (positive);
2. its value which gives the number of electrons over which control has changed.

The change of electron control may be complete (in ionic compounds) or partial (in covalent compounds). For example, in SO_2 the sulphur has an oxidation number +4, having gained partial control over 4 electrons compared to sulphur atoms in pure sulphur. The oxygen has an oxidation number -2, each oxygen having lost partial control over 2 electrons compared to oxygen atoms in gaseous oxygen. Oxidation is a reaction involving an increase in oxidation number and reduction involves a decrease. Thus in reaction:

$2H_2 + O_2 \rightarrow 2H_2O.$

The hydrogen in water is +1 and the oxygen -2. The hydrogen is oxidized and the oxygen is reduced. The oxidation number is used in naming inorganic compounds. Thus in H_2SO_4, sulphuric (VI) acid, the sulphur has an oxidation number of +6. Compounds that tend to undergo reduction readily are oxidizing agents; those that undergo oxidation are reducing agents.

Oxygen and ozone

Oxygen is a colourless odourless gaseous element belonging to group 16 (formerly VI B) of the periodic table; a.n. is 8; r.a.m. is 15.9994; d. is 1.429 gdm $^{-3}$; m.p. is -218.4°C; b.p. is -183°C. It is the most abundant element in the Earth's crust (49.2% by weight) and is present in the atmosphere (28% by volume). Atmospheric oxygen is of vital importance for all organisms that carry out aerobic respiration. For industrial purposes it is obtained by fractional distillation of liquid air. It is used in metallurgical processes, in high-temperature flames (e.g. for welding) and in breathing apparatus. The common form is diatomic (dioxygen, O_2). There is also a reactive allotrope ozone (O_3). Chemically, oxygen reacts with most other elements forming oxides. The element was discovered by Joseph Priestley in 1774. Ozone (trioxygen) is a colourless gas, O_3, soluble in cold water and in alkalis; m.p. is -192.7°C; b.p. – is 1119°C. Liquid ozone is dark blue in colour and is diamagnetic (dioxygen, O_2, is paramagnetic). The gas is made by passing oxygen through a silent electric discharge and is usually used in mixtures with oxygen. It is produced in the stratosphere by the action of high-energy ultraviolet radiation on oxygen and its presence there acts as a screen for ultraviolet radiation. Ozone is also one of the greenhouse gases**.** It is a powerful oxidizing agent and is used to form ozonides by reaction with alkenes and subsequently by hydrolysis to carbonyl compounds. Ozone layer (ozonosphere) is a layer of the Earth's atmosphere in which most of the atmosphere's ozone is concentrated. It occurs 15-50 km above the Earth's surface and is virtually synonymous with the stratosphere. In this layer most of the sun's ultraviolet radiation is absorbed by the ozone molecules, causing a rise in the temperature of the stratosphere and preventing vertical mixing so that the stratosphere forms a stable layer. By absorbing most of the solar ultraviolet radiation the ozone layer protects living organisms on the Earth. The fact that the ozone layer is thinnest at the equator is believed to account for the high equatorial incidence of skin cancer as a result of exposure to unabsorbed solar ultraviolet radiation. In the 1980s it was found that depletion of the ozone layer was occurring over both the poles, creating ozone holes. This is thought to have been caused by a series of complex photochemical reactions involving nitrogen oxides produced from aircraft and, more seriously, chlorofluorocarbons (CFCs) and halons. CFCs rise to the stratosphere, where they react with ultraviolet light to release chlorine atoms; these atoms, which are highly reactive, catalyze the destruction of ozone. Use of CFCs is now much reduced in an effort to reverse this human-induced damage to the ozone layer.

Lesson 5

Part 1

Participle I

Participle I has two forms: present and perfect. Present participle in the active voice is formed by adding ending -ing to the verb and translated by Russian participle of the active voice:
to buy - buying - покупать - покупающий.
Present participle has also a passive form which is formed in the following way: being + V_3 (V_{ed}) and is translated by Russian participle of the passive voice:
being bought - покупаемый или тот, который покупают.
Perfect Participle has also both passive and active forms:
an active form: having bought - купив;
a passive form: having been bought - будучи купленный.
In the sentence it can play a few roles:

1. it can play the role of an attribute and be placed before or after a subject. In this case it is translated by a participle in an active voice or a subordinate clause.

E.g.: A number of animals living on the Earth eat plants. - Ряд животных, живущих (или которые живут) на земле, питаются растениями.

2. It can play the role of an adverb and be placed at the beginning of a sentence or at the end of a sentence. In this case it is translated by the Russian verbal participle. E.g.: Taking into account this news we decided to change our plans. - Принимая во внимание эту новость мы решили изменить наши планы.
3. It can play the role of a parenthetical word:

allowing for - принимая во внимание;
assuming that - полагая, что;
judging by - судя;
putting it mildly - мягко говоря;
roughly speaking - грубо говоря.

4. It can also play the role of a subject and is translated by a verbal noun, e.g.: Substituting carbon for this substance will reduce environmental pollution - Замена углерода на это вещество позволит снизить уровень загрязнения окружающей среды.

Vocabulary

admixture - примесь
limited scope - ограниченная сфера применения
hydrochloric acid - соляная кислота
residue - остаток, осадок
powder- порошок
affinity - сродство
ketal - кетал
partake - участвовать
convention - условие
abstraction - отделение
nitrosation - нитрование

Practice

a) Translate the following sentences paying attention to Participle I.

1. This reaction involves the following temperature changes.
2. We have analyzed the following compounds.
3. The remaining admixtures were separated from the end product.
4. Judging by the results, the pressure has fallen.
5. These moving parts are electrically powered.
6. Considering the limited scope of the method it has been used by two researchers.
7. The yield was 12% of the dried wood, varying with the amount of hydrochloric acid.
8. This concerns the following problem.
9. Judging by the recent works one can say that some amount of ketal is present in diethyl.
10. The dialyzed solution was evaporated to dryness and the residue was dried at 50 ^{o} C, giving nondeliquescent brown powder.
11. One should bear in mind that this information can be misleading.
12. Having determined all parameters we started our experiment.
13. The research being carried out by our Institute in this field is of a great importance.
14. We have obtained these values in the terms of the following formula.
15. Z is favoured by the following data.
16. What is the number of the scientists partaking in the conference ?
17. Having filtered the solution we defined its colour.
18. Having regarded to the summation convention we identified four different products.
19. If the attacking radical had a greater affinity for hydrogen, then the hydrogen-abstraction process would be favoured.
20. Having considered his article we decided to renew our research.
21. The process leading to nitrosation may consist o f a few steps.
22. Last year our researchers obtained remarkable results.

b) Put the following verbs in Participle I: to follow, to plan, to buy, to give, to get, to receive, to write, to do, to make, to recognize, to invent, to see, to reproduce, to measure.

c) Answer the following:

1. How is Perfect Participle formed ?
2. How is Participle I translated ?

Part 2

Exercise 1. Read and translate the text. Make the summary of the text.

Cobalt

Cobalt is a light-grey transition element; a.n. is 27; r.a.m. is 58.933; r.d. is 8.9; m.p. is 1495°C; b.p.is 2870°C. Cobalt is a ferromagnetic metal. Its Curie point is below 1150°C. Small amounts of metallic cobalt are present in meteorites but it is usually extracted from the ore deposits worked in Canada, Morocco and Zaire. It is present in the minerals: cobaltite, smaltite, but also associated with copper and nickel as sulphides and arsenides. Cobalt ores are usually roasted to the oxide and then reduced with carbon or water gas. Cobalt is usually alloyed for use. Alnico is a well-known magnetic alloy and cobalt is also used to make stainless steels and in high-strength alloys that are resistant to oxidation at high temperatures (for turbine blades and cutting tools).The metal is oxidized by hot air and also reacts with carbon, phosphorus, sulphur and dilute mineral acids. Cobalt salts, usual oxidation states (+2) and (+ 3), are used to give a brilliant blue colour in glass, tiles and pottery.

Anhydrous cobalt (II) chloride paper is used as a qualitative test for water and as a heat-sensitive ink. Small amounts of cobalt salts are essential in a balanced diet for mammals. Artificially produced cobalt-60 is an important radioactive tracer and cancer-treatment agent. The element was discovered by Georg Brandt (1694-1768) in 1737. Cobalt (II) oxide is a pink solid, CoO; its shape is cubic; r.d.is 6.45; m.p. is 1935°C. The addition of potassium hydroxide to the solution of cobalt (II) nitrate gives a bluish-violet precipitate, which on boiling is converted to pink impure cobalt(II) hydroxide. On heating this in the absence of air, cobalt (II) oxide is formed. The compound is readily oxidized in air to form tricobalt tetroxide and is readily reduced by hydrogen to the metal.

Cobalt (III) is a black grey insoluble solid; its shape is hexagonal or rhombic, r. d. is 5.18; it decomposes at 895°C. It is produced by the ignition of cobalt nitrate; however, the product doesn’t have the composition corresponding to cobalt (III) oxide. On heating it readily forms Co_3O_4 which contains both Co (II) and Co (III) and is easily reduced to the metal by hydrogen. Cobalt (III) oxide dissolves in strong acid to give unstable brown solutions of trivalent cobalt salts. Cobalt steel is any of a group of alloy steels containing 5-12% of cobalt, 14-20% of tungsten, usually with 4% of chromium and 1-2% of vanadium. They are very hard but somewhat brittle. Their main use is in high-speed tools.

Vocabulary

cobalt - кобальт
tricobalt tetroxide - тетроксид трикобальта
ferromagnetic - ферромагнитный
Curie point - температура Кюри
deposit - месторождение
cobaltite - кобальтин, кобальтовый блеск
smaltite - смальтин
sulphide - сульфид
arsenide - арсенид
to roast - прокаливать, обжигать

to reduce - восстанавливать
to alloy - сплавлять, легировать
alnico - альнико
anhydrous cobalt (II) chloride paper - индикаторная бумага, пропитанная безводным хлоридом кобальта (II)
heat-sensitive ink - термочувствительные чернила
stainless steel - нержавеющая сталь
strength - прочность
resistant - устойчивый
oxidation - окисление
oxidation state - степень окисления
to oxidize - окислять
phosphorus - фосфор
dilute mineral acids - разбавленные минеральные кислоты
tiles - черепица, кафель
pottery - керамика, гончарные изделия
turbine blade - лопатка турбины
cutting tool - режущий инструмент
amount - количество
precipitate - осадок
to convert - превращать, преобразовывать
mammal - млекопитающее
radioactive tracer - радиоактивный индикатор
cancer-treatment agent - агент (препарат), используемый при лечении рака
composition - состав
to dissolve - растворять
tungsten - вольфрам
chromium - хром
brittle - хрупкий
ignition - воспламенение, сжигание, зажигание, прокалывание
high-speed tools - высокоскоростные приборы
high-strength alloy - высокопрочный сплав

Exercise 2. Answer the following questions.

1. Where is cobalt present?
2. What uses of cobalt do you know?
3. What compounds does cobalt have? Give their main characteristics.
4. What elements does cobalt steel contain?
5. What is Cobalt (III)?

Exercise 3. Put questions to the bold-typed words.

1. **Artificially produced cobalt-60** is an important radioactive tracer and cancer-treatment agent.
2. **Small amounts of metallic cobalt** are present in **meteorites** but it is usually extracted from the **ore deposits**.
3. **Cobalt** is oxidized by **hot air** and also reacts with **carbon**.
4. **Cobalt (II) oxide** forms **tricobalt tetrooxide** .
5. Cobalt (III) is produced by **the ignition of cobalt nitrate.**
6. **On heating** cobalt (III) readily forms Co_3O_4.
7. **Cobalt ores** are usually roasted to **the oxide** and then reduced with **carbon.**
8. Cobalt (III) is **a black grey insoluble solid**.
9. The element was discovered by **Georg Brandt**.

10. Cobalt (II) oxide shape is **cubic.**
11. **Alnico** is a well-known magnetic alloy.
12. Cobalt steel contains **14-20%** of tungsten.

Exercise 4. Give the equivalents for the following words and make up sentences with them: amount, phosphorous, to reduce, reduction, to oxidize, oxidation, oxidation state, high-speed tools, cutting tools, pottery, cancer-treatment agent, potassium, turbine blade, tiles, mammals, to convert, brittle, strength, dilute, compound, radioactive tracer, stainless steel, smaltite, cobaltite, copper, to dissolve, tungsten.

Exercise 5. Match the beginnings of the sentences with the endings.

1. Cobalt (II) oxide is a
2. Iron is also used to
3. Alnico is a
4. This metal is produced
5. Stainless steel is used
6. Tungsten often
7. Cobalt steel is very
8. The metal
9. Cobalt steel
10. This precipitate

a) make stainless steel.
b) in high –speed tools.
c) pink solid.
d) a well-known magnetic alloy.
e) by the ignition of cobalt nitrate.
f) brittle.
g) occurs naturally.
h) contains 12%of cobalt.
i) is oxidized by hot air.
k) has a violet colour.

Exercise 6. Put the following words in the gaps: stainless steel, alnico, ferromagnetic, transition, brittle, to dissolve, oxidation state, glass, pottery, to contain, violet, hot air, tungsten, cutting tool, alloy.

1. … is a magnetic alloy.
2. This compound doesn't … in water.
3. All little children should drink a lot of milk, because their bones are … .
4. He will remain the head of the government during … period.
5. All electrotechnical devices are made of … .
6. Cobalt is … metal.
7. … of this substance is very low.
8. Windows are made of … .
9. Pots and dishes are made of clay are called … .
10. Cobalt steel … 2% of vanadium.
11. This substance is oxidized in … .
12. … is used in making filaments for light bulbs.
13. … are made of high – strength alloys.
14. Bismuth is employed to make low-melting-point casting … .
15. Yesterday I bought the hat which was of a … colour.

Exercise 7. Put the words into the right order.

1. Is / paper / test / for / used / anhydrous / qualitative / cobalt (II) / chloride / as / a / water.

2. Is / solid / a / grey / cobalt (III) / black / insoluble.
3. To make / steels / cobalt / is / and / that / resistant to / at / stainless / used / in / oxidation / high - strength / alloys / high temperatures / alloys / are.
4. Bluish / precipitate / the / potassium / to / hydroxide / cobalt (II) nitrate / gives / addition / a / violet / solution /of / of / the.
5. Brittle / somewhat / are /very /they / hard / but.
6. Tungsten / contains / cobalt steel / vanadium / and.
7. Is / artificially / cobalt -60 / used / cancer - treatment agent / produced / as / a.
8. Alnico /is / what ?
9. Are / usually / cobalt ores / roasted / the / to / oxide.
10. Dissolves / strong / solutions / cobalt (III) oxide / acid / to / unstable / give / brown/ usually / in.
11. The / cobalt / of / what / properties / physical /are ?
12. This / gives / the / solution / the / of / a / colour / precipitate /violet / addition.
13. Can / identify / the / substance / I / of / composition / how / the?
14. Differ / terbium / does / oxygen / from ?
15. This / of / steel / very / is / brittle / type.
16. Is / cobalt / in / present / minerals.
17. Cobalt / associated / copper / with / as / is / arsenides.

Exercise 8.

a) Compare melting point, boiling point, relative density and relative atomic mass of bismuth and cobalt using comparative and superlative degrees. Then compare these both metals with the following elements using the scheme given in Lesson 4.:
   1. potassium;
   2. beryllium;
   3. lithium;
   4. magnesium;
   5. iron;
   6. cadmium.

b) Chemical quiz: Are these sentences true or false:
   1. Diamond is very soft.
   2. Carbon has one amorphous form.
   3. Cobalt steel contains iron, chromium, vanadium, sulpher, hydrogen and cobalt.
   4. Graphite is very hard.
   5. Cobalt was discovered by Mendeleev.
   6. Carbon is a ferromagnetic metal, but cobalt is a diamagnetic.
   7. Bismuth and lead are similar.

8. Beryllium, the first member of the group, has anomalous properties because of the small size of molecule.

c) Grammar and lexical quiz: Find and correct the mistakes:

1. The metal oxideze by hot air.
2. Contains cobalt steel vanadium 12%.
3. They is very hardly.
4. Addition of potassium hydroxide in solution of nitrate cobalt (II) give bluishe-violete precipitate.
5. This element have anomalous properties.
6. What does the first membe of these group?
7. Small amount of metall cobalt is present among meteorites.
8. Lithum reat in water much slowly that other metals.
9. Graphite is very hard substance;

d) Divide the following sentences into two sentences:

1. The compound is readily oxidized in air to form tricobalt tetroxide and is readily reduced by hydrogen to the metal.
2. On heating it readily forms Co_3O_4 which contains both Co (II) and Co (III), and is easily reduced to the metal by hydrogen.
3. The metal is oxidized by hot air and also reacts with carbon, phosphorus, sulphur and dilute mineral acids.

Texts for educational purposes

Iron and its compounds

Iron is a silvery malleable and ductile metallic transition element. Its atomic number is 26. It has r.a.m. being equal to 55.847. Its relative density is 7.87. Its melting point is 1535°C and boiling point is 2750°C. The main sources are the ores haematite (Fe_2O_3), magnetite (Fe_3O_4), limonite ($FeO(OH)_nH_2O$), ilmenite ($FeTiO_3$), siderite ($FeCO_3$) and pyrite (FeS_2). The metal is smelted in a blast furnace to give impure pig iron, which is further processed to give cast iron, wrought iron and various types of steel. The pure element has three crystal forms: alpha-iron, stable below 906°C with a body-centered-cubic structure; gamma-iron, stable between 906°C and 1403°C with a nonmagnetic face-centered-cubic structure; and delta-iron, which is the body-centered-cubic form above 1403°C. Alpha-iron is ferromagnetic up to its Curie point (768°C). The element has nine isotopes (mass numbers 52-60) and is the fourth most abundant in the Earth's crust. It is required as a trace element by living organisms. Iron is quite reactive, being oxidized by moist air, displacing hydrogen from dilute acids, and combining with nonmetallic elements. It forms ionic salts and numerous complexes with the metal in the +2 or +3 oxidation states. Iron (VI) also exists in the ferrate ion FeO_4^{2-} and the element also forms complexes in which its oxidation number is zero (e.g. $Fe(CO)_5$).

Iron (II) chloride is a green-yellow deliquescent compound, $FeCl_2$. Its shape is hexagonal. Its relative density is 3.16. It has melting point being equal to 670°C. It also exists in hydrated forms: $FeCl_2.2H_2O$ (green monoclinic; relative density is 2.36) and $FeCl_2.4H_2O$ (blue-green monoclinic deliquescent; relative density is 1.93). Anhydrous iron (II) chloride can be made by passing a stream of dry hydrogen chloride over the heated metal. The hydrated forms can be made using dilute hydrochloric acid or by recrystallizing with water. It is converted into iron (III) chloride by the action of chlorine.

Iron (III) chloride is a black-brown solid, $FeCl_3$. Its shape is hexagonal. Its relative density is equal to 2.9 and melting point is equal to 306°C. It decomposes at 315°C. It also exists as the hexahydrate $FeCl_3.6H_2O$, a brown-yellow deliquescent crystalline substance (melting point is 37°C; boiling point is 280-285°C). Iron (III) chloride is prepared by passing dry chlorine over iron wire or steel wool. The reaction proceeds with incandescence when started and iron (III) chloride sublimes as almost black iridescent scales. The compound is rapidly hydrolysed in moist air. In solution it is partly hydrolysed. Hydrolysis can be suppressed by the addition of hydrochloric acid. The compound dissolves in many organic solvents, forming solutions of low electrical conductivity. In ethanol, ethoxyethane and pyridine the molecular weight corresponds to $FeCl_3$ but is higher in other solvents corresponding to Fe_2Cl_6. The vapour is also dimerized. In many ways the compound resembles aluminium chloride, which it may replace in Friedel-Crafts reactions.

Iron (II) oxide is a black solid, FeO. Its shape is cubic. It has relative density being equal to 5.7. its melting point is 1420°C. It can be obtained by heating iron (II) oxalate. The carbon monoxide formed produces a reducing atmosphere thus preventing oxidation to iron (III) oxide. The compound has the sodium chloride structure, indicating its ionic nature, but the crystal lattice is deficient in iron (II) ions and it is nonstoichiometric. Iron (II) oxide dissolves readily in dilute acids.

Iron (III) oxide is a red-brown to black insoluble solid, Fe_2O_3. Its shape is trigonal. Its relative density is equal to 5.24 and melting point is 1565°C. There is also a hydrated form, $Fe_2O_3.xH_2O$, which is a red-brown powder. Its relative density is 2.44-3.60. Iron (III) oxide occurs naturally as haematite and can be prepared by heating iron (III) hydroxide or iron (II) sulphate. It is readily reduced on heating in a stream of carbon monoxide or hydrogen.

Iron (II) sulphate is an off-white solid, $FeSO_4.H_2O$. Its shape is monoclinic. Its relative density is 2.970. There is also a heptahydrate, $FeSO_4.7H_2O$. It is blue-green monoclinic with relative density of 1.898 and melting point of 64°C. The heptahydrate is the best known iron (II) salt and is sometimes called green vitriol or copperas. It is obtained by the action of dilute sulphuric acid on iron in a reducing atmosphere. The anhydrous compound is very hygroscopic. It decomposes at red heat to give iron (III) oxide, sulphur trioxide and sulphur dioxide. A solution of iron (II) sulphate is gradually oxidized on exposure to air, a basic iron (III) sulphate being deposited.

Iron (III) sulphate is a yellow hygroscopic compound, $Fe_2(SO_4)_3$. Its shape is rhombic. Its relative density is 3.097. It decomposes above 480°C. It is obtained by heating an aqueous acidified solution of iron (II) sulphate with hydrogen peroxide:

$2FeSO_4 + H_2SO_4 + H_2O_2 \rightarrow Fe_2(SO_4)_3 + 2H_2O$.

On crystallizing, the hydrate $Fe_2(SO_4)_3.9H_2O$ is formed. The acid sulphate $Fe_2(SO_4)_3.H_2SO_4.8H_2O$ is deposited from solutions containing a sufficient excess of sulphuric acid.

Nickel and its compounds

Nickel is a malleable ductile silvery metallic transition element. Its atomic number is 28. Its relative atomic mass is 58.70. Its relative density is 8.9. its melting point is 1450°C. its boiling point is 2732°C. It is found in the minerals pentlandite (NiS), pyrrhoite ((Fe, Ni)S), and garnierite ($(Ni,Mg)_6(OH)_6Si_4O_{11}.H_2O$). Nickel is also present in certain iron meteorites (up to 20%). The metal is extracted by roasting the ore to give the oxide, followed by reduction with carbon monoxide and purification by the Mond process. Alternatively electolysis is used. Nickel metal is used in special steels, in Invar, and, being ferromagnetic, in magnetic alloys, such as Mumetal. It is also an effective catalyst, particularly for hydrogenation reactions. The main compounds are formed with nickel in the +2 oxidation state; the +3 state also exists (e.g. the black oxide, Ni_2O_3). Nickel was discovered by Axel Cronstedt (1722-65) in 1751.

Nickel carbonyl is a colourless volatile liquid, $Ni(CO)_4$. Its melting point is 25°C and boiling point is 43°C. It is formed by direct combination of nickel metal with carbon monoxide at 50-60°C. The reaction is reversed at higher temperatures and the reactions are the basis of the Mond process for purifying nickel. The nickel in the compound has an oxidation state of zero and the compound is a typical example of a complex with pi-bonding ligands, in which filled d-orbitals on the nickel overlap with empty p-orbitals on the carbon.

Nickelic compounds are the compounds of nickel in its +3 oxidation state; e.g. nickelic oxide is nickel (III) oxide.

Nickelous compounds are the compounds of nickel in its +2 oxidation state; e.g. nickelous oxide is nickel (II) oxide .

Nickel (II) oxide is a green powder with a relative density of 6.6. It can be made by heating nickel (II) nitrate or carbonate with air excluded.

Nickel(III) oxide is a black or grey powder with relative density of 4.8. It is made by heating nickel (II) oxide in air and used in nickel-iron accumulators.

Transition elements

Transition elements are the set of elements in the periodic table in which filling of electrons in an inner d- or f-level occurs. With increasing proton number, electrons fill atomic levels up to argon, which has the electron configuration $ls^2 2s^2 2p^6 3s^2 3p^6$. In this shell, there are 5 d-orbitals, which can each contain 2 electrons. However, at this point the subshell of lowest energy is not the 3d but the 4s. The next two elements, potassium and calcium, have the configurations [Ar] $4s^1$ and [Ar]$4s^2$ respectively. For the next element, scandium, the 3d level is of lower energy than the 4p level, and scandium has the configuration [Ar]$3d^1$ $4s^2$. This filling of the inner d-level continues up to zinc [Ar]$3d^{10}4s^2$, giving the first transition series. There is a further series of this type in the next period of the table: between yttrium ([Kr]4d $5s^2$) and cadmium ([Kr]$4d^{10}5s^2$). This is the second transition series. In the next period of the table the situation is rather more complicated. Lanthanum has the configuration [Xe]$5d^1$ $6s^2$. The level of lowest energy then becomes the 4 f level and the next element, cerium, has the configuration [Xe]$4f^1 5d^1$ $6s^2$. There are 7 of these f- orbitals, each of which can contain 2 electrons, and filling of the f -levels continues up to lutetium ([Xe]$4f^{14}5d^1 6s^2$). Then the filling of the 5d levels continues from hafnium to mercury. The series of 14 elements from cerium to lutetium is a series within a series called an inner transition series. This one is the lanthanoid series. In the next period there is a similar inner transition series, the actinoid series, from thorium to lawrencium. Then filling of the d-level continues from element 104 onwards.

In fact, the classification of chemical elements is valuable only in so far as it illustrates chemical behaviour and it is conventional to use the term transition elements in a more restricted sense. The elements in the inner transition series from cerium (58) to lutetium (71) are called the lanthanoids; those in the series from thorium (90) to lawrencium (103) are the actinoids. These two series together make up the f-block in the periodic table. It is also common to include scandium, yttrium and lanthanum with the lanthanoids (because of chemical similarity) and to include actinium with the actinoids. Of the remaining transition elements, it is usual to speak of three main transition series*:* from titanium to copper; from zirconium to silver; and from hafnium to gold. All these elements have similar chemical properties that result from the presence of unfilled d-orbitals in the element or (in the case of copper, silver and gold) in the ions. The elements from 104 to 109 and the undiscovered elements 110 and 111 make up a fourth transition series. The elements zinc, cadmium and mercury have filled d-orbitals both in the elements and in compounds, and are usually regarded as nontransition elements forming group 12 of the periodic table. The elements of the three main transition series are all typical metals (u the nonchemical sense), i.e. most are strong hard materials that are good conductors of heat and electricity and have high melting and boiling points. Chemically, their behaviour depends on the existence of unfilled d-orbitals. They exhibit variable valency, have coloured compounds, and form coordination compounds. Many of their compounds are paramagnetic as a result of the presence of unpaired electrons. Many of them are good catalysts. They are less reactive than the s- and p-block metals.

Texts from scientific articles

Journal Inorganic Nuclear Chemistry

Solvolytic disproportionation of non-stoichiometric oxides of praseodymium

Abstract

The solvolytic disproportionation of non-stoichiometric PrO_x in acid solutions to produce higher oxides has been investigated. Some new non-stoichiometric phases have been reported. A number of interesting features of the non-stoichiometric rare earth oxides have been discussed and the need for a satisfactory structural model has been pointed out.

Experimental

Rates of dissolution of Pr_6O_{11} in 8 N acetic acid solution were found to follow the first-order rate law with an energy of activation of 4 to 5 kcal. This value of the energy of activation could be reproduced although the values of the rate constants varied from sample to sample. For one sample, the rate constants were $1{\cdot}20 \times 10^{-3}$ and $1{\cdot}58 \times 10^{-3}$ min^{-1}at 29 and 40°C respectively, while for another sample the values were $2{\cdot}9 \times 10^{-4}$ and $3{\cdot}5 \times 10^{-4}$ min^{-1} at 40^{o} and 50^{o}C respectively. The low value of the energy of activation is significant and together with the first-order dependence of the reaction, it indicates that the process is akin to a simple dissolution. An attempt to study the rate of dissolution of a 1:4 mixture of Pr_2O_3 and PrO_2 (corresponds to Pr_6O_{11}) was unsuccessful since the dissolution of Pr_2O_3 was complete in about 5 min at 20^{o}C. Further, X-ray patterns of Pr_2O_3 and PrO_2 mixed in the proper proportions to form $PrO_{1.71}$ and $PrO_{1.833}$ showed only lines belonging to Pr_2O_3 and PrO_2.

In order to examine the nature of the intermediate products, samples of residues from solvolysis at 40^{o}C were separated after intervals of 15 min and 1 hr and their powder patterns were taken. The pattern of the 1 hr sample turned out to be that of PrO_2 ($a = 5{\cdot}400 \pm 0{\cdot}005$Å) with several additional lines which belonged neither to a fluoride type lattice nor to $Pr(OH)_3$. The pattern of the specimen after 15 and 25 min showed larger d-spacing and the fluoride lines could be accounted for by cells with lattice constants of $5{\cdot}460 \pm 0{\cdot}005$ and $5{\cdot}435 \pm 0{\cdot}003$Å respectively. While even these patterns did not show any Pr_6O_{11} lines, they showed the same additional lines as the 1-hr specimen. The absence of Pr_6O_{11} lines after only 15 min of solvolysis is surprising. A fluoride cell with $a = 5{\cdot}435$Å which is between the size of the Pr_6O_{11} and PrO_2 cells could mean a solid solution. Using a smooth curve obtained by plotting the unit cell lengths of all the cubic and rhombohedral phases of praseodymium oxides from the literature vs. the composition(pseudo cell dimensions were used where necessary), it was found that $a = 5{\cdot}435$Å corresponds to a composition of $PrO_{1.92}$. A similar composition with about the same lattice constant was also obtained by solvolysis of Pr_6O_{11} with 16 N acetic acid. A miscibility gap is known to exist between Pr_6O_{11} and PrO_2 and how such a uniphasic composition in this region could result is not clear; but it is possible that in the medium of a solution of praseodymium ions, such solid solutions could form. This would also explain the absence of Pr_6O_{11} lines and is a strong argument in favour of solid solution formation.

Lesson 6

Part 1

Participle II

Participle II is formed by adding the ending -ed to the verb if it is a regular verb, in the case with irregular verbs we use the third form of the irregular verb.

Participle II is translated by the Russian participle of passive voice with endings: -ен, -ем, -ат, ят:

to play - played - играемый, сыгранный.

It can also play a few roles in a sentence:

1. it can play the role of an attribute and be placed before or after a subject, sometimes there is a conjunction “as” before it and it can be translated by a subordinate clause with the word “в том виде как”, e.g.: The idea as stated by the scientists is not of any interest - Эта мысль, в том виде как она изложена учеными, не представляет никакого интереса.

   If Participle II stands before a subject it is translated by an attribute and put before a subject, e.g.: The instrument used is very reliable - Использованный прибор очень надежен. If Participle II is formed from the verb with a preposition, it will be translated by a subordinate clause with the word “который” and the preposition will be put at the beginning of a subordinate sentence, e.g.: Some theoretical considerations touched upon in the last chapter will be considered in the next work. - Некоторые теоретические соображения, о которых вскользь упоминалось в последней главе, будут освещены в следующей работе.
2. Participle II can play the role of an adverb and be placed at the beginning or at the end of a sentence. In this case it is translated by a subordinate clause with the conjunctions: “так как”, “когда”, “если”. E.g.: Written in pencil the article was difficult to read. - Так как статья была написана карандашом, ее трудно было читать. United we stand, divided we fall - Если мы вместе, мы выстоим, если мы врозь, мы падем.

Vocabulary

bromepoxide - бромэпоксид
velocity - скорость
as far as our knowledge goes - насколько нам известно
throw light - проливать свет

firmness - прочность
plate - пластина
equation - уравнение
to vary - изменяться
to calculate - рассчитывать

Practice

a) Translate the following sentences paying attention to Participle II.

1. The values obtained have a little relevance to this problem.
2. Increased inductive power affects the electron bonds.
3. It was shown that the velocity constant was unaffected by an increase in viscosity.
4. Confirmation of double bond types must be sought in the other part of spectrum.
5. The number of plates needed for chromatography is much higher than that required for distillation.
6. This suggests that these compounds obtained from the isomeric bromepoxides are not identical.
7. As far as our knowledge goes, the course of polymerization is almost the same as that observed with the pure monomer phase.
8. The data provided vary with the purpose of each particular investigation.
9. According to the viewpoint adopted the form of the equations 1 and 2 is an oversimplification.
10. This section concerned with the behaviour of optical isomers on melting should be studied closely.
11. We learnt that the results reported by these scientists were wrong.
12. We can also write that the heat energy absorbed in such a process to be as follows.
13. The results obtained are analogous to those reported by the previous researchers.
14. The difference between the values calculated was close to 2%.
15. The ore found in uranium is rarely-met naturally.
16. The products obtained are very pure.
17. The equipment delivered to us last week is of a good quality.
18. Both ketones distilled in vacuum weren’t obtained in this state.
19. The idea proposed by them will throw light on the firmness of the binding of groups.

Part 2

Exercise 1. Read and translate the text. Make the summary.

Aluminium

Aluminum is a silvery-white lustrous metallic element belonging to the group 3 (formerly IIIB) of the periodic table; a.n.is 13; r.a.m. is 26.98; r.d. is 2.7; m.p. is 660°C; b.p. is 2467°C. The metal itself is highly reactive but is protected by a thin transparent layer of the oxide, which is formed quickly in air. Aluminium and its oxide are amphoteric. The metal is extracted from purified bauxite ($A1_2O_3$) by electrolysis. The main process uses a Hall-Heroult cell but other electrolytic methods are under development, including conversion of bauxite with chlorine and electrolysis of the molten chloride. Pure aluminium is soft and ductile but its strength can be increased by work-hardening. A large number of alloys are manufactured. Alloying elements include copper, manganese, silicon, zinc and magnesium. Its lightness, strength (when alloyed), corrosion resistance and electrical conductivity make it suitable for a variety of uses, including vehicle and aircraft construction, building (window and door frames) and overhead power cables. Although it is the third most abundant element in the Earth's crust (8.1% by weight) it was not isolated until 1825 by H. C. Oersted.

Aluminium chloride is a whitish solid, $A1C1_3$, which fumes in moist air and reacts violently with water (to give hydrogen chloride). It is known as the anhydrous salt (hexagonal; r. d. is 2.44 (fused solid); m. p. is 190°C (2.5 atm.); it sublimes at 178°C) or the hexahydrate $A1C1_3.6H_2O$ (rhombic; r. d. is 2.398; it loses water at 100°C), both of which are deliquescent. Aluminium chloride may be prepared by passing hydrogen chloride or chlorine over hot aluminium or by passing chlorine over heated aluminium oxide and carbon. The chloride ion is polarized by the small positive aluminium ion and the bonding in the solid is intermediate between covalent and ionic. In the liquid and vapour phases dimer molecules exist, $A1_2C1_6$, in which there are chlorine bridges that make coordinate bonds to aluminium atom. The $A1C1_3$ molecule can also form compounds with other molecules that donate pairs of electrons (e.g. amines or hydrogen sulphide); i.e. it acts as a Lewis acid. Aluminium chloride is used commercially as a catalyst in the cracking of oils. It is also used as a catalyst in certain organic reactions, especially in the Friedel-Crafts reaction

Vocabulary

lustrous - блестящий
transparent - прозрачный
bauxite - боксит
to purify - очищать
pure - чистый
molten - расплавленный
ductile - плавкий , ковкий
manganese - марганец
zinc- цинк
lightness - легкость
abundant - распространенный
liquid - жидкость
corrosion resistance - коррозионная стойкость
work-hardening - механическое упрочнение
deliquescent - растворяющийся
aircraft - самолет
vehicle - транспортное средство
to sublime - сублимироваться
to donate - передавать
cracking - крекинг
oil - масло
overhead power cable - воздушный силовой кабель

Exercise 2. Answer the following questions.

1. How is aluminium extracted?
2. What are the properties of aluminium?

3. Why is aluminium suitable for variety of uses?
4. How is aluminium chloride prepared?
5. Where is aluminium chloride used?

Exercise 3. Put questions to the bold-typed words.

1. **Aluminium chloride** is a **whitish solid**.
2. Alloying element is **copper**.
3. **Strength** of any metal can be increased **by work-hardening.**
4. Aluminium chloride sublimes at **178^{o} C**.
5. **Copper oxide** is prepared **by electrolysis**.
6. **Aluminium chloride** is soluble in **water**.
7. **In the liquid and vapour phases** dimer molecules exist.
8. **The $A1C1_3$ molecule** can also form **compounds**.
9. **Aluminium chloride** is used commercially **as a catalyst**.
10. Aluminium chloride is also used in **certain organic reactions**.
11. Pure aluminum is **soft and ductile**.
12. The metal is protected by a **thin transparent layer of the oxide**.

Exercise 4. Give the equivalents for the following words and make up sentences with them: copper, zinc, manganese, electrolysis, to exist, to sublime, vehicle, aircraft, work-hardening, corrosion resistance, liquid, to extract, deliquescent, abundant, to increase, conversion, silicon, magnesium.

Exercise 5. Match the following words with the correct definition.

1. Acid rain is
2. Corrosive substance is
3. Flammable means
4. Chlorine is
5. Fuel is
6. Pesticide is
7. Citric acid is
8. Oxide is
9. Silicon is

a) a chemical used for killing insects.
b) a material that produces heat when it burns.
c) a poisonous greenish-yellow gas. It has strong smell. It is a non-metal element.
d) a substance that can damage through chemical action, e.g. stone or metal.
e) fire-catching and easily - burning.
f) rain that contains factory gases that damage crops and buildings.
g)an acid contained in orange or lemon juice.
h) a chemical element found in rocks and sand.
i) a compound of oxygen and another chemical element.

Exercise 6. Give the explanation for the following words: corrosion resistance, electrical conductivity, bauxite, zinc, silicon, liquid.

Exercise 7. Find and correct the mistakes in the text based on the text from Ex.1:

Chloride aluminium

Are chloride aluminium an solid whitish, $A1C1_3$, which have fuming on moist air and reacting violently to water (to have given chloride hydrogen). It are knowed in salt the anhydrous (hexagonal; r.d. is 2.44 (fused solid); m.p. is 190°C (2.5 atm.); it sublime at 178°C) or the hexahydrate $A1C1_3.6H_2O$ (rhombic; r.d. 2.398 is ; lose it water in 100°C), both of which is deliquescent. Chloride aluminium may is prepare in pass chloride hydrogen or chlorine at hot aluminium or in pass chlorine to heated oxide aluminium and carbon. is polarizes the ion chloride by small ion positive aluminium and the bonding on the solid are intermediate between covalent and ionic. On the phases in liquid and vapour dimer molecules existed, $A1_2C1_6$, in which there is bridges chlorine who makes coordinate binds on atom aluminium . can also formed the $A1C1_3$ molecule compounds under other molecules who donated pairs of electrons (e.g. amines or hydrogen sulphide); i.e. it acts in a acid Lewis . are used commercially Chloride aluminium to a catalyst under the cracking in oils. It are also a catalyst in certain other organ reactions, especially above the reaction Friedel-Crafts

Exercise 8.

a) Put the verbs in the correct tense form, paying attention to the voice.

1. Aluminium chloride (dissolve) in water.
2. Last year a very interesting report about the interaction of tungsten with oxygen (to publish) by us.
3. We just (to find out) the composition of this substance.
4. Aluminium chloride (to use) in the cracking of oils.
5. The strength of aluminium (to improve) by work-hardening.
6. We (to develop) a new type of fuel which (not to pollute) the environment.
7. When (to invent) overhead power cable ?
8. How (to produce) carbon dioxide industrially ?
9. Nowadays many chemists (to pay) more attention to the problem of the corrosion of metals.
10. What (to be) your understanding of the term “corrosion” ?
11. To determine the properties of this substance we (to employ) the method developed by Hopkins.
12. This article (to discuss) the solvolytic disproportionation of terbium oxide.

b) Compare aluminium with cobalt using comparative and superlative degrees on the scheme given in Lesson 4.

c) Chemical quiz: Are these sentences true or false ?

1. Aluminium chloride is a bluish solid.
2. Aluminum a brown metallic element without luster and it belongs to the group 5 of the periodic table.

3. Carbon reacts with aluminium and forms water.
4. Pure aluminium is soft and ductile.
5. The $A1C1_3$ molecule can also form compounds with other molecules that donate pairs of electrons.
6. Alloying elements include copper, silicon, tungsten and magnesium.
7. Aluminum is extracted from purified smaltine.
8. Cobalt is oxidized by hot air and also reacts with carbon, phosphorus, sulphur and dilute mineral acids.

d) Finish the sentences:
1. Cobalt is a …
2. Carbon has …
3. Bismuth is also used in …
4. Aluminium is protected by …
5. Aluminum chloride sublimes ….
6. Diamond occurs …
7. Citric acid is contained …

Texts for educational purposes

Colloids

Colloids were originally defined by Thomas Graham in 1861 as substances, such as starch or gelatin, which will not diffuse through a membrane. He distinguished them from crystalloids (e.g. inorganic salts), which would pass through membranes. Later it was recognized that colloids were distinguished from true solutions by the presence of particles that were too small to be observed with a normal microscope yet were much larger than normal molecules. Colloids are now regarded as systems in which there are two or more phases, with one (the dispersed phase) distributed in the other (the continuous phase). Moreover, at least one of the phases has small dimensions (in the range nT^9-10 ^{6} m). Colloids are classified in various ways.

Sols are dispersions of small solid particles in a liquid. The particles may be macromolecules or may be clusters of small molecules. Lyophobic sols are those in which there is no affinity between the dispersed phase and the liquid. An example is silver chloride dispersed in water. In such colloids the solid particles have a surface charge, which tends to stop them coming together. Lyophobic sols are inherently unstable and in time the particles aggregate and form a precipitate. Lyophilic sols, on the other hand, are more like true solutions in which the solute molecules are large and have an affinity for the solvent. Starch in water is an example of such a system. Association colloids are systems in which the dispersed phase consists of clusters of molecules that have lyophobic and lyophilic parts. Soap in water is an association colloid .

Emulsions are colloidal systems in which the dispersed and continuous phases are both liquids, e.g. oil-in-water or water-in-oil. Such systems require an emulsifying agent to stabilize the dispersed particles.

Gels are colloids in which both dispersed and continuous phases have a three-dimensional network throughout the material, so that it forms a jelly-like mass. Gelatin is a common example. One component may sometimes be removed (e.g. by heating) to leave a rigid gel (e.g. silica gel).

Other types of colloid include aerosols (dispersions of liquid or solid particles in a gas, as in a mist or smoke) and foams (dispersions of gases in liquids or solids).

Flocculation

Flocculation is the process in which particles in a colloid aggregate into larger clumps. Often, the term is used for a reversible aggregation of particles in which the forces holding the particles together are weak and the colloid can be redispersed by agitation. The stability of a lyophobic colloidal dispersion depends on the existence of a layer of electric charge on the surface of the particles. Around this are attracted electrolyte ions of opposite charge, which form a mobile ionic atmosphere. The result is an electrical double layer on the particle, consisting of an inner shell of fixed charges with an outer mobile atmosphere. The potential energy between two particles depends on a repulsive interaction between double layers on adjacent particles and an attractive interaction due to van der Waals' forces between the particles.

At large separations, the repulsive forces dominate, and this accounts for the overall stability of the colloid. As the particles become closer together, the potential energy increases to a maximum and then falls sharply at very close separations, where the van der Waals' forces dominate. This potential-energy minimum corresponds to coagulation and is irreversible. If the 'ionic strength of the solution is high, the ionic atmosphere around the particles is dense and the potential-energy curve shows a shallow minimum at larger separation of particles. This corresponds to flocculation of the particles. Ions with a high charge are particularly effective for causing flocculation and coagulation.

Dipole and dipole-dipole interaction

Dipole is a pair of separated opposite electric charges. The dipole moment (symbol u) is the product of the positive charge and the distance between the charges. Dipole moments are often stated in debyes. The SI unit is the coulomb meter. In a diatomic molecule, such as HC1, the dipole moment is a measure of the polar nature of the bond; i.e. the extent to which the average electron charge is displaced towards one atom (in the case of HC1, the electrons are attracted towards the more electronegative chlorine atom). In a polyatomic molecule, the dipole moment is the vector sum of the dipole moments of the individual bonds. In a symmetrical molecule, such as tetrachloromethane ($CC1_4$), there is no overall dipole moment, although the individual C-Cl bonds are polar.

Dipole-dipole interaction is the interaction of two systems, such as atoms or molecules, by their dipole moments. The energy of dipole-dipole interaction depends on the relative orientation and the strength of the dipoles and how far apart they are. A water molecule has a permanent dipole moment, thus causing a dipole-dipole interaction if two water molecules are near each other. Although isolated atoms do not have permanent dipole moments, a dipole moment can be induced by the presence of another atom near it, thus leading to induced dipole-dipole interactions. Dipole-dipole interactions are responsible for van der Waals' forces and surface tension in liquids.

Texts from scientific articles

Journal of Electroanalytical Chemistry

Polarographic behaviour of Cerium (IV)

Introduction

The polarographic study of strong oxidant ionic species, such as Ce (1V), presents serious limitations with the dropping mercury electrode because of the easy oxidability of mercury. We obtain, in fact, polarographic waves which start at the zero of the e.m.f. applied. These waves were utilized by Canneri and Cozzi for analytical purposes. The difficulty of studying the behavior of ceric ion with the dropping mercury electrode justifies the dearth of bibliographic notices upon problems connected with the equilibrium of the red/ox couple Ce (IV)/Ce (III) in the dynamic phase. With the realization of the bubbling platinum electrode which is analogous to the dropping mercury electrode, it is possible to extend polarographic investigations even to strong oxidant ionic species, such as ceric ion. As is known, the ceric ion forms complexes with several reducing ligands but their existence is not compatible with the oxidant powers of ceric ion which reduces itself, in a very short time, to cerous ion. Therefore we have investigated sulphure complexes , which present not only notable stability but , with the non-reducing character of the ligand , are compatible with the strong oxidant character of Ce (1V).

Summary

The Ce (1V) reduction in sulphuric media on the bubbling smooth platinum electrode was widely investigated. The influence on the ceric ion behavior of H_2SO_4 ionic activity, the presence of catalysts, as well as the temperature change was observed. The conditions under which the red/ox Ce (1V)/Ce (III) system becomes reversible in sulphuric media are defined and the influence of acidity, catalysts and temperature are studied. Finally a polarographic direct determination of Ce (1V) is described.

Lesson 7

Part 1

Dependent Participle Constructions

Dependent participle constructions - are constructions that don't have a word, denoting a doer or an object, before the participle. So when you translate such kind of constructions you should repeat a subject in a subordinate clause. Dependent participle constructions without a conjunction are translated by a subordinate clause with the word "который", e.g.: Barometer is an instrument measuring atmospheric pressure. - Барометр - это прибор, который измеряет атмосферное давление. Dependent participle constructions with a conjunction are translated by a subordinate clause with the words: "когда", "если", "если не", e.g.: When frozen water is a colourless solid - Когда вода заморожена, она представляет собой бесцветное твердое вещество. Sometimes in translating the word combinations with "if", "as", "unless", "when" we need to repeat a subject. Such situations can be met with the constructions: as it was mentioned - как упоминалось, if it is desired - если нужно, unless it is stated - если не утверждается, as it is seen - как видно. In this cases subject can be omitted. E.g.: If it is desired the instrument may be used . - Если нужно, этот прибор может быть использован. As mentioned above the experiment was successful - Как упоминалось выше, эксперимент был успешным.

Practice

Translate the following sentences paying attention to the translation of dependent participle constructions.

1. While taking part in the discussion he advanced his famous theory.
2. While being treated for several hours the compound turned dark red.
3. While being a boy he showed a great aptitude to chemistry.
4. When exposed to sunlight the peroxide is isomerized to the oxidoketone.
5. While being a young man of 16 Kekule synthesized his first compound.
6. When filtered through a crucible the solution was washed with water.
7. After having been developed this method was widely used by many researchers.
8. After standing for some time this solution was poured onto ice.
9. The product containing chlorine has varied as a result of temperature rise.
10. The gas rates reported in literature range from 10 to 400 ml/min.
11. The close agreement of six compounds listed here is unlikely to be a coincidence.

Part 2

Exercise 1. Read and translate the text. Make the summary of the text.

Ammonia

Ammonia is a colourless gas, NH_3, with a strong pungent odour; r.d. is 0.59 (relative to air); m.p. is -77.7°C; b.p. is -33.35°C. It is very soluble in water and soluble in alcohol. The compound may be prepared in the laboratory by reacting ammonium salts with bases such as calcium hydroxide or by the hydrolysis of a nitride. Industrially it is made by the Haber process and over 80 million tons per year are used either directly or in combination. Major uses are the manufacture of nitric acid, ammonium nitrate, ammonium phosphate and urea (the last three as fertilizers), explosives, dyestuffs and resins.

Liquid ammonia has some similarity to water as it is hydrogen bonded and has a moderate dielectric constant, which permits it to act as an ionizing solvent. It is weakly self-ionized to give ammonium ions, NH_4^+ and amide ions, NH_2^-. It also dissolves electropositive metals to give blue solutions, which are believed to contain solvated electrons. Ammonia is an extremely soluble in water giving basic solutions that contain solvated NH_3 molecules and small amounts of the ions NH_4^+ and OH^-. The combustion of ammonia in air yields nitrogen and water. In the presence of catalysts NO, NO_2 and water are formed; this last reaction is the basis for the industrial production of nitric acid. Ammonia is a good proton acceptor (i.e. it is a base) and gives rise to a series of ammonium salts, e.g.

$NH_3 + HC1 \rightarrow NH_4^+ + Cl^-$.

It is also a reducing agent.

The participation of ammonia in the nitrogen cycle is a most important natural process. Nitrogen-fixing bacteria are able to achieve similar reactions to those of the Haber process, but under normal conditions of temperature and pressure. They release ammonium ions, which are converted by nitrifying bacteria into nitrite and nitrate ions.

Vocabulary

ammonia - аммиак
pungent - едкий
alcohol - спирт
hydrolysis - гидролиз
ammonium nitrate - нитрат аммония
ammonium phosphate - фосфат аммония
urea - мочевина, карбамид
fertilizer - удобрение
explosive - взрывчатое вещество
dyestuff - краситель
resin - смола
moderate - усредненный
to permit - позволять
solvent - растворитель
combustion - горение
to contain - содержать
to nitrify - нитрифицировать
to yield - вызывать, приводить к образованию
bacterium (pl. bacteria) - бактерия
nitrogen-fixing bacteria - бактерии, связывающие азот
to give rise - приводить к образованию

to release - высвобождать proton acceptor - акцептор протонов
nitrogen cycle - азотный цикл

Exercise 2. Answer the following questions.

1. Where is ammonia soluble?
2. What substance is liquid ammonia similar to?
3. How is ammonia made industrially?
4. What substances does ammonia give when it burns in air?
5. What are the major uses of ammonia?

Exercise 3. Put questions to the bold-typed words.

1. **Ammonia** may be prepared **in the laboratory** by **reacting ammonium salts with bases.**
2. **Ammonia** is a good proton acceptor.
3. In the presence of **catalysts** NO, NO_2 and water are formed.
4. **Moderate dielectric constant** permits ammonia **to act as an ionizing solvent**.
5. **Ammonia** is used in the manufacture of **nitric acid.**
6. Ammonia dissolves **electropositive metals.**
7. **When burnt in air** ammonia yields **nitrogen and water**.

Exercise 4. Match the definition with the correct word.

1. Chemical energy is	a) a substance that causes a chemical reaction to happen quickly.
2. Carbon monoxide is	b) a process of using fuel to produce heat or energy.
3. Commercial use means	c) a poisonous gas produced by the engines of vehicles.
4. Compound is	d) an energy which is stored in fuels.
5. Catalyst is	e) use in business.
6. Burning is	f) a chemical substance that consists of two or more elements that together form a molecule.
7. Potassium hydroxide is	g) a white alkaline compound that is used, for example, in soap manufacture.

Exercise 5. Give the synonyms for the following words and make up sentences with them: burning, to yield, amount, to give rise, to convert, important, to release, manufacture.

Exercise 6. Put the following words in the gaps: to contain, amount, vehicles, to release, pungent, fertilizers, bacteria.

1. We have obtained a large … of calcium oxide during this experiment.
2. This cheese has very … odour.
3. Ammonia … hydrogen and nitrogen.
4. Yesterday there were a lot of parked … near the theatre.
5. When heating water solution ammonia gas … .

6. Our farmers usually use many … to make soil more fertile.
7. … exist in large quantities in air, water, dead creatures and plants.

Exercise 7. Make the following sentences interrogative and negative.

1. Liquid ammonia has some similarity to water.
2. Nitrogen - fixing bacteria are able to achieve the reactions which are similar to the reaction of the Haber process.
3. It also dissolves electropositive metals.
4. The combustion of ammonia in air yields nitrogen and water.
5. It is very soluble in water and soluble in alcohol.
6. Ammonia is a good proton acceptor.

Exercise 8.: Paraphrase the following expressions using attributive chain and translate them.

E.g.: the reduction of carbon – carbon reduction:

1. the technology of the production of fullerenes;
2. the production of soot;
3. the synthesis of vinyl acetate;
4. the pyrolysis of ethylene;
5. the technique of the determination of the content of soot particles;
6. the investigation of the rare earth oxides of terbium and praseodymium.;
7. the combustion of ammonia;
8. the modifications of electric field;
9. the solution of ammonia.

Texts for educational purposes

Synthesized and natural compounds of nitrogen

Amides are organic compounds containing the group $-CO.NH_2$ (the amide group). Compounds containing this group are primary amides. Secondary and tertiary amides can also exist, in which the hydrogen atoms on the nitrogen are replaced by one or two other organic groups respectively. Simple examples of primary amides are ethanamide, CH_3CONH_2, and propanamide, $C_2H_5CONH_2$. They are made by heating the ammonium salt of the corresponding carboxylic acid. Amides can also be made by reaction of ammonia (or an amine) with an acyl halide. Amides can also be defined as inorganic compounds containing the ion NH_2^-, e.g. KNH_2 and $Cd(NH_2)_2$. They are formed by the reaction of ammonia with electropositive metals.

Amination is a chemical reaction in which an amino group ($-NH_2$) is introduced into a molecule. Examples of amination reaction include the reaction of halogenated hydrocarbons with ammonia (high pressure and temperature) and the reduction of nitro- compounds and nitriles.

Amines are organic compounds derived by replacing one or more of the hydrogen atoms in ammonia by organic groups. Primary amines have one hydrogen replaced, e.g. methylamine, CH_3NH_2. They contain the functional group $-NH_2$ (the amino group). Secondary amines have two hydrogens replaced, e.g. methylethylamine, $CH_3(C_2H_5)NH$. Tertiary amines have all three hydrogens replaced, e.g. trimethylamine, $(CH_3)_3N$. Amines are produced by the decomposition of organic matter. They can be made by reducing nitro compounds or amides.

Amine salts are salts similar to ammonium salts in which the hydrogen atoms attached to the nitrogen are replaced by one or more organic groups. Amines readily form salts by reaction with acids, gaining a proton to form a positive ammonium ion. They are named as if they were substituted derivatives of ammonium compounds; for example, dimethylamine ($(CH_3)_2NH$) will react with hydrogen chloride to give dimethylammonium chloride, which is an ionic compound $[(CH_3)_2NH_2]^+ Cl^-$. When the amine has a common nonsystematic name the suffix -ium can be used; for example, phenylamine (aniline) would give $[C_6H_5NH_3]^+ Cl^-$, known as anilinium chloride. Formerly, such compounds were sometimes called hydrochlorides, e.g. aniline hydrochloride with the formula $C_6H_5NH_2.HC1$.

Salts formed by amines are crystalline substances that are readily soluble in water. Many insoluble alkaloids (e.g. quinine and atropine) are used medicinally in the form of soluble salts (hydrochlorides). If alkali (sodium hydroxide) is added to solutions of such salts the free amine is liberated. If all four hydrogen atoms of an ammonium salt are replaced by organic groups a quaternary ammonium compound is formed. Such compounds are made by reacting tertiary amines with halogen compounds; for example, trimethylamine ($(CH_3)_3N$) with chloromethane (CH_3C1) gives tetramethylammonium chloride, $(CH_3)_4N^+ Cl^-$. Salts of this type do not liberate the free amine when alkali is added, and quaternary hydroxides (such as $(CH_3)_4N^+ OH^-$) can be isolated. Such compounds are strong alkalis, comparable to sodium hydroxide.

Amino acid is any of a group of water-soluble organic compounds that possess both a carboxyl (-COOH) and an amino ($-NH_2$) group attached to the same carbon atom, called the α-carbon atom. Amino acids can be represented by the general formula $R-CH(NH_2)COOH$. R may be hydrogen or an organic group and determines the properties of any particular amino acid. Through the formation of peptide bonds, amino acids join together to form short chains (peptides) or much longer chains (polypeptides). Proteins are composed of various proportions of about 20 commonly occurring amino acids. The sequence of these amino acids in the protein polypeptides determines the shape, properties and hence biological role of the protein. Some amino acids that never occur in proteins are nevertheless important, e.g. ornithine and citrulline, which are intermediates in the urea cycle.

Plants and many microorganisms can synthesize amino acids from simple inorganic compounds, but animals rely on adequate supplies in their diet. The essential amino acids must be present in the diet whereas others can be manufactured from them.

On acids and their properties

Acid is a type of compound that contains hydrogen and dissociates in water to produce positive hydrogen ions. The reaction, for an acid HX, is commonly written

$HX = H^+ + X^-$.

In fact, the hydrogen ion (the proton) is solvated and the complete reaction is:
$HX + H_2O = H_3O^+ + X^-$.

The ion H_3O^+ is the oxonium ion (or hydroxonium ion or hydronium ion). This definition of acids comes from the Arrhenius theory. Such acids tend to be corrosive substances with a sharp odor, which turn litmus red and give colour changes with other indicators. They are referred to protonic acids and are classified into strong acids, which are almost completely dissociated in water (e.g. sulphuric acid and hydrochloric acid) and weak acids, which are only partially dissociated (e.g. ethanoic acid and hydrogen sulphide). The strength of an acid depends on the extent to which it dissociates, and is measured by its dissociation constant. In the Lowry-Brensted theory of acids and bases (1923), the definition was extended to one in which an acid is a proton donor (Brensted acid) and a base is a proton acceptor (Brensted base). For example, in $HCN + H_2O = H_3O^+ + CN^-$.

The HCN is an acid, in that it donates a proton to H_2O. The H_2O is acting as a base in accepting a proton. Similarly, in the reverse reaction H_3O^+ is an acid and CN^- is a base. In such reactions, two species related by loss or gain of a proton are said to be conjugate. Thus, in the reaction above HCN is the conjugate acid of the base CN^- and CN^- is the conjugate base of the acid HCN. Similarly, H_3O^+ is the conjugate acid of the base H_2O. An equilibrium, such as that above, is a competition for protons between an acid and its conjugate base. A strong acid has a weak conjugate base and vice versa. Under this definition water can act as both acid and base. Thus in
$NH_3 + H_2O = NH_4^+ + OH^-$ the H_2O is the conjugate acid of OH^-. The definition also extends the idea of acid-base reaction to solvents other than water. For instance, liquid ammonia, like water, has a high dielectric constant and is a good ionizing solvent. Equilibria of the type:
$NH_3 + Na^+Cl^- = NaNH_2 + HC1$ can be studied, in which NH_3 and HC1 are acids and NH_2^- and CI^- are their conjugate bases.

A further extension of the idea of acids and bases was made in the Lewis theory (G. N. Lewis, 1923). Here a Lewis acid is a compound or atom that can accept a pair of electrons and a Lewis base is one that can donate an electron pair. This definition encompasses traditional acid-base reactions. In
$HCl + NaOH = NaCl + H_2O$
the reaction is essentially $H^+ + :OH^- = H:OH$
i.e. donation of an electron pair by OH^-. But it also includes reactions that do not involve ions, e.g.
$H_3N: + BC1_3 = H_3NBC1_3$ in which NH_3 is the base (donor) and $BC1_3$ is the acid (acceptor). The Lewis theory establishes a relationship between acid-base reactions and oxidation-reduction reactions.

Acidic describes a compound that is an acid, a solution that has an excess of hydrogen ions and a compound that forms an acid when dissolved in water. Carbon dioxide, for example, is an acidic oxide.

Acidic hydrogen is a hydrogen atom in an acid that forms a positive ion when the acid dissociates.

Acid salt is a salt of a polybasic acid (i.e. an acid having two or more acidic hydrogens) in which not all the hydrogen atoms have been replaced by positive ions. For example, the dibasic acid carbonic acid (H_2CO_3) forms acid salts (hydrogencarbonates) containing the ion HCO_3^-. Some salts of monobasic acids are also known as acid salts. For instance, the compound of potassium hydrogendifluoride, KHF_2, contains the ion $[F...H-F]^-$, in which there is hydrogen bonding between the fluoride ion F^- and hydrogen fluoride molecule.

Acidimetry is a volumetric analysis using standard solutions of acids to determine the amount of base present.

Texts from scientific articles

Journal: Analytica Chimica Acta

Oxidizing properties of Perchloric Acid solution

Introduction

The oxidizing properties of hot concentrated perchloric (chloric (VII)) acid are well known. From the oxidations performed the reduction potential of the boiling perchloric acid-water azeotrope is estimated to be +2.0 V. As noted by Smith, this suggests the possibility of using this reagent to oxidize cerium to the tetravalent state. However, no suitable procedure has been published. Indeed, cerium is not oxidized to the tetravalent state by boiling with perchloric acid alone, a fact utilized by O’Laughlin to determine chromium in a chromium-cerium-uranium alloy. Although a faint yellow color appears in cerium solutions during boiling with perchloric acid , the solution becomes colorless when it is cooled and or diluted with water. However , if a small amount of sulphuric (VI) acid is also present, rapid oxidation occurs , indicated by the appearance of the characteristic red-orange color of cerium(IV). This paper presents a satisfactory procedure and optimum conditions for the oxidation of cerium(III) to cerium(1V) using a mixture of hot concentrated perchloric and sulphuric (VI) acids. The procedure is potentially useful for the oxidimetric determination of cerium as well as for the preparation of cerium (IV) solutions that are free of foreign cations and of anions other than sulphate and perchlorate.

Journal: Analytica Chimica Acta

Oxidation of Cerium (III) to Cerium (1V)

Reagents and equipment.

Cerium (IV) sulphate solution, 0.1 N . A stock solution of cerium (IV) sulphate was prepared by slurring 438.6 g of primary standard grade ammonium hexanitratocerate (IV) in 450 ml of concentrated sulphuric (VI) acid and slowly diluting with water to 8:1 while stirring vigorously. After standing for 2 days a significant amount of precipitate formed, and the solution therefore was decanted. It was standardized against arsenious oxide using osmium tetroxide (osmium (IV) oxide) as a catalyst, and against electrolytic iron, and found to be 0.1000 N. This value was confirmed by subsequent restandardization at intervals throughout the work.

Oxidations were carried out in 300 ml conical flasks equipped with special condenser heads to prevent loss of material by spattering and reduce the escape of perchloric acid into the atmosphere by condensing the vapours in the neck of the flask.

Samples containing 4-5meq of cerium were taken for each oxidation so that subsequent titrations could be carried out using an ordinary 50-ml Normax burette. The same burette was used for both titrations and measuring sample solutions to eliminate errors in glassware calibration.

Lesson 8

Part 1

Absolute Participle Constructions

An absolute participle construction - is an independent sentence which is marked by commas and has a subject followed by a predicate. This construction is translated by a subordinate clause. If it is placed at the beginning of a sentence it is translated by a subordinate clause with the conjunctions: “так как”, “когда”, “если”, “хотя”, “после того как” and etc. E.g.: The choice having been made, all the other alternatives have been rejected - После того, как выбор был сделан, все другие возможности были отвергнуты. If the construction is placed at the end of a sentence it is translated by a subordinate clause with the conjunction: “причем”. E.g.: We carried out a series of reactions, the raw materials brought from laboratory - Мы провели серию реакций, причем исходные материалы были взяты из лаборатории. Sometimes absolute participle constructions can be introduced with the conjunction: “with” and be translated with a subordinate clause with conjunctions: “когда”, “причем”, “так как”. E.g.: With water being cooled, the rate of reaction is low - Когда воду охлаждают, скорость реакции ниже. “With” has a few meanings: 1) с; 2) путем, с помощью; 3) в зависимости; 4) в случае; 5) в соответствии. Along with - наряду с, with an exception - за исключением; with no exception - без исключения, with regard to - относительно.

Vocabulary

binding power - способность к образованию связи
mean - среднее значение
dative π bonds- донорные π связи
preheater - предварительный нагреватель
Grignard reagent - реагент Гриньяра
carboxylic acids - карбоновые кислоты
to seek - притягивать

Practice

Translate the following sentences paying attention to the translation of absolute participle constructions.

1. The temperature being 10 ^{0}C, water boiled quickly.
2. A new technique having been worked out, the yield rose.
3. All the values found experimentally are considerably higher, their mean being 6.54.
4. The experiments having been carried out, we started new investigations.
5. We found new routes of synthesis, the older ones being unsatisfactory.
6. Electrophilic reagents are those which seek electrons, the most common being positive ions.
7. This theory assumed binding power as an intrinsic property of atoms, the number of bonds formed by an atom, its valence being characteristic for each kind of atom.
8. Here only one of the rings retains its symmetrical and aromatic character, the other being linked to cobalt by dative π bonds from two conjugated double bonds.
9. In many ways the reduction resembles the action of Grignard reagent, hydrogen entering the reactant molecule in the place of an alkyl or aryl group.
10. With the isomerization preceding the reaction, the yields were low.
11. A preheater is unnecessary with the oxygen normally available.
12. A number of compounds were prepared and tested with the results of any promise.
13. Carboxylic acids exist in dimeric form with very hydrogen strong bridges between carbonyl and hydroxyl groups.

Part 2

Exercise 1. Read and translate the text. Make the summary of the text.

Electric - field - induced flame speed modification

A rather large amount of works has been reported on the various effects of electric field on a wide variety of flames. However, the mechanisms responsible for the dramatic field-induced effects on the size and shape of the inner cone of some hydrocarbon flames are still not well understood. Bradley provides a good overview of this subject.

Electric - field - induced modifications of flame geometry have been known for some time, the first report being published by Chattock in 1889. Since then, many aspects of the effects of externally applied fields have been investigated. For example, increases in flame blow-off flow rate due to the application of external fields in both diffusion and premixed methane-air flames have been measured. Similar increases in flame stability have also been observed at fields sufficient to produce a corona discharge within the flame. Improved heat transfer to solid surfaces due to externally applied fields has been reported. Increased burning velocities for hydrocarbon flames in direct current (DC) fields and elevated temperatures for flames in microwave fields have been similarly established. It has also been shown that soot formation in diffusion flame is diminished by application of DC external field. Flame extinction limits in premixed flame are also perturbed by DC fields. The most extensive efforts to construct and test theoretical model sufficient to predict the maximum practical effects of electric fields on flames are contained in the publications by Lawton and co-workers. Recently, a kinetic model simulating the effects of electric fields in premixed methane flames has been used to simulate microgravity in small diffusion flames.

The effects of pulsed and continuous direct current electric fields on the reaction zones of premixed propane/air flames have been investigated using several types of experimental measurements. All observed effects on the flame are dependent on the applied voltage polarity, indicating that negatively charged flame species do not play a role in the perturbation of the reaction zone. Experiments characterize the electric-field-induced modifications of the shape and size of the inner cone, and the concomitant changes in the temperature profiles of flames with equivalence ratios between 0.7 and 0.8 are also reported. High-speed two-dimensional imaging of the flame response to a pulsed direct current voltage shows that the unperturbed conical flame front (laminar flow) is driven into wrinkled laminar flame (cellular) geometry on a time scale of the order of 5 ms. Temperature distributions derived from pyrometry measurements in flames perturbed by continuous direct current field show similar large changes in the reaction zone geometry, with no change in maximum flame temperature. All measurements are consistent with the observed flame perturbations being a fluid mechanical response to the applied field brought about by forcing positive flame ions counter to the flow. The resulting electric pressure decreases. The observed increases in flame speed and the flame front trend toward turbulence can be described in terms of the wrinkling of flame front and concomitant increase in reaction sheet area. This effect is a potentially attractive means of controlling flame fluid mechanical characteristics. The observed effects require a minimal input of electrical power due to the better electric field coupling in the present experiments to the previous studies.

Vocabulary

modification - видоизменение
dramatic - резкий
to induce - индуцировать
various - различный
speed - скорость
size - размер
shape - форма
inner - внутренний
cone - конус
electric field - электрическое поле
flame - пламя
flow rate - скорость потока
flame blow -off - срыв пламени
diffusion flame - диффузионное пламя
premixed flame - пламя предварительно смешанных горючих веществ
to perturb - возмущать
corona discharge - коронный разряд
applied field - приложенное поле
hydrocarbon flame - углеводородное пламя

heat transfer - передача тепла
to simulate - моделировать
DC (direct current) - постоянный ток
external - внешний
to establish - устанавливать
extinction - затухание
to observe - наблюдать
to investigate - исследовать
soot formation - сажеобразование
velocity - скорость
to diminish - уменьшаться
microgravity - микрогравитация
reaction zone - реакционная зона
propane - пропан
voltage - напряжение
applied voltage - приложенное напряжение
ratio - соотношение
pressure - давление
concomitant - сопутствующий
fluid - жидкий, жидкость
pyrometry - пирометрия
laminar flow - ламинарный поток

Exercise 2. Answer the following questions.

1. Who published the first report about electric - field - induced –flame – speed modifications?
2. Why can one observe increases in flame blow-off flow rate?
3. Due to what scientific fact has improved heat transfer to solid surfaces been reported?
4. How is soot formation diminished in diffusion flame?
5. How have the effects of pulsed and continuous direct current electric fields on the reaction zones of premixed propane/air flames been investigated ?

Exercise 3. Put questions to the bold-typed words.

1. **Kinetic model** has been used to simulate **microgravity in small diffusion flames**.
2. Electric - field - induced modifications of flame geometry have been known for **some time**.
3. Many aspects of **the effects of externally applied fields** have been investigated.
4. **Increases in flame stability** have also been observed **at fields sufficient to produce a corona discharge within the flame.**
5. **Flame extinction limits** in **premixed flame** are **also perturbed** by **DC fields**.
6. **Bradely** provides a **good overview of this subject**.
7. **All observed effects** on the flame are dependent on the **applied voltage polarity**.
8. Experiments characterize the **electric-field-induced modifications**.
9. **Temperature distributions** derived from pyrometry measurements in flames were perturbed by **continuous direct current field**.
10. **The resulting** electric pressure decreases.
11. A rather large amount of works has been reported on **the various effects of electric field on a wide variety of flames.**
12. **Increased burning velocities** for hydrocarbon flames in direct current field have been established.
13. **Soot formation** in **diffusion flame** is diminished by **application of DC external field**.
14. **The observed effects** require a **minimal input of electrical power**.

Exercise 4. Translate the following sentences into English.

1. Изменения скорости горения углеводородных пламеней происходит в процессе передачи тепла.
2. В результате изменения температуры плавления на твердой поверхности образуются частицы сажи, которые в дальнейшем коагулируются.
3. Процесс моделирования условий для горения предварительно смешанных пламеней проводился в лабораторных условиях.
4. Увеличение стабильности пламени происходит под действием коронного разряда.
5. Изменения скорости пламени, вызываемые электрическим полем, происходят под действием постоянного тока.
6. Чтобы ускорить процесс получения частиц сажи, используется приложенное поле.

Exercise 5. Translate the following sentences into Russian.

1. Electric - field - induced modifications of flame geometry have been recently investigated.

2. Recently we have used a kinetic model to simulate microgravity in small diffusion flames.
3. Similar increases in flame stability have also been observed at fields sufficient to produce a corona discharge within the flame.
4. However, the mechanisms responsible for the dramatic field-induced effects on the size and shape of the inner core of some hydrocarbon flames is still not well understood.
5. Flame extinction limits in premixed flame are also perturbed by DC fields.
6. The effects of pulsed and continuous direct current electric fields on the reaction zones of premixed propane/air flames have been investigated.
7. The observed increases in flame speed can be caused by the flame front wrinkling.

Exercise 6. Guess the concept based on the definition.

1. A hard type of iron that doesn't bend easily and is shaped by pouring the hot liquid metal into a mould.
2. A soft metal from which aluminium is obtained.
3. A natural or artificial compound that consists of large molecules that are made from combinations of small simple molecules.
4. The measurement in degrees of how cold or hot a thing or place is.
5. The amount of space that an object or a substance fills.
6. Electrical force which is measured in volts.

Exercise 7. Find and correct the mistakes.

Fullerene production

Fullerenes is expect to is one of a first carbon nanomaterials to are wide employing for various commercial applications. However, none critical factor who have limited a development in such applications are high cost and limited availability under fullerenes. Many of this problem is due in the small-scaling, batch nature of fullerene production use carboning arcs. On contrast, the combustion method generate soot with an very high yield above fullerenes use a continuous and easily scalable process. We developed a combustion system who have to produce fullerenes in the tons for year scale. Use this system, a laminar premixed flat sooting low-pressure toluene/ oxygen flame who produced fullerenes were investigated. When the atomic C/O ratio were high, the fullerene content declined even though the fuel, pressure, and other combustion conditions was same. On the other leg, the fullerene content reminded constant when the cold gas velocity were increased from 0.78 m/s to 1.7 m/s.

Exercise 8. Put the following sentences into Active:

1. The effects of pulsed and continuous direct current electric fields on the reaction zones of premixed propane/air flames have been investigated by us.
2. Electric - field - induced modifications of flame geometry was reported by Chattock in 1889.

3. Flame extinction limits in premixed flame are also perturbed by DC.
4. Heat transfer was caused by applied field.
5. Temperature distributions in flames were perturbed by continuous direct current field.
6. A good overview of this subject was provided by Bradely.
7. A minimal input is required by the observed effects.
8. Kinetic model was used by us to simulate microgravity.
9. Total soot yield was measured by us.
10. A new technique has been developed by us to reach high soot yield.

Text from a scientific article

Journal: Progress in Energy and Combustion Science

Flame configurations

Introduction

This review focuses on flames studies; the conditions in laboratory flames resemble those in combustors more closely than do the conditions in non-flame systems such as flow reactors, jet-stirred reactors and shock tubes. The most important difference, with respect to aromatics formation, is the breadth of the reactant pool. The non-flame systems usually contain a much smaller set of hydrocarbons; this makes them ideal for studying specific reaction pathways, but means that the relative importance of a group of competing pathways can differ from the case in flames.

Most laboratory flames can be classified as premixed or nonpremixed based on the mixing state of the reactants. In premixed flames, the fuel and oxidizer mix before the flame and approach the main reaction front together. In a nonpremixed flame, the fuel and oxidizer do not mix before the flame and they approach the main reaction front from opposite sides. Spark-ignition engines contain premixed flames because the fuel and air are perfectly mixed (in principle) with a flame front propagating through the mixture. Diesel engines contain nonpremixed flames because the fuel and air are not well-mixed and regions of evaporating fuel are surrounded by air with a flame front at the interface between the fuel vapor and air. Roughly speaking, premixed flames are easier to study, but nonpremixed flames more closely resemble the combustors where soot forms. This article reviews studies in both configurations; Section 2 discusses premixed flames and Section 3 discusses nonpremixed flames.

Lesson 9

Part 1

Gerund

The gerund is a very important grammatical peculiarity of scientific and technical texts. It is formed by adding the ending -ing to the verb: to read – read*ing*, to paln - plann*ing*.

The features of the gerund:

1. the gerund as a verb:

a) can have a direct object: carrying out experiments - проведение экспериментов;

b) is defined by an adverb: reading books aloud - чтение книг вслух) can have both a simple form (doing) and a compound form (being done, having done, having been done);

2. the gerund as a noun**:**

a) possessive pronouns, prepositions and attributes can be before the gerund:

his reading - его чтение
for measuring - для измерения
my sister’s singing - пение моей сестры.

However, there are no articles before the gerund.

Techniques for gerund translation

1. It can be translated by a verb, e.g.: *Saying* is the one thing but *doing* is another - *Сказать* - это одно, а *сделать* другое.

2. It can be translated as a participle, e.g.: By *doing* nothing we learn to do ill - Ничего *не делая*, мы учимся делать зло.

3. It can be translated by a noun, e.g.: We have obtained new results by *considering* changes in temperature -Мы получили новые результаты посредством *исследования* изменений температуры.

Vocabulary

betain - бетаин
choline - холин
to diminish - снижать
mercaptan – меркаптан

Practice

Translate the following sentences paying attention to the gerund.

1. Seeing is believing.
2. They were against postponing the meeting.
3. It is worthwhile thinking over the effect I have just described.
4. We were all for starting this experiment.
5. The transfer to a slide for microscope reading requires careful handling.
6. This company started manufacturing synthetic catalyst in 1942.
7. Balancing is done by adjusting the position of the rods.
8. This is done by employing two gas channels.
9. They kept working.
10. Passing carbon vapours over the catalyst gives the moderate yield of mercaptan.
11. Carrying out this reaction was hindered.

12. Substituting sulphur for nitrogen in the compounds of betain and choline types diminishes this effect.

Part 2

Exercise 1. Read and translate the text. Make the summary of the text.

Fine particle toxicity and soot formation

Atmospheric particles can be classified as fine particles or coarse particles. The fine particles are typically formed by chemical processes such as soot formation, whereas the coarse particulates are formed by physical processes such as grinding of soil during road construction. Numerous studies over the past decade, in both the United States and Europe, have concluded that exposure to fine particles increases mortality due to heart and lung disease. Since these studies involve real-world subjects they can’t be completely definitive. However, the results are reproducible and have withstood considerable scrutiny. Furthermore , the magnitude is potentially enormous: the toxicity of fine particles may cause up to 60, 000 deaths per year in the United States which is more than either homicide or traffic accidents (about 15, 000 and 40, 000 annual deaths). Overall, these considerations have been persuasive enough to cause regulatory action. For example, the United States Environmental Protection Agency has adopted a new health effects-based Ambient Quality Standard that limits the maximum allowable ambient concentrations of fine particles. It estimates that meeting these standards will cost more than 30 billion US dollars per year and require the development of the new control technology.

Soot formation is a complex process that involves many chemical and physical steps. They include: 1) the decomposition of the hydrocarbons in the fuel; 2) the formation of small aromatic hydrocarbons from decomposition products; 3) the growth of the small aromatics to the compounds containing larger numbers of rings; 4) the inception of the small soot particles from the large aromatic hydrocarbons and 5) the growth of the small particles to the particles with larger masses. In this review, ‘fuel decomposition’ refers to chemical consumption of the fuel by any chemical process, including either unimolecular or bimolecular reactions. The dividing line between the small and large aromatics is ~ 3 benzenoid rings. We have chosen this value so that the small aromatics are the compounds formed by the addition of the first new benzenoid ring to the aliphatic, single-ring and two-ring hydrocarbons that constitute the bulk of combustion fuels, while the large aromatics are the compounds formed by subsequent growth steps. This division is significant because the addition of the first new ring is typically the rate-controlling step in soot production. Furthermore, the mechanisms of the first ring addition are much more sensitive to the chemical structure of the fuel than subsequent growth steps. All of these steps are important research topics. Indeed too much literature exists on each one to cover them all in a single review. Instead this review will focus on fuel decomposition and small aromatics formation.

Although fuel decomposition and small aromatics formation constitute only a small part of the overall soot formation process, they are frequently the rate-controlling steps and thus they strongly influence the soot concentration in flames.

Vocabulary

soot - сажа
particle - частица
fine particle - тонкодисперсная частица
coarse particle - крупнозернистая частица
grinding - измельчение
soil - почва
to withstand - выдержать, пройти
decade - десятилетие
scrutiny - тщательное изучение, исследование
magnitude - величина
homicide - убийство
to adopt - принять
ambient - внешняя среда, внешний, окружающий
to estimate - насчитывать, оценивать
allowable - допустимый
to require - требовать
to prevent - предотвращать
lungs - легкие
mortality - смертность
data - данные
inception - начало
aromatic - ароматическое соединение
benzonoid ring - бензоидное кольцо
value - значение
bulk - масса
rate - скорость

Exercise 2. Answer the following questions.

1. Why are fine particles toxic?
2. How can atmospheric particles be classified?
3. How are fine and coarse particles formed?
4. What physical and chemical steps does the process of soot formation include ?
5. What is your understanding of the term: “soot formation”?

Exercise 3. Put questions to the bold-typed words.

1. **The fine particles** are typically formed by **chemical processes** such as soot formation.
2. **The coarse particles** are formed by **physical processes**.
3. A new health effects-based Ambient Quality Standard limits the **maximum allowable ambient concentrations of fine particles.**
4. These studies involve **real-world subjects.**
5. **The meeting of these standards** will cost more **than 30 billion US dollars** per year.
6. Soot formation is a complex process that involves **many chemical and physical steps.**

7. In this review, ‘fuel decomposition’ refers to **chemical consumption of the fuel by any chemical process.**
8. **The small aromatics** are the compounds formed by the addition of **the first new benzenoid** ring.
9. The mechanisms of first ring addition are **very sensitive**.

Exercise 4. Translate the following sentences.

1. Atmospheric particles can be two types.
2. Fine particles are formed by chemical processes such as soot formation.
3. Exposure to fine particles can be very dangerous for environment and human’s health.
4. To prevent the negative impact of fine particles on people’s health the United States government has adopted new legislation.
5. To preserve our environment we should meet these standards.
6. Soot formation includes many stages.
7. The small aromatics are formed by the addition of the first new benzenoid ring.
8. The addition of this ring is a very important step in soot production because this step controls the rate of soot formation.

Exercise 5. Give the equivalents for the following words and make up sentences with them: to adopt, fine particles, coarse particles, toxicity, standard, ambient, to cause, mortality, heart, lung, disease, to withstand, scrutiny, soot, grinding, soil, particle, rate, soot, ring, single-ring, benzenoid ring, aromatic.

Exercise 6. **Background** can be translated as основа, основание, общее положение, исходный, основной, общий. Translate the following sentences paying attention to the meaning of the word **background.**

1. The discussion of thermal interactions is particularly important, and it serves as a background to the coverage of laser surgery.
2. With the theoretical discussion as a background, an expression for the amount of solar visible radiation will be derived.
3. The background on holographic microscopy and pattern recognition is not treated here.
4. The paper presents a concise treatment of major application with more than usual emphasis on the background physics.
5. The goal of this paper is to present background information about hydrocarbon flames.

Exercise 7. Put the following sentences into Passive.

1. We have investigated the effect of nonthermal plasma on diffusion flames experimentally.
2. Yesterday we studied the effects of flame on the behavior of electrical discharge.
3. Recently we have identified the regime of plasma generation.
4. We have decreased the effect of stream on flame behavior.

5. We are measuring the temperature of burnt gases now.
6. Now we are investigating new species.

Exercise 8. Reading check: correct the mistakes in the summary of the text.

Fine particle toxicity and soot formation

Soot establishing is an easy process that involve many mechanical and physical phases. They include: 1) the collapse of the hydrocarbons in the oil; 2) the formation of little aromatic hydrocarbons from collapse products; 3) the rise of the little aromatics to the combinations including bigger numbers of rings; 4) the beginning of the little soot particles from the bigger aromatic hydrocarbons and 5) the rise of the little particles to the particles with greater masses. In this review, 'oil collapse' refers to physical consumption of the oil by any physical process, including either organic or inorganic reactions. The dividing band among the little and great aromatics is ~ 3 benzenoid rings. We choose this meaning so that the little aromatics are the compounds done by the addition of the first new benzenoid ring to the aliphatic, single-ring and two-ring hydrocarbons that make up the volume of burning fuels, while the great aromatics are the combinations made by subsequent rise steps. This division is significant because the addition of the first new ring is typically the speed-controlling step in soot obtaining.

Texts from scientific articles

Journal: Progress in Energy and Combustion Science

Studies of aromatic hydrocarbon formation mechanisms in flames

Introduction

This review article concerns the chemical mechanisms of fuel decomposition and small aromatic hydrocarbon formation in fuel-rich flames. These processes are essential steps towards soot production, and, in most cases, they are the rate-controlling steps. Most studies of fuel decomposition and aromatics formation in flames have used small hydrocarbons such as methane, ethylene and acetylene as the fuel. However, recent research has begun to close the “gap” between these small hydrocarbons and the larger, more structurally complex hydrocarbons that constitute all liquid combustion fuels. We believe that this research has progressed to the point where a review of its methods and conclusions is appropriate.

Discussion

Soot particles formed in combustors are important for many well-known reasons: their contribution to radiant heat transfer, their industrial value as pigments and tire additives, their capacity to clog flow passages, etc. We discuss two recent developments that provide additional motivation for understanding and reducing soot formation.

The climate-change community refers to soot particles suspended in the atmosphere as black carbon. These particles warm the atmosphere directly by absorbing sunlight and indirectly by affecting cloud formation. Most other atmospheric particles, such as sulphates, primarily scatter sunlight and cause cooling. The magnitude of warming from black carbon is difficult to estimate: the short atmospheric lifetime of particles causes their concentrations to vary greatly with time and geographical location. Several recent calculation conclude that the radiative forcing due to the black carbon is 0.5 – 0.8 W/m^2, while other studies put it much lower. If the larger values are correct, then black carbon plays a critical role in warming: its forcing would be one-third to one-half of the forcing due to CO_2(1,46 W/m^2) and would be larger than the forcing from the second most important greenhouse gas (CH_4; 0.48 W/m^2). This comparison has led several atmospheric scientists to argue that reducing soot emissions is a better strategy for countering warming than reducing CO_2 emissions. Some of the reasons for focusing on soot include: (1) it has other adverse consequences, whereas warming is the only issue associated with CO_2, (2) its short atmospheric lifetime means that soot reductions will rapidly affects the global temperature, and (3) it results from combustion inefficiency, which can be prevented with proper engineering, whereas CO_2 is an inevitable product of hydrocarbon combustion.

Lesson 10

Part 1

Functions of the Gerund in a Sentence

In a sentence the gerund can play a few roles.

1. Role of a subject: the gerund is placed before a predicate and translated as a noun, e.g.: Obtaining cytokines is a stage process. - Получение цитокининов - это стадийный процесс.
2. Role of an attribute: the gerund is placed before the word it belongs to, e.g. : the melting point. In this case it is translated as a noun: melting point - температура плавления.
3. Role of an adverb: the gerund can have a preposition and can be translated as an adverbial participle, e.g.: Through having investigated new types of polymers we obtained new materials - Исследовав свойства полимеров, мы получили новые материалы.
4. Role of an object: the gerund is placed before a predicate and can be translated as a noun, e.g.: The turbulent flow of gases produces cooling - Турбулентное течение газов вызывает охлаждение.
5. Also the gerund can play the role of the nominal part of a compound predicate. Such kind of verbs can be:

a) link - verb “to be” which is translated by the words “заключаться”, “являться”, e.g.:This technique is to determine the composition of any substance in an exact way. - Этот метод заключается в точном определении состава любого вещества.

b) Verbs that mean continuation, beginning or interruption of an action: to start, to continue, to go on, to finish, to keep on, e.g.: The temperature went on rising - Температура продолжала увеличиваться.

Also a special attention should be paid to the word combinations after which gerund is used:

cannot help - нельзя (не можем не). E.g.: He couldn't help crying. - Он не мог не плакать.

It is worth (worthwhile) - стоит. E.g.: It is worth seeing it. - Это стоит увидеть.

No use - нет смысла, бесполезно. E.g.: It is no use considering this method. - Не имеет смысла рассматривать этот метод.

Practice

Translate the following sentences paying attention to the gerund. What role does it play in the sentences ?

1. Appetite comes with eating.
2. A committee has been established for coordinating the nomenclature.
3. From here on, the theory starts evaluating the various alternatives of action in terms of the objectives.
4. It is no use of speaking of it.
5. Upon switching off the current the pressure dropped.
6. Instead of using chlorine they took bromine.
7. The new opportunities may make life on this planet much more worth living.
8. In fact neither shock cooling nor any other method has been found to give an entirely amorphous product.
9. The heating of metallic surface until sintering occurs invariably.
10. This method is passing hydrocarbon with hydrogen over the catalyst.
11. For convenience in writing these models are represented by the projection formulas.
12. Using this procedure we were able to reach good results.
13. This process causes increasing the yield of hydrocarbons.

Part 2

Exercise 1. Read and translate the text. Make the summary of the text.

Electroanalysis with chemically modified electrodes

The feasibility of using electrodes with functionalized polymer films for performing electroanalysis in solution is demonstrated. The proposed approach not only takes the advantages of the favorable aspects of chemically modified electrodes (e.g. sensitivity) but also provides many synthetic variations (and therefore) as well as ways to detect and overcome matrix and saturation effects. The method is based on the use of copolymer films that incorporate both an electroactive center (used for inducing precipitation of the polymer on the electrode) and a coordinating site chosen on the basis of the species. Even though the method is presented in the context of electroanalysis of metal ions in solution, this approach could be extended to be determination of organic functionalities through the appropriate choice of reagents.

Today there is a great need for the development of analytical methods for the selective and quantitative determination of metal ions and organic contaminants at trace level, particularly, in the light of new challenges posed by environmental samples. One field that offers great potential in this respect is that comprised by chemically modified electrodes. Chemically modified electrodes are very suitable for electroanalytical applications since they offer high sensitivity. There have been some reports on the use of chemically modified electrodes for electroanalysis. One of the first examples of the analytical utility of these modified interfaces was represented by Lane and Hubbard. In their work they complexed Fe (III) ions from the aqueous solution using a salicylate ligand that was chemisorbed to a platinum surface via an olefinic group. They furthermore hinted at the possibility of modulating the coordinative properties of the interface through the control of the electrode potential. Cheek and Nelson reported on the determination of Ag (I) from the solution using modified carbon paste electrodes. They reported a truly remarkable detection limit. M. Oyama and Anson reported on the use of polymer modified electrodes capable of incorporating metal complexes either by coordination to pyridine groups in the polymer or electrostatic binding to polycationic or polyanionic polymer films. They reported that they could incorporate ions from solutions as dilute as 5 x 10^{-8} M. These studies point to the feasibility of using not only metal/ligand interaction but electrostatic effects for performing electroanalysis.

Cox and Majda incorporated Fe(II) onto a platinum electrode modified with absorbed adenosine 5-monophosphate and subsequently determined the amount of incorporated ions via cyclic voltammetry. Price and Baldwin reported on the use of ferrocene carboxaldehyde for the determination of aromatic amines absorbed on the surface of a platinum electrode. They reported the detection limits that are equal to 10^{-7} M. These authors also point out the different aspects (such as saturation) that must be kept in mind when attempting to use these modified interfaces for analytical purposes.

Vocabulary

feasibility - возможность
copolymer - сополимер
polymer - полимер
precipitation - осаждение
selective - селективный
quantitative - количественный
determination - определение
contaminant - загрязнитель, загрязняющее вещество
utility - полезность
interface - контактная поверхность
aqueous - водный
ligand - лиганд
salicylate - соль или эфир салициловой кислоты
platinum – платина
olefinic group - олефиновая группа
to incorporate - включать

pyridine - пиридин
paste electrode - пастовый электрод
reagent - реагент
adenosine - аденозин
ferrocene - ферроцен
amine - амин
saturation - насыщение
voltammetry- вольтамперометрия

Exercise 2. Answer the following questions.

1. Why are chemically modified electrodes useful for electroanalytical applications?
2. What scientists have already made a report about analytical utility of chemically modified electrodes?
3. Ions of which chemical element did Lane and Hubbard extract from the aqueous solution?
4. What did Cheek and Nelson make a report about?
5. What electrodes did Oyama and Anson investigate? Why?

Exercise 3. Put questions to the bold-typed words.

1. Today there is a great need for the development of analytical methods for **the selective and quantitative determination of metal ions.**
2. **The feasibility of using electrodes** is demonstrated.
3. The method is based on **the use of copolymer films**.
4. **Cheek and Nelson** reported on **the determination of Ag (I) from the solution.**
5. **Chemically modified electrodes** are very suitable for **electroanalytical applications.**
6. Electrodes offer **high sensitivity**.
7. One of the first examples of the analytical utility of these modified electrodes was represented by **Lane and Hubbard**.
8. There have been some reports on **the use of chemically modified electrodes**.
9. They reported **a truly remarkable detection limit**.
10. **Price and Baldwin** reported on the use of ferrocene carboxaldehyde for **the determination of aromatic amines**.
11. Amines are absorbed **on the surface**.
12. These authors also point out **the different aspects**.
13. **Cox and Majda** incorporated **Fe(II)** onto **a platinum electrode**.
14. **The proposed approach** takes only the advantages of **the favorable** aspects of chemically modified electrodes.

Exercise 4. Give the equivalents for the following words and make up sentences with them: utility, sensitivity, film, interface, surface, an electrode, determination, to be suitable for, reagent, aqueous, development, to incorporate, ferrocene, to report, amine, saturation, absorption.

Exercise 5. Translate the following sentences.

1. Analytical methods for the selective and quantitative determination of metal ions are under development today.
2. We used salicylate ligand to complex Fe (III) ions from the aqueous solution.
3. The determination of Ag (I) ions is a difficult and time-consuming process.
4. To define the composition of this substance we used chemically modified past electrodes.
5. The sample of soot was placed on the substrate (подложка) for further investigation.
6. These electrodes have high sensitivity that allows using them in many spheres.
7. To study the chemical properties of calcium we used modified electrodes.
8. Cox and Majda incorporated Fe(II) onto a platinum electrode modified with absorbed adenosine 5-monophosphate and subsequently determined the amount of incorporated ions via cyclic voltammetry.
9. These authors also point out the different aspects (such as saturation) that must be kept in mind when attempting to use these modified interfaces for analytical purposes.
10. These electrodes are widely-used for electroanalytical purposes.

Exercise 6. Give the definitions for the following words: an electrode, reagent, ligand, pyridine, olefinic group.

Exercise 7. Put the verbs in the correct tense form.

1. Recently new paste electrodes (to develop) in our laboratory.
2. While John (to research) flame-speed modifications, our research team (to obtain) a new type of polymer.
3. Last month Dr. Oyma and his colleagues (to make) a report about their remarkable experimental results at the conference.
4. When Stan (come) Dr. Richardson (to research) perturbations of the flame.
5. This substance (to have) amphoteric properties.
6. Be oxide (to react) with acids.
7. These detection limits (to report) by us last year.
8. This method (to be based) on the use of polymers.
9. You just (to make) an interesting offer.
10. The previous results (to be) much better than these ones.
11. We (to discuss) this topic later.
12. He (not to describe) the properties of this element yet.
13. When I (to come) home my parents (to discuss) something very important.

Exercise 8.

a) Put the words into the gaps: need, organic, trace, use, offer, sensitivity, for, examples, by, utility, applications, modified, samples, reports.

Utility of chemically modified electrodes

Today there is a great …. . For the development of analytical methods for the selective and quantitative determination of metal ions and …. contaminants at … level, particularly, in the light of new challenges posed by environmental … One field that offers great potential in this respect is that comprised by chemically … electrodes. Chemically modified electrodes are very suitable … electroanalytical … since they … high … . There have been some … on the …. of chemically modified electrodes for electroanalysis. One of the first … of the analytical … of these modified interfaces was represented … Lane and Hubbard.

b) Finish the sentences:

1. Price and Baldwin reported on the use of …
2. Chemically-modified electrodes offer …
3. Chemically modified electrodes are very suitable for …
4. These studies point to the feasibility of …
5. This method is based on …
6. They complexed Fe (III) ions from …

c) Grammar quiz: correct the mistakes:

1. Cox and Majda incorporated Fe(II) from a platinum electrode.
2. They furthermore hintes on the possibility of modulating the coordinative properties.
3. There has been some reports for the use of chemically modified electrodes for electroanalysis.
4. These studies points in the feasibility of use not only metal/ligand intaraction but electrostatic effects for performing electroanalysis.

d) Reading check: Are these sentences true or false?:

1. Today there is no need for the development of analytical methods for the selective and quantitative determination of metal ions and organic contaminants at trace level.
2. Hunter reported on the use of hydrogen for the determination of aromatic amines absorbed on the surface of a platinum electrode.
3. Cheek and Nelson reported on the determination of Fe (I) from the solution.
4. Chemically modified electrodes are very suitable for electroanalytical applications since they don't offer high sensitivity.

Texts for educational purposes

Electrochemical processes

Electrochemistry is the study of chemical properties and reactions involving ions in solution, including electrolysis and electric cells.

Main concepts of electrochemistry.

Electrical double layer is a model of the interface between an electrode and the solution close to it. In this model a sheet of one type of electrical charge surrounds the surface of the electrode and a sheet of the opposite charge surrounds the first sheet in the solution. In the Helmholtz model the double layer is regarded as consisting of two planes of charge, with the inner plane of ions from the solution being caused by the charge on the electrode and the outer plane being caused by oppositely charged ions in the solution responding to the first layer of ions. In the Gouy - Chapman model (diffuse double layer) thermal motion of ions is taken into account. Neither model is completely successful since the Helmholtz model exaggerates the rigidity of the structure of the charges and the Gouy-Chapman model underestimates the rigidity of the structure. The Stern model improves on both models by assuming that the ions next to the electrode have a rigid structure, while taking the second layer to be as described by the Gouy-Chapman model.

Electrochemical equivalent is the mass of a given element liberated from a solution of its ions in electrolysis by one coulomb of charge.

Electrode is a conductor that emits or collects electrons in a cell, thermionic valve, semiconductor device, etc. The anode is the positive electrode and the cathode is the negative electrode.

Electrode potential is the potential difference produced between the electrode and the solution in a half cell. It is not possible to measure this directly since any measurement involves completing the circuit with the electrolyte, thereby introducing another half cell**.** Standard electrode potentials are defined by measuring the potential relative to a standard hydrogen half cell using 1.0 molar solution at 25°C. The convention is to designate the cell so that the oxidized form is written first. For example,

$Pt(s) \mid H_2(g)H^+ (aq) \mid Zn^{2+}(aq) \mid Zn(s)$ .The e.m.f. of this cell is -0.76 volt (i.e. the zinc electrode is negative). Thus the standard electrode potential of the $Zn^2+\mid Zn$ half cell is -0.76 V.

Electrolyte is a liquid that conducts electricity as a result of the presence of positive or negative ions. Electrolytes are molten ionic compounds or solutions containing ions. i.e. solutions of ionic salts or of compounds that ionize in solution. Liquid metals, in which the conduction is done by free electrons, are not usually regarded as electrolytes. Solid conductors of ions, as in the sodium-sulphur cell, are also known as electrolytes.

Electrolysis is the production of a chemical reaction by passing an electric-current through an electrolyte. In electrolysis, positive ions migrate to the cathode and negative ions to the anode. The reactions occurring depend on electron transfer at the electrodes and are therefore redox reactions. At the anode, negative ions in solution may lose electrons to form neutral species. Alternatively, atoms of the electrode can lose electrons and go into solution as positive ions. In either case the reaction is an oxidation. At the cathode, positive ions in solution can gain electrons to form neutral species. Thus cathode reactions are reductions.

Electrolysis –law-based methods

Electrodeposition is the process of depositing one metal on another by electrolysis, as in electroforming and electroplating.

Electrolytic refining is the purification of metals by electrolysis. It is commonly applied to copper. A large piece of impure copper is used as the anode with a thin strip of pure copper as the cathode. Copper (II) sulphate solution is the electrolyte. Copper dissolves at the anode: $Cu \rightarrow Cu^{2+} + 2e$ and is deposited at the cathode. The net result is transfer of pure copper from anode to cathode. Gold and silver in the impure copper form a so-called (anode sludge at the bottom of the cell, which is recovered.

Electrolytic separation is a method of separating isotopes by exploiting the different rates at which they are released in electrolysis. It was formerly used for separating deuterium and hydrogen. On electrolysis of water, hydrogen is formed at the cathode more readily than deuterium, thus the water becomes enriched with deuterium oxide.

Electroplating is a method of plating one metal with another by electrodeposition. The articles to be plated are made the cathode of an electrolytic cell and a rod or bar of the plating metal is made the anode. Electroplating is used for covering metal with a decorative, more expensive, or corrosion-resistant layer of another metal.

Methods based on the movement of charged particles in electric field (electromigration)

Electrodialysis is a method of obtaining pure water from water containing a salt, as in desalination. The water to be purified is fed into a cell containing two electrodes. Between the electrodes there is placed an array of semipermeable membranes alternately semipermeable to positive ions and negative ions. The ions tend to segregate between alternate pairs of membranes, leaving pure water in the other gaps between membranes. In this way, the water being fed is separated into two streams: one of pure water and the other of more concentrated solution.

Electrophoresis (cataphoresis) is a technique for the analysis and separation of colloids, based on the movement of charged colloidal particles in an electric field. There are various experimental methods. In one the sample is placed in a U-tube and a buffer solution added to each arm, so that there are sharp boundaries between buffer and sample. An electrode is placed in each arm, a voltage applied and the motion of the boundaries under the influence of the field is observed. The rate of migration of the particles depends on the field, the charge on the particles and on other factors, such as the size and shape of the particles. More simply, electrophoresis can be carried out using an adsorbent, such as a strip of filter paper, soaked in a buffer with two electrodes making contact. The sample is placed between the electrodes and a voltage applied. Different components of the mixture migrate at different rates, so the sample separates into zones. The components can be identified by the rate at which they move. In gel electrophoresis the medium is a gel, typically made of polyacrylamide, agarose or starch. Electrophoresis, which has also been called electrochromatography, is used extensively in studying mixtures of proteins, nucleic acids, carbohydrates, enzymes, etc. In clinical medicine it is used for determining the protein content of body fluids.

Lesson 11

Part 1

The forms of the Gerund

Indefinite Gerund means that an action occurs simultaneously with an action expressed by a predicate: active voice.

Perfect Gerund means an action that occurred before an action expressed by a predicate.

Active Gerund means that a subject does an action expressed by gerund itself.

Passive Gerund means an action which is expressed by gerund and comes to a subject. E.g.: We know of the work being carried out in the laboratory. - Мы знаем, что эту работу выполняют в лаборатории. In this case gerund in Indefinite form (being carried out) is translated by a verb in Present tense. In Perfect form it will be translated by a verb in Past tense. E.g.: We know of the work having been carried out in the laboratory. - Мы знаем, что эту работу выполнили в лаборатории.

Practice

Translate the following sentences paying attention to the forms of the gerund.

1. He avoids being involved in such affairs.
2. He avoided having been involved in such affairs.
3. We are interested in the results being obtained by our colleagues.
4. We are interested in the results having been obtained by colleagues.
5. This issues deserves being discussed at the conference.
6. We rely on the data of electrochemical analysis having been obtained during the experiment.
7. The solution having been standing for some time turned into ice.
8. This procedure having been developed by us is finding increasing use.
9. These substances being studied by us are common to sulphates.
10. The nitro compound obtained in our laboratory is still active.

11. Solubility parameters being used by many researchers are useful for selecting solvents.
12. The compound having been added into solution was less reactive.
13. The compounds having been obtained by us are free of admixtures.
14. This is due to the reaction running at a low temperature.
15. I like studying electronics.
16. I hate missing lectures.
17. The lecture having been delivered by Prof. Thomson was very interesting.
18. They were busy packing.
19. They started working.
20. The properties of this substance being investigated are of a great importance for industry.
21. When I came into the room they were discussing his article.

Part 2

Exercise 1. Read and translate the text**.**

Coal

It has been proved that all coals had their origin in the vegetable matter of prehistoric forests. The woody fiber and other vegetable matters were transformed into peat by fermentation due to bacteria. During this process, a great part of oxygen and hydrogen was eliminated, while the amount of carbon remained practically the same. Subsequently the peaty matter was changed into coal by a process of destructive distillation, which had been caused by great pressure and high temperature. The differences in types of coal can be easily explained by different conditions during this process of evolution. Among these variable conditions by which the formation of coal had been affected the following may be mentioned: time, depth of the bed below the surface of the Earth, and amount of disturbance of the bed due to the movements of the Earth. So one can say that coal is a brown carbonaceous deposit that was derived from the accumulation or alteration of ancient vegetation which originated largely in swamps or other moist environments.

Peat is an intermediate condition between wood and coal. It is often used as fuel in the Temperate Zone, where it is found in large quantities in the swampy regions. It is commonly cut into blocks and dried in the air.

Foreign matter was introduced during this movement of the Earth. Coal is composed of the following principal elements: carbon, oxygen, hydrogen, nitrogen and sulphur. As the process of coalification (i.e. the transformation resulting from high temperatures and pressures) continues there is a progressive transformation of the deposit: the proportion of carbon relative to oxygen rises and volatile substance and water are driven out. The various stages in this process are referred to as ranks of the coal. These ranks are given below.

Lignite or brown coal is soft and brown and has a high moisture content. Bituminous coal is the name which is usually given to coal containing more than 20

% of volatile matter. Subbituminous coal is used chiefly by power - generating stations. Bituminous coal is not susceptible to spontaneous combustion, although care must be exercised in its storage. Semianthracit coal has a fixed carbon content of between 86% and 92 % and anthracite coal which is hard and black with a fixed carbon content of between 92% and 98%. Since there is a wide range of variation in the characteristics of the bituminous coals, they have been divided commercially into the following classes: coking, cannel and non-coking. Coking coal upon being burned gives off gas and tends to fuse together in a pasty mass (coke). Cannel coal has a high percentage of volatile hydrocarbons, ignites easily and is so valuable as a gas-producing coal that it is rarely burnt to produce steam. Non-coking coal does not coke upon being burned and is very extensively used as a fuel to produce steam.

Most deposits of coal were formed during the Carboniferous and Permian periods. The more recent periods of coal formation occurred during the early Jurassic and Tertiary periods. Coal deposits occur in all the major continents. The leading producers include the USA, China, the Ukraine, Poland, the UK, South Africa, India, Australia, Germany. Coal is used as a fuel in industry.

Vocabulary

coal - уголь
vegetable matter - вещество растительного происхождения
prehistoric - доисторический
woody fiber - древесное волокно
peat - торф
fermentation - ферментация
to eliminate - удалять, извлекать
destructive distillation - сухая перегонка
depth - глубина
bed - пласт
elementary state - первоначальное состояние
volatile - летучий, быстро испаряющийся
bituminous coal - битуминозный уголь
to be susceptible to smth. - подвергаться чему-либо
storage - хранение
cannel coal - кеннельский уголь
to give off - выделять
to fuse - соединяться
Temperate Zone - умеренный пояс
to exercise - использовать
swamp - болото
subbituminous coal - полубитуминозный уголь, бурый уголь
carboniferous - угленосный, карбоновый
carbonaceous - каменноугольный, углеродистый
Permian - Пермский
lignite - лигнит, бурый уголь
anthracite - антрацит

Exercise 2. Answer the following questions.

1. What process causes the transformation of peaty matter into coal?
2. How can one explain differences in the types of coal?
3. What elements is coal composed of?
4. What is peat?

5. What is bituminous coal?

Exercise 3. Put questions to the bold-typed words.

1. **Bituminous coal** contains **more than 20 %** of volatile matter.
2. Coals have been divided commercially into the following classes: **coking, cannel and non-coking.**
3. Coking coal **upon being burned** gives off gas**.**
4. **Cannel coal** has a high percentage of **volatile hydrocarbons**.
5. Non-coking coal is used as **a fuel to produce steam**.
6. Bituminous coal is not susceptible to **spontaneous combustion**.
7. **Foreign matter** was introduced **during the movement of the Earth**.
8. Most deposits of coal were formed during **the Carboniferous and Permian periods.**

Task 4. Give the synonyms for the following words and make up sentences with them: to transform, to exercise, various, to produce, to affect, to give off.

Exercise 5. Give the explanation for the following words: coal, peat, cannel coal, coking coal, non-coking coal, combustion, fuel, hydrocarbon.

Exercise 6. Put the following words in the gaps: volatile, foreign matters, bituminous coal, to give off, to produce, to exercise, peat.

1. Ammonia is a … gas.
2. Concentrated nitric acid … brown vapors of $NO_{2.}$
3. Accumulator … electrical energy.
4. Care should be … to keep volatile substances.
5. … contains more that 20 % of volatile matter.
6. … have been found during excavations that are not characteristic of the modern landscape of that region.
7. … is used to improve garden soil.

Exercise 7. Put the following sentences into Active.

1. The determination of Ag (I) from the solution using modified carbon paste electrodes was reported by Cheek and Nelson.
2. One of the first examples of the analytical utility of these modified interfaces was represented by Lane and Hubbard.
3. The use of polymer modified electrodes capable of incorporating metal complexes was reported by Oyama and Anson.
4. Subsequently the peaty matter was changed into coal by the process of destructive distillation.
5. This volatile matter was obtained by us two year ago.
6. This process was caused by great pressure and high temperature.

Exercise 8. Make the summary of the text: “Coal” from Ex. 1

Texts for educational purposes

Types of fuel

Petroleum is a naturally occurring oil that consists chiefly of hydrocarbons with some other elements, such as sulphur, oxygen and nitrogen. In its unrefined form petroleum is known as crude oil (sometimes rock oil). Petroleum is believed to have been formed from the remains of living organisms that were deposited, together with rock particles and biochemical and chemical precipitates, in shallow depressions, chiefly in marine conditions. Under burial and compaction the organic matter went through a series of processes before being transformed into petroleum, which migrated from the source rock to become trapped in large underground reservoirs beneath a layer of impermeable rock. The petroleum often floats above a layer of water and is held under pressure beneath a layer of natural gas. Petroleum reservoirs are discovered through geological exploration: commercially important oil reserves are detected by exploratory narrow-bore drilling. The major known reserves of petroleum are in Saudi Arabia, Russia, China, Kuwait, Iran, Iraq, Mexico, USA, United Arab Emirates, Libya and Venezuela. The oil is actually obtained by the sinking of an oil well. Before it can be used it is separated by fractional distillation in refineries. The main fractions obtained are:

1. Refinery gas is a mixture of methane, ethane, butane and propane used as a fuel and for making other organic chemicals.
2. Gasoline is a mixture of hydrocarbons containing from 5 to 8 carbon atoms, boiling in the range of 40 - 180°C. It is used for motor fuels and for making other chemicals.
3. Kerosene (or paraffin oil) is a mixture of hydrocarbons having 11 or 12 carbon atoms, boiling in the range of 160 - 250°C. Kerosene is a fuel for jet aircraft and for oil-fired domestic heating. It is also cracked to produce smaller hydrocarbons for use in motor fuels.
4. Diesel oil (or gas oil) is a mixture of hydrocarbons having from 13 to 25 carbon atoms, boiling in the range of 220 - 350°C It is a fuel for diesel engines.

The residue is a mixture of higher hydrocarbons. The liquid components are obtained by vacuum distillation and used in lubricating oils. The solid components (paraffin wax) are obtained by solvent extraction. The final residue is a black tar containing free carbon.

Classification of fuels

The principal fuels used at present for making steam are coal, coke, wood, charcoal, peat, mineral oil, natural and artificial gas. All kinds of fuel may, in fact, be virtually subdivided into three classes: solid, liquid and gaseous. All coals seem to be derived from vegetable origin and their differences appeared as a result of the varying conditions under which they were formed. Anthracite coal consists almost entirely of carbon and inorganic matters; it contains little or no hydrocarbon at all. Some varieties appear to approach graphite in their characteristics and are burnt with difficulty unless at first mixed with other coals. Good anthracite is hard, compact and lustrous. It burns with very little flame unless it is moist, and gives a very intense fire, free of smoke. Even when carefully used, it is liable to break up at high temperatures and, in this way, the fine pieces may be lost with the ash. Semianthracite contains some hydrocarbon, is less dense than anthracite, ignites at once, and burns readily with a short flame. Bituminous coals contain a large and varying percents of hydrocarbons or bituminous matter. Their physical properties and behavior, when burning, vary widely so that classification is difficult, though at least three kinds may be distinguished : dry bituminous coals, caking bituminous coals and, at last, long-flaming bituminous coals. The latter has a strong tendency to produce smoke; some do and some do not cake at all while burning. Charcoal is made by charring wood; it is no longer used for making steam but is widely applied for special metallurgical purposes.

Lesson 12

Part 1

The gerundial constructions

The gerund and the words relating to it form gerundial constructions that usually begin with a preposition, a possessive pronoun or a noun. Gerundial constructions can be of two types:

1. Dependent gerundial constructions;
2. Absolute gerundial constructions.

Dependent gerundial constructions

Dependent gerundial constructions are constructions which don’t have a word denoting a doer before gerund. These gerundial constructions are translated into Russian by a subordinate clause and gerund itself is translated by a predicate, e.g.: This polymer differs from that one by having absorption properties - Этот полимер отличается от того тем, что он обладает адсорбционными свойствами.

Absolute gerundial constructions

Absolute gerundial constructions are constructions where is a word between a preposition and gerund. This word denotes a doer. Such kind of word can be a possessive pronoun or noun in common or possessive case. In translation of this construction a noun becomes a subject, a gerund becomes a predicate, e.g.: There is unmistakable proof of Pauling’s *having been wrong* - Имеются несомненные доказательства того, что Полинг ошибался.

Vocabulary

impurity - примесь
powder photograph - рентгенография порошков

tetraethyl germanium - тетраэтил германия
germanium -германий
to treat - обрабатывать

germanium tetrachloride - тетрахлорид германия
diethylzinc - диэтиловый цинк
to agitate - перемешивать
double bond - двойная связь
electron cloud - электронное облако
intermediate phases - промежуточные фазы
magnetic susceptibility - магнитная восприимчивость
to visualize - наблюдать, представлять
mercury - ртуть
antimony - сурьма
incompatible - несовместимый
nitrobenzene - нитробензол
by-product - побочный продукт
apparent - очевидный
radius - радиус
ammonium cyanate - цианат аммония

Practice

Translate the following sentences paying attention to the gerundial constructions.

1. Experiments showed that the starting products did indeed contain impurities.
2. Identical procedures are followed in preparing the powder photographs.
3. Winkler prepared tetraethyl germanium by treating germanium tetrachloride with diethylzinc.
4. Having analyzed antimony and mercury properties we came to the conclusion that they were incompatible .
5. Instead of having a magnetic susceptibility the substance proved to be diamagnetic.
6. Considering hydrolysis as the first order reaction it is possible to draw some conclusions.
7. While agitating the mixture no temperature rise was observed.
8. In approaching the double bond the radical may be visualized as a particle drawing out electron from electron cloud.
9. The possibilities for investigating the electronic structures of intermediate phases are very promising.
10. They pointed the reaction proceeding via two routes.
11. The extraction process can be economic on the basis of uranium being a by-product of the superphosphate.
12. Nitrobenzene cannot be heated above 170^{o} C with sulphuric acid without violent decomposition.
13. The reaction must have taken place with the data showing a change in the infrared region.
14. In a view of the reaction proceeding via other route the results were different.
15. Care must be taken to prevent moisture from the bottle diffusing into carbon dioxide tube.
16. On the basis of radius of the boron atom being 0.89 A, the apparent electron affinity of boron trifluoride was calculated to be 6.1 electron volts.

17. Under conditions which lead to a significant fraction of ammonium cyanate being associated as ion-pairs the treatment of the data should be different.

Part 2

Exercise 1. Read and translate the text.

Hydrogen bond

Hydrogen bond is a type of electrostatic interaction between molecules occurring in molecules that have hydrogen atoms bound to electronegative atoms (F, N, O). It can be regarded as a strong dipole-dipole attraction caused by the electron-withdrawing properties of the electronegative atom. Thus, in the water molecule the oxygen atom attracts the electrons in the O-H bonds. The hydrogen atom has no inner shells of electrons to shield the nucleus, and there is an electrostatic interaction between the hydrogen proton and a lone pair of electrons on an oxygen atom in a neighboring molecule. Each oxygen atom has two lone pairs and can make hydrogen bonds to two different hydrogen atoms. The strengths of hydrogen bonds are about one tenth of the strengths of normal covalent bonds. Hydrogen bonding does, however, have significant effects on physical properties. Thus it accounts for the unusual properties of water and for the relatively high boiling points of H_2O, HF and NH_3 (compared with H_2S, HC1 and PH_3). It is also of great importance in living organisms. Hydrogen bonding occurs between bases in the chains of DNA. It also occurs between the C=O and N-H groups in proteins and is responsible for maintaining the secondary structure. Hydrogen bonds are not purely electrostatic and can be shown to have some covalent character. Bond energy is an amount of energy associated with a bond in a chemical compound. It is obtained from the heat of atomization. For instance, in methane the bond energy of the C-H bond is one quarter of the enthalpy of the process:

$$CH_4(g) \rightarrow C(g) + 4H(g).$$

Bond energies (or bond enthalpies) can be calculated from the standard enthalpy of formation of the compound and from the enthalpies of atomization of the elements. Energies calculated in this way are called average bond energies or bond-energy terms. They depend to some extent on the molecule chosen. The C-H bond energy in methane will differ slightly from that in ethane. The bond dissociation energy is a different measurement, being the energy required to break a particular bond: e.g. the energy for the process.

Vocabulary

hydrogen bond - водородная связь
interaction - взаимодействие
negative - отрицательный
to attract - притягивать
to account for - объяснять
chain - цепь
nucleus (pl. nuclei) - ядро
compared with - по сравнению
enthalpy - энтальпия

Exercise 2. Answer the following questions.

1. What is hydrogen bond?
2. Where does oxygen atom attract the electrons in the O-H bonds?
3. What is the strength of hydrogen bond?
4. Why can't hydrogen atom shield the nucleus?
5. How many lone electron pairs does each oxygen atom have?

Exercise 3. Put questions to the bold-typed words.

1. **The hydrogen atom** has **no inner shells of electrons**.
2. **Hydrogen bonding** has significant effects on **physical properties**.
3. There is **an electrostatic interaction** between the hydrogen proton and a lone pair of electrons on an oxygen atom in a **neighboring molecule.**
4. **Hydrogen bond** is caused by **the electron-withdrawing properties.**
5. **Hydrogen** bonds are **not purely electrostatic**.
6. **Hydrogen bonding** occurs between **bases**.
7. These bases are in the chains of **DNA.**
8. Hydrogen bond has a **covalent** character**.**

Exercise 4. Give the equivalents for the following words and make up sentences with them: atom, electron, bond, covalent, shell, oxygen, interaction, proton, boiling point, chain, nucleus, to attract, attraction, lone.

Exercise 5. Put the following words in the gaps: lone, electrons, shell, to shield, DNA, properties, chain.

1. … are particles that are contained in the atoms of any substances.
2. Boron atom in outer … has three electrons.
3. Aluminium has amphoteric … .
4. … is a carrier of genetic properties of living organisms.
5. Hydrogen atom has a … electron.
6. He … his child with his own body.
7. Yesterday my brother gave me a beautiful golden … .

Exercise 6. Give the explanation for the following words: shell, electron, chain, DNA, proton, hydrogen bond, covalent bond, oxygen.

Exercise 7. Put the prepositions into the gaps: between, in, to, on, of, by, during,

1. Hydrogen bond is a type … electrostatic interaction … molecules.
2. It can be regarded as a strong dipole-dipole attraction caused … the electron-withdrawing properties … the electronegative atom.
3. … the water molecule the oxygen atom attracts the electrons.
4. The substance was placed … the substrate.
5. Each oxygen atom has two lone pairs and can make hydrogen bonds ... two different hydrogen atoms.
6. ... the experiment there were no changes.

Exercise 8. Find and correct the mistakes.

Ammonium hydrogen carbonate

Hydrogen ammonium carbonate (ammonium bicarbonate) are the white crystal compound, NH_4HCO_3. It are formed naturally as a decay product to nitrogenous matter and are made commercially to various methods: the action in carbon dioxide and steam under a solution in ammonium carbonate; a heating of commercial ammonium carbonate (which always contained some hydrogencarbonate); and a interaction to ammonia, carbon dioxide, and water vapor. It are using to some baking powders now medicine.

Texts for educational purposes

Noble gases

Noble gases (inert gases; rare gases; group 18 elements) is a group of monatomic gaseous elements forming group 18 (formerly group 0) of the periodic table: helium (He), neon (Ne), argon (Ar), krypton (Kr), xenon (Xe) and radon (Rn). The electron configuration of helium is Is^2. The configurations of the others terminate in ns^2np^6 and all inner shells are fully occupied. The elements thus represent the termination of a period and have closed-shell configuration and associated high ionization energies (He 2370 to Rn 1040 kj $^{mol-1}$) and lack of chemical reactivity. Being monatomic the noble gases are spherically symmetrical and have very weak interatomic interactions and consequent low enthalpies of vaporization. The behaviour of the lighter members approaches that of an ideal gas at normal temperatures; with the heavier members increasing polarizability and dispersion forces lead to easier liquefaction under pressure. Four types of compound have been described for the noble gases but of these only one can be correctly described as compounds in the normal sense. One type consists of such species as HHe^+. He_2^+, Ar_2^+, $HeLi^+$, which form under highly energetic conditions, such as those in arcs and sparks. They are short-lived and only detected spectroscopically. A second group of materials described as inert-gas-metal compounds do not have defined compositions and are simply noble gases adsorbed onto the surface of dispersed metal. The third type, previously described as 'hydrates' are in fact clathrate compounds with the noble gas molecule trapped in a water lattice. True compounds of the noble gases were first described in 1962 and several fluorides, oxyfluorides, fluoroplatinates, and fluoroantimonates of 'xenon are known. A few krypton fluorides and a radon fluoride are also known although the short half-life of radon and its intense alpha activity restrict the availability of information. Apart from argon, the noble gases are present in the atmosphere at only trace levels. Helium may be found along with natural gas (up to 7%), arising from the radioactive decay of heavier elements (via alpha particles).

Equilibrium and equilibrium constant

Equilibrium is a state in which a system has its energy distributed in the statistically most probable manner: a state of a system in which forces, influences, reactions and etc. balance each other out so that there is no net change. A body is said to be in thermal equilibrium if no net heat exchange is taking place within it or between it and its surroundings. A system is in chemical equilibrium when a reaction and its reverse are proceeding at equal rates (see also equilibrium constant). These are examples of dynamic equilibrium, in which activity in one sense or direction is in aggregate balanced by comparable reverse activity.

Equilibrium constant for a reversible reaction of the type is the following :
$xA + yB \leftrightarrow zC + wD$.

Chemical equilibrium occurs when the rate of the forward reaction equals the rate of the back reaction, so that the concentrations of products and reactants reach steady-state values. It can be shown that at equilibrium the ratio of concentration
is a constant for a given reaction and fixed temperature, called the equilibrium constant K_C (where the c indicates concentrations have been used). Note that, by convention, the products on the right-hand side of the reaction are used on the top line of the expression for equilibrium constant. This form of the equilibrium constant was originally introduced in 1863 by C. M. Guldberg and P. Waage using the law of mass action. They derived the expression by taking the rate of the forward reaction:
$k_f\ [A]^x [B]^y$
and that of the back reaction
$k_b [C]^z [D]^w$.

Since the two rates are equal at equilibrium, the equilibrium constant K_C is the ratio of the rate constants k_f / k_b. The principle that the expression is a constant is known as the equilibrium law or law of chemical equilibrium.

The equilibrium constant shows the position of equilibrium. A low value of K_C indicates that [C] and [D] are small compared to [A] and [B]; i.e. that the back reaction predominates. It also indicates how the equilibrium shifts if concentration changes. For example, if [A] is increased (by adding A) the equilibrium shifts towards the right so that [C] and [D] increase, and K_C remains constant.

For gas reactions, partial pressures are used rather than concentrations. The symbol K_P is then used. Thus, in the example above
$K_P = P_C^z\ P_D^w / P_A^x\ P_B^y$

It can be shown that, for a given reaction $K_P = K_C(RT)^{\Delta v}$ where Δv is the difference in stoichiometric coefficients for the reaction (i.e. $z + w - x - y$). Note that the units of K_P and K_C depend on the numbers of molecules appearing in the stoichiometric equation. The value of the equilibrium constant depends on the temperature. If the forward reaction is exothermic, the equilibrium constant decreases as the temperature rises: if endothermic it increases.

The expression for the equilibrium constant can also be obtained by thermodynamics: it can be shown that the standard equilibrium constant K^O is given by expression $(-\Delta G^O / RT)$, where ΔG^O - is the standard Gibbs free energy change for the complete reaction.

Lesson 13
Part 1
The Infinitive
The functions of the infinitive in a sentence

The infinitive is an indefinite form of a verb. In a sentence it can play a few roles:

1. role of a subject: it is usually put at the beginning of a sentence and can be rendered by the indefinite form of a verb or a noun, e.g.: **To think** otherwise would be mistake. - **Думать** по другому было бы ошибкой.
2. Role of an object: infinitive is put after a predicate and is translated into Russian by an indefinite form of a verb , e.g.: We try to minimize the old disadvantages. - Мы стараемся свести к минимуму, ранее имевшиеся недостатки.
3. Role of an attribute: in this case infinitive is put after the word which it relates to and is translated by a subordinate clause with the word «который». E.g.: The curves to be presented in Part V were obtained using this method. - Кривые, которые были представлены в главе V, были получены при помощи этого метода.
4. Role of a parenthetical word: infinitive is usually put at the beginning of a sentence and has commas. It can be translated by a verbal participle or by an indefinite form of a verb. E.g. To sum up, we shall present the table. - Подводя итог, приведем таблицу.

Examples of verbs that play the role of a parenthetical word in a sentence:

To begin with - прежде всего
To make a long story short - короче говоря
To mention – если упомянуть
To put it briefly - короче говоря
To put it simply – проще говоря
Needless to say - нет надобности говорить
To say nothing of – не говоря уже
Suffice it to say – достаточно сказать
To be exact – точнее говоря
To sum up – подводить итог.

5. Role of an adverbial modifier: it can be put at the beginning or at the end of a sentence and be translated by an indefinite form of a verb with the conjunctions : “чтобы”, “для того чтобы”.

There are two types of adverbial modifiers expressed in the form of infinitive:

a)infinitive of a purpose - this infinitive is put at the beginning of a sentence and has the following conjunctions: “so as to” - так чтобы, “in order to” - для того чтобы , “to” - чтобы. It is translated into Russian by an indefinite form of a verb with the conjunctions: “с тем чтобы”, ”для того чтобы”. E.g. : To live long it is necessary to live slowly. - Чтобы жить долго, нужно жить не торопясь.

b)Infinitive of a consequence - this infinitive is put at the end of a sentence and it is preceded by the following words: “too” - слишком, “enough” -достаточно, “sufficiently” - достаточно, “sufficient” - достаточный. E.g.: Some people are too proud enough to admit that they don’t know it. - Некоторые люди достаточно горды, чтобы признать, что они не знают этого.

Infinitive of the verbs: “to give” - давать, “to yield” - вызывать, “to provide” - обеспечивать, “to form” - образовывать should be translated as a verbal participle, e.g.: Condensation proceeded as usual to give corresponding compounds - Конденсация протекала обычным путем, давая соответствующие соединения.

Vocabulary

to seek (sought, sought) - разрабатывать
elution - элюирование
rotation - вращение
spectrum (pl. spectra) - спектр
enhancement - усиление

Practice

Translate the following sentences paying attention to the infinitive.

1. It is the most difficult to oxidize this substance.
2. It is a simple matter to record a small wave.
3. The paper presents a new procedure to prepare these compounds.
4. It did not take them 2 hours to carry out this reaction.
5. Compound II can be hydrolyzed to yield free amine.
6. A more general theory must be sought to account for these interconversions.
7. Rotation spectra can be used to measure bond length.
8. The oxide preparation was closely controlled to minimize chlorides.
9. To minimize decomposition of the iodine –containing compound, he employed alkaline hydrolysis.
10. A given fluid is made to flow very slowly into the reaction vessel.
11. This phenomenon causes peaks emerging by elution from the column to be very asymmetric.
12. The enhancement in the intensity of this band is sufficient to enable conjugation to be recognized.

Part 2

Exercise 1. Read and translate the text.

Blast furnace

Blast furnace is a furnace for smelting iron ores, such as haematite (Fe_2O_3) or magnetite (Fe_3O_4) to make pig iron. The furnace is a tall refractory-lined cylindrical structure that is charged at the top with the dressed ore, coke and a flux, usually limestone. The conversion of the iron oxides to metallic iron is a reduction process in which carbon monoxide and hydrogen are the reducing agents. The overall reaction can be summarized thus:

$$Fe_3O_4 + 2CO + 2H_2 \rightarrow 3Fe + 2CO_2 + 2H_2O.$$

The CO is obtained within the furnace by blasting the coke with hot air from a ring of tuyeres about two-thirds of the way down the furnace. The reaction producing the CO is:

$$2C + O_2 \rightarrow 2CO.$$

In most blast furnaces hydrocarbons (oil, gas, tar, etc.) are added to the blast to provide a source of hydrogen. In the modern direct-reduction process the CO and H_2 may be produced separately so that the reduction process can proceed at a lower temperature. The pig iron produced by a blast furnace contains about 4% of carbon and further refining is usually required to produce steel or cast iron.

Vocabulary

blast furnace - доменная печь
to smelt - плавить, выплавлять
haematite - красный железняк, гематит
magnetite - магнетит, магнитный железняк
refractory - огнеупорный, огнеупор, огнеупорный материал
lined - футерованный
dressed - обработанный
coke - кокс
flux - флюс
limestone - известняк
cast iron - чугун
to obtain - получать
tuyere - фурма
pig iron - чугун в чушках
tar - деготь
blast - дутье, форсированная тяга

Exercise 2. Answer the following questions.

1. What is blast furnace used for?
2. How is CO obtained in blast furnace?
3. What is an appearance of blast furnace?
4. Why are hydrocarbons added to the blast in most blast furnaces?
5. What alloys does blast furnace produce?

Exercise 3. Put questions to the bold-typed words.

1. **Blast furnace** is a furnace for **smelting haematite** (Fe_2O_3).
2. The conversion of the iron oxides to metallic iron is **a reduction process**.
3. **In most blast furnaces** hydrocarbons (oil, gas, tar, etc.) are added to the blast **to provide a source of hydrogen.**
4. **The reduction process** can **proceed** at **a lower temperature**.
5. **The pig iron** contains about **4%** of carbon.
6. **Further refining** is usually required to **produce steel or cast iron**.
7. **The furnace** is a tall refractory-lined cylindrical structure.

Exercise 4. Give the equivalents for the following words and make up sentences with them: refractory, lined, dressed, ore, magnetite, furnace, blast, reduction, hydrocarbon, to smelt, flux, tar, limestone.

Exercise 5. Put the following words in the gaps: blast furnace, to obtain, reduction, hydrocarbons, cast iron, pig iron, refractory.

1. To take out the metal we have melted iron ore in… .
2. We have converted iron oxide to metallic iron by … .
3. Pig iron can be … at high - temperature melting.
4. … is a hard type of iron that does not bend easily.
5. … is a form of iron that is not pure.
6. There are various … found in natural gas and petrol.
7. … materials are fire-resistant materials.

Exercise 6. Guess the concept based on the definition.

1. A substance that allows heat or electricity to pass through it.
2. A colorless gas that is the lightest of all chemical elements. It combines with oxygen to form water.
3. A yellow precious metal which is used for making coins, jewellery, ornaments.
4. The smallest part of a chemical element that can take part in a chemical reaction.
5. A strong hard metal that is made of the mixture of iron and carbon.
6. A chemical element found in all living organisms and existing in a pure state as graphite or diamond.

Exercise 7. Put the following sentences into Passive.

1. Yesterday we bought a new blast furnace.
2. Now we are testing new equipment.
3. We added hydrocarbons to the blast to provide a source of hydrogen.
4. We used new technique to increase the yield of hydrocarbons.

Exercise 8. Make the summary of the text: “Blast furnace” from Ex. 1.

Texts for educational purposes

Types of burner

Bunsen burner is a laboratory gas burner having a vertical metal tube into which the gas is led, with a hole in the side of the base of the tube to admit air. The amount of air can be regulated by a sleeve on the tube. When no air is admitted the flame is luminous and smoky. With air, it has a faintly visible hot outer part (the oxidizing part) and an inner blue cone where combustion is incomplete (the cooler reducing part of the flame). The device is named after Robert Bunsen, who used a similar device (without a regulating sleeve) in 1855.

Oxyacetylene burner is a welding or cutting torch that burns a mixture of oxygen and acetylene (ethyne) in a specially designed jet. The flame temperature of about 3300°C enables all ferrous metals to be welded. For cutting, the point at which the steel is to be cut is preheated with the oxyacetylene flame and a powerful jet of oxygen is then directed onto the steel. The oxygen reacts with the hot steel to form iron oxide and the heat of this reaction melts more iron, which is blown away by the force of the jet.

Catalytic reactions

Catalysis is the process of changing the rate of a chemical reaction by use of a catalyst.

Catalyst is a substance that increases the rate of a chemical reaction without itself undergoing any permanent chemical change. Catalysts that have the same phase as the reactants are homogeneous catalysts (e.g. enzymes in biochemical reactions or transition-metal complexes used in the liquid phase for analyzing organic reactions). Those that have a different phase are heterogeneous catalysts (e.g. metals or oxides used in many industrial gas reactions). The catalyst provides an alternative pathway by which the reaction can proceed, in which the activation energy is lower. It thus increases the rate at which the reaction comes to equilibrium, although it does not alter the position of the equilibrium. The catalyst itself takes part in the reaction and consequently may undergo physical change (e.g. conversion into powder). In certain circumstances, very small quantities of catalyst can speed up reactions. Most catalysts are also highly specific in the type of reaction they catalyse, particularly enzymes in biochemical reactions. Generally, the term is used for a substance that increases reaction rate (a positive catalyst). Some reactions can be slowed down by negative catalysts.

Catalytic converter is a device used in the exhaust systems of motor vehicles to reduce atmospheric pollution. The three main pollutants produced by petrol engines are: unburnt hydrocarbons, carbon monoxide produced by incomplete combustion of hydrocarbons, and nitrogen oxides produced by nitrogen in the air reacting with oxygen at high engine temperatures. Hydrocarbons and carbon monoxide can be controlled by a higher combustion temperature and a weaker mixture. However, the higher temperature and greater availability of oxygen arising from these measures encourage formation of nitrogen oxides. The use of three-way catalytic converters solves this problem by using platinum and palladium catalysts to oxidize the hydrocarbons and the CO and rhodium catalysts to reduce the nitrogen oxides back to nitrogen. These three-way catalysts require that the air-fuel ratio is strictly stoichiometric. Some catalytic converters promote oxidation reactions only, leaving the nitrogen oxides unchanged. Three-way converters can reduce hydrocarbons and CO emissions by some 85%, at the same time reducing nitrogen oxides by 62%.

Texts from scientific articles

Journal: Combustion and flame

Gas phase chemistry in catalytic combustion of methane/air mixtures over platinum at pressure of 1 to 16

Abstract

The gas-phase combustion of fuel-lean methane/air premixtures over platinum was investigated experimentally and numerically in a laminar channel-flow catalytic reactor at pressures $1\ \text{bar} \leq p \leq 16\ \text{bar}$. In situ, spatially resolved one-dimensional Raman and planar laser induced fluorescence (LIF) measurements over the catalyst

boundary layer were used to assess the concentrations of major species and of the OH radical, respectively. Comparisons between measured and predicted homogeneous (gaseous) ignition distances have led to the assessment of the validity of various elementary gas-phase reaction mechanisms. At low temperatures ($900 \leq T \leq 1400^{o}K$) and fuel-to-air equivalence ratios ($0.05 \leq \varphi \leq 0.50$) typical to catalytic combustion systems, there were substantial differences in the performance of the gaseous reaction mechanisms originating from the relative contribution of the low- and the high-temperature oxidation routes of methane. Sensitivity analysis has identified the significance of the chain-branching reaction CHO+M=CO+H+M on homogeneous ignition, particularly at lower pressures. A gas-phase reaction mechanism validated at $6 \leq p \leq 16$ bar has been extended to 1 bar $\leq p \leq$ 16 bar, thus encompassing all catalytic combustion applications. A reduced gas-phase mechanism was further derived, which when used in conjunction with a reduced heterogeneous (catalytic) scheme reproduced the key catalytic and gaseous combustion characteristics of the full hetero/homogeneous reaction schemes.

Experimental

Four different C1/H/O gas-phase mechanisms were investigated, which included the part of C2 chemistry that led to recombination of C1 radicals to C2 species. The mechanisms are further denoted as Warnatz-Maas, Warnatz et.al. and Leeds. The species transport properties were calculated from the Chemkin database. Each of the mechanisms in Refs. [22,35,36] was provided with its own thermodynamic data had the same thermo data as Warnatz. It is emphasized, however, that the discrepancies in the predictions with the above schemes (see next section) predominantly reflected kinetic and not thermodynamic differences; this was verified by interchanging the thermodynamic databases of the different mechanisms. Gas-phase and surface reaction rates were evaluated using Chemkin and Surface-Chemkin respectively. A set of hetero/homogeneous schemes will be further denoted by the assigned names of its components, for example, Deutschmann/Warnatz schemes. Finally, the prefixes S and R will denote a surface and a gaseous reaction, respectively.

Conclusions

The homogeneous ignition of fuel-lean ($0.31 \leq \varphi \leq 0.40$) methane/air mixtures over platinum was investigated in the pressure range 1 bar $\leq p \leq$ 16 bar, which encompasses all practical catalytic combustion systems. In situ nonintrusive measurements of major species and trace species concentrations over the catalyst boundary layer of a channel-flow reactor were compared against detailed numerical predictions with elementary hetero/homogeneous chemical reaction schemes. The following are the key conclusions of this study. It was also shown that crucial in the performance of the gaseous schemes was the correct prediction of the minimum equivalence ratio above which the self-inhibited ignition behavior of methane was maintained. Finally, notwithstanding the ultra fuel-lean conditions, C2 chemistry could not be ignored. In particular, the inclusion of the radical recombination reaction $CH_3+CH_3=C_2H_6$ was necessary for accurate homogeneous ignition predictions.

Lesson 14

Part 1

The Forms of The Infinitive

Form	Voice	Voice
	Active voice	Passive voice
Indefinite	To write	To be written
Perfect	To have written	To have been written
Continuous	To be writing	To be being writing
Perfect continuous	To have been writing	To have been being written

Indefinite Infinitive expresses the action that takes place at the same time with a predicate or the action that will happen in future. It is translated by the verb in Present Simple or in Future Simple. E.g.: I have never known him **to take an active part** in the work – Я никогда не знал, что он **принимает активное участие** в этой работе. We expect him to carry out this experiment - Мы ожидаем, что он проведет этот эксперимент.

Perfect infinitive expresses an action that took place earlier . It is translated into Russian by a verb in Past Simple. E.g.: Such information is unlikely to have been available from the user – Маловероятно, что такая информация была получена от пользователя.

Continuous Infinitive expresses the action that takes place at the given moment, e.g:. I know her to be working at this problem – Я знаю, что она работает над этой проблемой.

The Use of The Infinitive with a Verb

1.Infinitive with “to”: it is put after **to be** and is translated as : заключается в том, чтобы, значит. E.g.: To do two things at once is to do neither. - Делать два дела одновременно, значит не делать ни одного.

2.Infinitive without “to” is used after the modal verbs and Future Simple.

3.Infinitive after “have to” and “to be to” is translated as: “должен”, “нужно”. E.g.: The question has to be settled. - Вопрос нужно решить. Friendship is not to be bought. - Дружбу нельзя купить.

Practice

Translate the following sentences paying attention to the infinitive.

1.To choose time is to save time.
2.The interval is to be measured.
3.These reactions can be classified into three types.
4.It did not take them more than two hours.
5.A more general theory must be sought to account for these interconversions.
6.This experiment will be carried out next month.
7. Bromide may be treated with potassium iodide.
8.To understand is to forgive.
9.It is necessary to observe a number of precautions.
10.The reaction of hydrogen with carbon to produce methane is not of a great importance at the moment.
11.An effort was made to obtain xenon isotherms at low temperatures.
12.The formation of trimethylene oxide may be assumed to arise from a simultaneous shift of electrons.

Part 2

Exercise 1. Read and translate the text.

The rusting of metals

It has long been known that metals can pass from a metallic to an earthy form. One must be careful not to expose unprotected iron to the open air, as under the influence of atmospheric conditions the outer layer of the iron quickly changes into a reddish crust called the rust. One can easily find that this new material differs from iron. The rust is very brittle, it is much lighter than iron and it is not attracted by a magnet. It was early observed that, although the specific gravity of the earthy product was less than that of the metal, yet there was a much greater bulk of it, and that, in fact, the earthy material weighed more than the original specimen of the metal.

It was Lomonosov who first proved that the extra material came from the air. He placed some tin in a flask and sealed up the mouth of the vessel. The tin was heated and converted into the white powder. Upon weighing the apparatus it was found that no change in weight occurred. It turned out, however, that when the mouth of the flask was opened, a good deal of air rushed in and the total weight was then greater. A portion of the original air had joined itself with the tin to form the powder.

Eighteen years later the same experiment was made and the same conclusion was drawn from it by Lavoisier. He named the gas taken from the air, oxygen. It is possible to confirm these conclusions in various ways. For example, when the air is pumped out of the flask before it is sealed, the metal can be heated in the vacuum indefinitely without rusting. Thus it can be seen that fundamentally rusting is the process in which metals oxidize and form compounds. It has been estimated that more than 25 % of the annual production of iron in the USA is consumed in replacing other iron that has been rendered unserviceable by rusting.

It is necessary, therefore, to wage a constant battle against this chemical process and our immediate concern is how to take care of metallic devices and structures once they enter our possession. We try to prevent or reduce rusting by various means, such as electroplating, painting or otherwise treating the metals that are susceptible to attack of this harmful action.

Vocabulary

rust - ржавчина, коррозия
light - легкий
specific gravity - удельный вес
specimen - образец
flask - колба
to seal - запечатывать
vessel - сосуд
powder - порошок
annual - ежегодный

Exercise 2. Answer the following questions.

1. What is your understanding of rusting?
2. What is the reason for rust?
3. What measures are taken to prevent rusting of metals today?
4. Who proved that the extra material came from the air?
5. Do you know any scientists in your country who are dealing with the problem of rusting?

Exercise 3. Put questions to the bold-typed words.

1. He placed **some tin in a flask**.
2. He named the gas taken from the air, **oxygen**.
3. **Eighteen years later the same experiment** was made.
4. **The tin** was heated and converted into **the white powder**.
5. **A portion of the original air** had joined itself with the tin to **form the powder**.
6. **Upon weighing the apparatus** it was found that no change in weight occurred.
7. **The rust** is much lighter than iron.
8. It is necessary to wage a constant battle against **this chemical process**.
9. When the mouth of the flask was opened, **a good deal of air** rushed in.
10. One can easily find that **this new material** differs from **iron**.
11. The rust is not attracted **by a magnet.**
12. It is possible to confirm these conclusions **in various ways**.

Exercise 4. Give the equivalents for the following words and make up sentences with them: vessel, flask, tin, metal, rust, powder, light, to prevent, air, annual, specimen, flask, device, to draw a conclusion.

Exercise 5. Match the beginnings of the sentences with the endings.

1. Oxygen is a	a) reduce rusting by various means.
2. Upon weighing the material	b) was about 25 % .
3. Annual production of cast iron	c) gas taken from the air.
4. We have obtained	d) we have determined its composition.

5. The rust is
6. The metal
7. We prevented to
8. This experiment
9. This new material differs

e) a white powder.
f) very brittle.
g) was heated.
h) from iron.
i) was made again.

Exercise 6. Guess the concept based on the definition.

1. A chemical compound which is usually a liquid that contains hydrogen and has pH of less than seven.
2. A colorless gas that is present in water and air and is necessary for people, animals, plants to live.
3. A hot bright steam of burning gas that comes from something is on fire.
4. A metal that is formed by mixing two types of metals together.
5. A chemical change produced by two or more substances acting on each other.
6. A substance which is used to cause chemical reaction.

Exercise 7. Make the following sentences negative and interrogative.

1. Eighteen years later the same experiment was made and the same conclusion was drawn from it by Lavoisier.
2. He named the gas taken from the air, oxygen.
3. The rust is very brittle.
4. This colorless gas is present in water.
5. A portion of the original air had joined itself with tin to form the powder.
6. We try to prevent or reduce rusting by various means.
7. It was Lomonosov who first proved that the extra material came from the air.
8. It has long been known that metals can pass from a metallic to an earthy form.
9. It is possible to confirm these conclusions in various ways.

Exercise 8.:

a) Grammar quiz: find and correct the mistakes:

1. When the air was pumped out the flaks was sealed.
2. While I watched TV, she did her homework.
3. When I returned home she went away.
4. When vegetation decomposed peat was formed.
5. Before I went to London I learnt English.

b) Divide the following sentences into a few simple sentences:

1. It is necessary, therefore, to wage a constant battle against this chemical process and our immediate concern is how to take care of metallic devices and structures once they enter our possession.
2. Eighteen years later the same experiment was made and the same conclusion was drawn from it by Lavoisier.

c) Paraphrase the following sentence: It was Lomonosov who first proved that the extra material came from the air.

Scientific Research

Carbon cycle

One of the major cycles of chemical elements in the environment is carbon cycle. Carbon (as carbon dioxide) is taken up from the atmosphere and incorporated into the tissues of plants in 'photosynthesis. It may then pass into the bodies of animals as the plants are eaten. During the respiration of plants, animals, and organisms that bring about decomposition, carbon dioxide is returned to the atmosphere. The combustion of fossil fuels (e.g. coal and peat) also releases carbon dioxide into the atmosphere.

In physics it is a series of nuclear reactions in which four hydrogen nuclei combine to form a helium nucleus with the liberation of energy, two positrons, and two neutrinos. The process is believed to be the source of energy in many stars and to take place in six stages. In this series carbon-12 acts as if it were a catalyst, being reformed at the end of the series.

Carbon dating

Carbon dating (radiocarbon dating) is a method of estimating the ages of archaeological specimens of biological origin. As a result of cosmic radiation a small number of atmospheric nitrogen nuclei are continuously being transformed by neutron bombardment into radioactive nuclei of carbon-14;

14/7N + n → 14/6C + p.

Some of these radiocarbon atoms find their way into living trees and other plants in the form of carbon dioxide, as a result of photosynthesis. When the tree is cut down photosynthesis stops and the ratio of radiocarbon atoms to stable carbon atoms begins to fall as the radiocarbon decays. The ratio $^{14}C/^{12}C$ in the specimen can be measured and enables the time that has elapsed since the tree was cut down to be calculated. The method has been shown to give consistent results for specimens up to some 40 000 years old, though its accuracy depends upon assumptions concerning the past intensity of the cosmic radiation. The technique was developed by Willard F. Libby and his coworkers in 1946-47.

Acid rain

Acid rain is precipitation having a pH value of less than about 5.0, which has adverse effects on the fauna and flora on which it falls. Rainwater typically has a pH value of 5.6, due to the presence of dissolved carbon dioxide (forming carbonic acid). Acid rain results from the emission into the atmosphere of various pollutant gases, in particular sulphur dioxide and various oxides of nitrogen, which originate from the burning of fossil fuels and from car exhaust fumes, respectively. These gases dissolve in atmospheric water to form sulphuric and nitric acids in rain, snow or hail (wet deposition). Alternatively, the pollutants are deposited as gases or minute particles (dry deposition). Both types of acid deposition affect plant growth - by damaging the leaves and impairing photosynthesis and by increasing the acidity of the soil, which results in the leaching of essential nutrients. This acid pollution of the soil also leads to acidification of water draining from the soil into lakes and rivers, which become unable to support fish life. Lichens are particularly sensitive to changes in pH and can be used as indicators of acid pollution.

Lesson 15

Part 1

Infinitive constructions

Infinitive and words relating to it can form infinitive constructions. There are two types of infinitive constructions.

Dependent infinitive constructions - are constructions where are no words denoting a doer before infinitive. These constructions are translated by a subordinate clause where infinitive becomes a predicate.
E.g.: The Combustion Problem Institute claimed **to have obtained** pure fusicocsine . - Сотрудники Института Проблем Горения утверждают, **что** они **получили** чистый фузикокцин.

Absolute infinitive construction: absolute infinitive is placed at the end of the sentence. It is translated by a subordinate clause with the conjunctions: “причем”, “так как”. E.g.: We asked him to help us, the work *to be done* in a week - Мы попросили его помочь нам, *так как* работа *должна быть сделана* через неделю.

Practice

Translate the following sentences paying attention to the infinitive constructions.

1. The product has been proved to affect the overall yield.
2. The data have been admitted to be incorrect.
3. Tests were scheduled to start in 1967.
4. This hydrolysis is taken to follow the above scheme.
5. The reactions was found to lead to low yields.
6. We proved this suggestion to be wrong.
7. There are two approaches to the solution of this problem, one to be used in analytical investigations, the other in simulation.

Part 2

Exercise 1. Read and translate the text.

Alloys and types of alloys

Generally speaking, metals are the most useful in the form of alloys. Around 30 metallic elements serve modern needs, but over five thousand alloys are known and hundreds of them are in common uses. Sizable amounts of certain metals are convertible into compounds of a great importance. Brass, bronze, pewter and stainless steel are examples of alloys. In general, alloys are formed when two or more metals are melted together and the mixture is allowed to cool and solidify.

Alloys may also contain certain nonmetals such as carbon, sulphur, arsenic, phosphorous and silicon.

The main reason why so many different alloys are prepared is that modern industry requires metals with certain properties or certain combinations of properties which no metallic element in the pure state can provide. Metallurgists attempt to regulate both physical and chemical properties of metals through the preparation of alloys. Various kinds of stainless steel illustrate alloys whose chemical properties help them to resist the action of acids and the corroding agents of the atmosphere. Some of the metals used in automobile and aircraft engines, particularly in valves, should be able to withstand extremely high temperatures. Even now, improvements in the gas turbine or jet engine may well depend on the development of new improved heat-resisting alloys.

The aircraft industry needs metals that combine great strength with light weight. Many other industries have their own particular needs for metals with certain chemical and physical properties. All this should give you a pretty good idea of why alloys have been described as «metals made to order». Alloys may be classified in several ways. They can be classified according to composition, uses or notable properties. According to composition, we have ferrous alloys (those which contain iron) and nonferrous alloys (those which do not contain iron). The former group includes all the various kinds of steel - ordinary steels as well as alloy or special steels.

The nonferrous alloys are further subdivided according to the predominant or base metal. Thus we have alloys in which aluminium, lead, copper, gold, silver, or any other metal except iron makes up the largest per cent of any constituent. In the terms of uses, there are antifriction alloys and solders. Groups of alloys based upon distinctive properties include the lightweight alloys and low melting point alloys.

Speculum is an alloy of copper and tin formerly used in reflecting telescopes to make the main mirror as it could be cast, ground, and polished to make a highly reflective surface. It has now been largely replaced by silvered glass for this purpose. steel Any of a number of alloys consisting predominantly of iron with varying proportions of carbon (up to 1.7%) and, in some cases, small quantities of other elements (alloy steels), such as manganese, silicon, chromium, molybdenum and nickel. Steels containing over 11-12% of chromium are known as stainless steels. Solder is an alloy used to join metal surfaces. A soft solder melts at a temperature in the range 200-300°C and consists of a tin-lead alloy. The tin content varies between 80% for the lower end of the melting range and 31% for the higher end. Hard solders contain substantial quantities of silver in the alloy. Brazing solders are usually alloys of copper and zinc, which melt at over 800°C.

Phosphor bronze is an alloy of copper containing 4% to 10% of tin and 0.05% to 1% of phosphorus as a deoxidizing agent. It is used particularly for marine purposes and where it is exposed to heavy wear, as in gear wheels.

German silver is an alloy of copper, zinc, and nickel, often in the proportions 5:2:2. It resembles silver in appearance and is used in cheap jewellery and cutlery and as a base for silver-plated wire.

Babbitt metal is any of a group of related alloys used for making bearings. They consist of tin containing antimony (about 10%) and copper (1-2 %), and often lead. The original alloy was invented in 1839 by the US inventor Isaac Babbit (1799-1862).

Brass is a group of alloys consisting of copper and zinc. A typical yellow brass might contain about 67 % of copper and 33 % of zinc.

Bronze is any of a group of alloys of copper and tin, sometimes with lead and zinc present. The amount of tin varies from 1 % to 30 %. The alloy is hard and easily cast, and extensively used in bearings, valves and other machine parts. Various improved bronzes are produced by adding other elements; for instance phosphor bronze contain up to 1% of phosphorous. In addition certain alloys of copper and metals other than tin are called bronzes - aluminium bronze is a mixture of copper and aluminium. Other special bronzes include bell metal, gun metal, beryllium bronze. Beryllium bronze is a hard, strong type of bronze containing about 2%of beryllium, in addition to copper and tin.

Cast iron is a group of alloys containing 1.8 to 4.5% of carbon. It is usually cast into specific shapes ready for machining, heat treatment or assembly. It is sometimes produced direct from the blast furnace or it may be made by from remelted pig iron.

Pewter is an alloy of lead and tin. It usually contains 63% of tin. Pewter tankards and food containers should have less than 35% of lead so that the lead remains in solid solution with tin in the presence of weak acids in the food and drink . Copper is sometimes added to increase ductility and antimony is added if a hard alloy is required.

Vocabulary

brass - латунь
pewter - пьютер, сплав олова со свинцом, сплав на оловянной основе
mixture - смесь
to melt - плавить
to cool - охлаждать
arsenic - мышьяк
ferrous alloys - сплавы черных металлов
non ferrous alloys - сплавы цветных металлов
valve - клапан
heat –resisting alloy - жаростойкий сплав
solder - припой
antifriction alloy - антифрикционный сплав
to be in common use - широко использоваться
engine - двигатель
lead - свинец
German silver - нейзильбер
cutlery – столовые приборы
Babbit - баббит
Brazing solders – твердый (тугоплавкий) припой
assembly -сборка
heat treatment – термообработка

Exercise 2. Answer the following questions.

1. How many alloys are in a common use today?
2. What nonmetals do alloys contain?
3. What is the reason for the preparation of different alloys?
4. How are alloys classified?
5. Where are alloys used?

Exercise 3. Put questions to the bold-typed words.

1. **Around 30** metallic elements serve **modern needs**.
2. According to composition we have **ferrous alloys and nonferrous alloys**.
3. **Alloys** may contain **carbon.**
4. **The nonferrous alloys** are subdivided into the **predominant or base metals.**
5. **Metallurgists** attempt to regulate both **physical and chemical properties of metals through the preparation of alloys**.
6. **Sizable** amounts of **certain metals** are convertible into **compounds of a great importance**.
7. Some of the metals are used in **automobile and aircraft engines**.

Exercise 4. Give the equivalents for the following words and make up sentences with them: nonferrous alloy, ferrous alloy, base metal, modern, aircraft, lead, engine, stainless steel, mixture, to melt.

Exercise 5. Give the definitions for the following concepts: alloy, lead, ferrous alloy, nonferrous alloy, pewter, brass.

Exercise 6. Put the following words in the gaps: systematic, to form , ultraviolet radiation, hydrocarbons, butane, pentane, natural gas, halogens, soda lime, high-molecular.

Alkanes (paraffins)

Alkanes are saturated … with the general formula C_nH_{2n+2} . In … chemical nomenclature their name ends with suffix –ane. They … homologous series methane (CH_4), ethane (C_2H_6) , propane (C_3H_8), … (C_4H_{10}), … (C_5H_{12}).
The lower members of the series are gases. … alkanes are waxy solids. Alkanes are present in … and petroleum. They can be made by the heating of sodium salt of a carboxylic acid with … . Other methods include Wurtz reaction, Kolbe's method. They … haloalkanes with … when they are irradiated with … .

Notes to the text:

high-molecular weight - высокомолекулярный
soda lime - натронная известь
unsaturated - ненасыщенный
carboxylic acid - карбоновая кислота
ultraviolet radiation - ультрафиолетовое излучение

Exercise 7. Make the summary of the text: “Alloys” from Ex. 1.

Exercise 8. Find and correct the mistakes.

Copper

Coper are a redbrown transition element; a.n. 29; r.a.m. 63.546; r.d. 8.92; m.p. 1083.4°C; b.p. 2567°C. Copper was extracted for thousands of years; it was knowed to Roman like cuprum, a title linked to a island of Cyprus. The metal are malleable and ductile and a excellent conductor of het and electricity. Copercontaining minerals included cuprite (Cu_2O) as well as azurite ($2CuCO_3.Cu(OH)_2$), chalcopyrite ($CuFeS_2$), and malachite ($CuCO_3.Cu(OH)_2$). Native copper appear on isolated pockets on some parts to the world. The large mines on the USA, Chile, Canada, Zambia, Congo, and Peru extrat ors containing sulphids, oxids, and carbonats. They was usually worked in smelting, leaching, and electrolysis. Copper metal are used make elctric cables and wires. Its alloys, bras (coperzinc) and bronz (copertinn) is using extensively. Water don’t attack coper but in moist atmospheres it slowly form a characteristic surface green layer (patina). The metal will not reacted on dilute sulphuric or acids hydrochloric, but on nitric acid oxides of nitrogen are formed. Compunds Copper contained the element in the +1 and +2 oxidation phase. Compunds Copper(I) are mostly white (the oxide is red). Copper(II) salts are blue in solution. The metal also form large number of coordination complexes..

Texts for educational purposes

On combustion and flame

Combustion is a chemical reaction in which a substance reacts rapidly with oxygen with the production of heat and light. Such reactions are often free-radical chain reactions, which can usually be summarized as the oxidation of carbon to form its oxides and the oxidation of hydrogen to form water.

Flame is a hot luminous mixture of gases undergoing combustion. The chemical reactions in a flame are mainly free-radical chain reactions and the light comes from fluorescence of excited molecules or ions or from incandescence of small solid particles (e.g. carbon).

Flame test is a simple test for metals, in which a small amount of the sample (usually moistened with hydrochloric acid) is placed on the end of a platinum wire and held in a Bunsen flame. Certain metals can be detected by the colour produced: barium (green), calcium (brick red), lithium (crimson), potassium (lilac), sodium (yellow), strontium (red).

Flash point is the temperature at which the vapour above a volatile liquid forms a combustible mixture with air. At the flash point the application of a naked flame gives a momentary flash rather than sustained combustion, for which the temperature is too low.

Flash photolysis is a technique for studying free-radical reactions in gases. The apparatus used typically consists of a long glass or quartz tube holding the gas, with a lamp outside the tube suitable for producing an intense flash of light. This dissociates molecules in the sample creating free radicals, which can be detected spectroscopically by a beam of light passed down the axis of the tube. It is possible to focus the spectrometer on an absorption line for a particular product and measure its change in intensity with time using an oscilloscope. In this way the kinetics of very fast free-radical gas reactions can be studied.

Hardness of water

Hardness of water means the presence in water of dissolved calcium or magnesium ions. The main cause of hard water is dissolved calcium hydrogencarbonate ($Ca(HCO_3)_2$), which is formed in limestone or chalk regions by the action of dissolved carbon dioxide on calcium carbonate. This type is known as *temporary hardness* because it is removed by boiling:

$$Ca\,(HCO_3)_2\,(aq) \rightarrow CaCO_3(s) + H_2O\,(1) + CO_2\,(g).$$

The precipitated calcium carbonate is the 'fur' (or scale) formed in kettles, boilers, pipes, etc. In some areas, hardness also results from dissolved calcium sulphate ($CaSO_4$), which cannot be removed by boiling *(permanent hardness).*

Hard water is a considerable problem in washing, reducing the efficiency of boilers, heating systems, etc. and in certain industrial processes. Various methods of *water softening* are used. In public supplies, the temporary hardness can be removed by adding lime (calcium hydroxide), which precipitates calcium carbonate:

$$Ca\,(OH)_2\,(aq) + Ca\,(HCO_3)_2(aq) \rightarrow 2CaCO_3\,(s) + 2H_2O\,(1).$$

This is known as the *Clark process* (or as *'clarking').* It does not remove permanent hardness. Both temporary and permanent hardness can be treated by precipitating calcium carbonate by added sodium carbonate. Calcium (and other) ions can also be removed from water by ion-exchange using zeolites (e.g. *Permutit).* This method is used in small domestic water-softeners. Another technique is not to remove the Ca^{2+} ions but to complex them and prevent them reacting further. For domestic use polyphosphates (containing the ion $P_6O_{18}^{6-}$, e.g. *Calgon)* are added. Other sequestering agents are also used for industrial water.

Hydrogen

Hydrogen **(**Symbol H.) is a colourless odourless gaseous chemical element; a.n.is 1; r.a.m. is 1.008; d. is 0.0899 g dm^{-3}; m.p. is -259.14°C; b.p. is -252.87°C. It is the lightest element and the most abundant in the universe. It is present in water and in all organic compounds. There are three isotopes: naturally occurring hydrogen consists of the two stable isotopes hydrogen-1 (99.985%) and deuterium. The radioactive tritium is made artificially. The gas is diatomic and has two forms: *orthohydrogen,* in which the nuclear spins are parallel, and *parahydrogen,* in which they are antiparallel. At normal temperatures the gas is 25% of parahydrogen. In the liquid it is 99.8% of parahydrogen. The main source of hydrogen is steam reforming of natural gas. It can also be made by the Bosch process and by electrolysis of water. The main use is in the Haber process for making ammonia. Hydrogen is also used in various other industrial processes, such as the reduction of oxide ores, the refining of petroleum, the production of hydrocarbons from coal, and the hydrogenation of vegetable oils. Considerable interest has also been shown in its potential use in a 'hydrogen fuel economy' in which primary energy sources not based on fossil fuels (e.g. nuclear, solar or geothermal energy) are used to produce electricity, which is employed in electrolysing water. The hydrogen formed is stored as liquid hydrogen or as metal hydrides. Chemically, hydrogen reacts with many elements. It was discovered by Henry Cavendish in 1776.

Hammett equation

Hammett equation is an equation relating the structure to the reactivity of side-chain derivatives of aromatic compounds. It arises from a comparison between rate constants for various reactions with the rate of hydrolysis of benzyl chloride on the one hand and a comparison between equilibrium constants (such as the dissociation constant of benzoic acid) on the other hand. The Hammett equation can be written in the form log(k/k_0) = plog (K/Ko), where log (K/K_0) refers to comparing dissociation constants to the dissociation constant, K_o, of benzoic acid in water at 25°C, and log (k/k_0) refers to comparing rates of reaction to the rate, k_0, of hydrolysis of benzyl chloride. The term log (K/K_0) = a is called the *substituent constant*, since the nature of the substituent affects the strength of the benzoic acid. If σ is positive, the substituent is electron attracting, while if σ is negative the substituent is electron donating, *p* is a reaction constant, which is determined for a given reaction by the slope of a graph of log (k/k_0) against σ. The numerical value of *p* depends on temperature and the type of solvent.

The Hammett equation applies to meta- and parasubstituents (provided that resonance interaction from the substituents does not occur) but not to ortho-substituents.

Albert Einstein

Albert Einstein (1879-1955) is a German-born US physicist, who took Swiss nationality in 1901. A year later he went to work in the Bern patent office. In 1905 he published five enormously influential papers, one on Brownian movement, one on the photoelectric effect, one on the special theory of relativity and one on energy and inertia (which included the famous expression $E = mc^2$). In 1915 he published the general theory of relativity, concerned mainly with gravitation. In 1921 he was awarded the Nobel Prize for Physics. In 1933 as a Jew, Einstein decided to remain in the USA (where he was lecturing), as Hitler had come to power. For all his life he sought a unified field theory. In 1939 he informed President Roosevelt that an atom bomb was feasible and that Germany might be able to make one.

Einstein coefficients are coefficients used in the quantum theory of radiation, related to the probability of a transition occurring between the ground state and an excited state (or vice versa) in the processes of induced emission and spontaneous emission. For an atom exposed to electromagnetic radiation, the rate of absorption R_a is given by $R_a = Bp$, where p is the density of electromagnetic radiation and B is the *Einstein B coefficient* associated with absorption. The rate of induced emission is also given by Bp, with the coefficient B of induced emission being equal to the coefficient of absorption. The rate of spontaneous emission is given by A, where A is the *Einstein A coefficient of spontaneous emission.* The A and B coefficients are related by $A = 8\pi hv^3B/c^3$, where h is the Planck constant, v is the frequency of electromagnetic radiation, and c is the speed of light. The coefficients were put forward by Albert Einstein in 1916-17 in his analysis of the quantum theory of radiation.

Einstein equation is the mass-energy relationship announced by Albert Einstein in 1905 in the form $E = mc^2$, where E is a quantity of energy, m its mass, and c is the speed of light. It presents the concept that energy possesses mass. The relationship $E_{max} = hf - W$, where E_{max} is the maximum kinetic energy of electrons emitted in the photoemissive effect, h is the Planck constant, f is the frequency of the incident radiation, and W is the work function of the emitter. This is also written $E_{max} = hf - \varphi e$, where e is the electronic charge and φ is a potential difference, also called the work function. (Sometimes W and φ are distinguished as *work function energy* and *work function potential.)* The equation can also be applied to photoemission from gases, when it has the form: $E = hf - I$, where I is the ionization potential of the gas.

VOCABULARY

To absorb - абсорбировать, поглощать, впитывать
Abundant- распространенный
Accessible -доступный
Accident - случай, случайность
To accompany - сопровождать
To account (for) - объяснять
Accuracy - точность
Acetate - ацетат
Acetic acid - уксусная кислота
Acetone - ацетон
Acetylide - ацетиленистое соединение метала
Acidification - подкисление
Acyl halide - галогенангидрид карбоновой кислоты
Acrylic fibers - акриловые волокна
Actinium - актиний
Actinoids -актиноиды
Activation energy - энергия активации
Addition - добавка, добавление
Addition reaction - реакция присоединения
Adenosine - адинозин
Adjacent - примыкающий, соседний, смежный
To adopt -принимать
Adverse - вредный, неблагоприятный
Aerosol - аэрозоль
Affinity - сродство, родственность, близость
Age - возраст
Aircraft - самолет
Alcohol - спирт
Aldehyde - альдегид
Aliphatic - алифатический
Alkali metals - щелочные металлы
Alkaline-earth metals - щелочноземельные металлы
Alkaline solution - щелочной раствор
Alkanes - алканы
Alkenes - алкены
Allotrope -аллотроп
Allotropic - аллотропический
Allowable - допустимый
Alnico - альнико
Alloy - сплав
Alteration - изменение, деформация
Alternative - альтернативный
Aluminium -алюминий
Ambient - внешний. окружающий
Ambient Quality Standard - Стандарт качества для окружающей среды
Amide - амид
Amination - аминирование
Amine - амин
Ammonia –аммиак
Ammonium nitrate - нитрат аммония
Ammonium phosphate - фосфат аммония
Amorphous - аморфный
Amount - количество
Amphoteric -амфотерный
Ancient -древний
Anglesite - англезит
Anhydrite -ангидрит
Anhydrous - безводный
Anhydrous cobalt(II) chloride paper - индикаторная бумага, пропитанная безводным хлоридом кобальта (II)
Anion - анион
Annual - ежегодный
Anode - анод
Anomalous - аномальный
Ant - муравей
Anthracite - антрацит

Antifriction - антифрикционный материал, уменьшающий трение
Antimony - сурьма
Antimony pentafluoride - пентафторид сурьмы
Apatite - апатит
Applied field - приложенное поле (электрополе)
Approach - подход, приближение (о методе)
Aqueous - водный
Aragonite – арагонит
Arc - дуга
Archetypal - первичный, первоначальный
Area - область, территория
Argon - аргон
To argue - спорить, аргументировать
Aromatic - ароматический
To arrange - располагать
Arsenic - мышьяк
Arsenide - арсенид
Arsenious oxide - оксид мышьяка
Artificially - искусственно
Asphalt - асфальт
Assessment - оценка, аттестация
Assign - назначать, определять, поручать
Assumption - предположение
Atomic number - атомный номер
To attach - присоединять
To attract - притягивать
Attractive - притягательный
Average - средний
Azeotrope – азеотроп (раствор, система)
Bacterium (pl.bacteria) - бактерия
Baking - выпечка
Baking powder - пекарный порошок
Barium - барий
Bark - кора, хина, дубить
Basalt - базальт
Bauxite - боксит
Bearing metals - баббит
Bed - пласт
Behavior - поведение
Belong to - принадлежать
Beneath - внизу, ниже чем
Benzene - бензол
Benzonoid ring - бензоноидное кольцо
Beryllium - берилий
Bismite - бисмит, висмутовая охра
Bismuth -висмут
Bismuthinite - висмутин, висмутовый блеск
Bisulphite addition - бисульфит содержащее соединение
Bituminous coal - битуминозный уголь
Blast - дутье, форсированная тяга
Blast furnace - доменная печь
Bleaching powder - отбеливающий порошок
To block - блокировать
Boiler - котел, бойлер
Boiling point(b.p.) - температура кипения
Boron - бор
Boundary - пограничный, граница
Brass - латунь
Breadth - ширина
Breathing - дыхание, дуновение
Brittle -хрупкий
Bromine - бром
Bromide - бромид
Buckyball - фуллерен
Buckytube - нанотрубка
Bulk - масса
Bullet -пуля
Burette - бюретка
Burial - захоронения

To burn - гореть
Burning - горение
By-product - побочный продукт
Cable - кабель
Cage - клетка
To calcine - кальцинировать, превращать в известь, прокаливать, обжигать
Calcite - кальцит
Calcium - кальций
Calcium phosphate(V) - фосфат (V) кальция
Cancer treatment agent - препарат для лечения рака
Cannel coal - кеннельский уголь
Car-exhaust gases - выхлопные газы
Carbide - карбид
Carbon - углерод
Carbon black - технический углерод, углеродная или газовая сажа, копоть
Carbon dating - датирование радиоуглеродом
Carbon dioxide - диоксид углерода
Carbon disulphide - дисульфид углерода
Carbon monoxide - моноксид углерода, угарный газ
Carbon paper - копировальная бумага
Carbonaceous - углеродистый, каменноугольный
Carbonate - карбонат
Carbonated drinks - газированные напитки
Carbonic acid - угольная кислота
Carboniferous - каменноугольный, угленосный, карбоновый
Carbonium ion - ион карбония
Carbonization - карбонизация, науглероживание, коксование, цементация, обугливание
Carbonize - обугливать, коксовать, карбонизировать, обжигать
Carbonyl chloride (phosgene) - карбонил хлорид (фосген)
Carborundum - карборунд
Carboxyl group - карбоксильная группа
Carnallite - карналлит
Carrier - носитель
To cast - лить, отливать
Cast-iron - чугун
Catalysis - катализ
Catalyst - катализатор
Catalytic converter - каталитический дожигатель выхлопных газов
Catalytic reactor - каталитический реактор
To catalyze - катализировать
Cathode - катод
Cation - катион
Cause - причина
To cause - вызывать
Caustic potash - гидроксид калия, едкое кали
Certain - определенный
Cerussite -церрусит
Cesium- цезий
Chain - цепь, цепная, разветвленная
Charcoal - древесный уголь
Charge- заряд, заряжать
Cheap - дешевый
Chemically modified electrodes - химически модифицированные электроды
Chemisorption - хемосорбция, сорбция, основанная на химическом механизме
Chlorate - хлорат (соли хлора (VII))
Chloride - хлорид (соли соляной кислоты)
Chlorine - хлор (газ)

Chlorofluorocarbon - хлорофторуглерод
Chromate - хромат (соли хрома (+6))
Chrome (alum) калий хромовые квасцы
Chromic acid - хромовая(VI) кислота
Chromite - хромит (соли хрома (Ш))
Chromium - хром
Cinder - зола, пепел
Circuit - цепь (электрическая)
Circumstance - подробность, деталь, факт, случай, обстоятельство
Clay - глина
Cluster - кластер
Coagulation - коагуляция
Coal - уголь
Coarse particle - крупнозернистая частица
To coat - покрывать, облицовывать
Cobalt - кобальт
Cobaltite - кобальтовый блеск
Coke - кокс
Colloids - коллоиды (коллоидный раствор)
Combustion - горение
To be in common use - широко использоваться
Compared with - по сравнению с
Complex - сложный, комплекс, совокупность
To compose - составлять
Composition - состав
Compound - соединение
Concomitant- сопутствующее обстоятельство
Condensation reaction - реакция конденсирования
Conductivity - проводимость
Conductor - проводник
Cone - конус
To confirm - подтверждать
Consequence - следствие
Considerable - значительный
Consistent - последовательный, совместимый, твердый, плотный
Constituent - составляющая, составная часть
To consume - поглощать, потреблять
To contain - содержать
Contaminant - загрязнитель
To contaminate - загрязнять
To contribute - способствовать
Conventional - общепринятый, стандартный, удовлетворяющий техническим условиям, традиционный
To convert - преобразовывать
To cool - охлаждать
To coordinate - координировать
Copolymer - сополимер
Copperas - купорос
Corona discharge - коронообразный разряд
Corroding lead - ржавеющий (разрушающийся окислением) свинец
Corrosion resistance - коррозионная устойчивость
Coworkers - соавторы
Crude - сырой, необработанный, неочищенный, сырая нефть
Crystalloids - кристаллоиды, кристаллические вещества
Curie point - точка Кюри
Current - струя, поток, течение
To cut - резать, отрезать, срезать
Cutting tool - режущий инструмент
Cyanide - цианид
Cyanohydrins - цианогидриды
Cycle - цикл, круг
Cyclical - циклический
Cyclopropane - циклопропан

Data - данные (результаты измерений и т.п.)
Decade - десятилетие
To decant - фильтровать, декантировать
Decline - склон, уклон; идти к концу, клониться, падение, понижение, спад
Declining – склоняющийся, исчезающий, меркнущий преклонный
To decompose - разлагать(-ся)
Deficient - недостаточный, неполный, недостающий, дефективный
Definitive - окончательный, безусловный
Dehydration - дегидратация, обезвоживание
Deliquescence - расплывание за счет атмосферной влаги
Deliquescent - растворяющийся, расплывающийся за счет поглощения влаги
To denote - означать, обозначать, указывать(на)
Density- плотность
Deoxidizer - раскислитель
To depend on - зависеть(от)
To deplete - истощать
Depletion - исчерпывание, истощение
Deposit -месторождение, отложения (горных, минеральных пород)
Depression -снижение
Depth - глубина
Destructive distillation - сухая перегонка
Detection - определение, обнаружение
Detection limit - предел обнаружения
Determination - определение, нахождение (методом, способом, в процессе)
To develop – развивать, разрабатывать
Device - прибор
Diamond - алмаз
Diazotization - диазотирование
Dichromate - бихромат (соли хрома (+7))
Diesel oil (gas oil) - жидкая смазка, дизельное масло
Diethyl ether- диэтиловый эфир
To diffuse - диффундировать
Diffusion - диффузия
Diffusion flame - диффузионное пламя
Dihydrate - дигидрат
Dilute - разбавлять, разбавленный
Dimension - измерение, размеры; величина, объем; протяжение, размах
To diminish - уменьшаться
Dipole - диполь
Direct current - постоянный ток
Disadvantage - вред, ущерб
Discoloration - изменение цвета
To discover - открыть, обнаружить
Discrepancy - различие; разногласие
Dispersed phase - диспергированная фаза
Dissimilarity - различие
To dissolve - растворять(-ся)
Distinguish - различать, разглядеть, проводить различие
To distort -искажать
Divalent ion - двухвалентный ион
To divide - делить
Division - деление, разделение
Dividing line - линия разделения
Dome - купол

Double - двойной
Dramatic - резкий
To draw a conclusion - делать вывод
Dressed - обработанный
Drilling - бурение, высверливание
Ductile - плавкий, ковкий, тягучий
Dull - тусклый
Dyestuff – краситель
To educe - выделять
Efficient - эффективный, производительный
Effort - усилие, попытка, достижение
To elapse - протекать, истекать (о времени)
Electric field - электрическое поле
Electrical double layer -двойной электрический слой
Electrical resistance - электрическое сопротивление
Electrochemical equivalent - электрохимический эквивалент
Electrode -электрод
Electrode potential - электродный потенциал
Electrolysis - электролиз
Electrolytic refining - электролитическое очищение (рафинирование)
E.M.F. - Electromotive force - Э.Д.С.(электродвижущая сила)
Electrophoresis - электрофорез
Electroplating (electroplate) - гальваностегия, гальванопокрытие
To eliminate - элиминировать, извлекать
Emission - эмиссия, излучение, выделение
Emphasize - придавать особое значение, подчеркивать
Empty - пустой, порожний
Emulsion - эмульсия
Enamel - эмаль, покрывать эмалью
Enclosure - ограда, ограждение, огороженное место
To encompass - окружать, обводить
To encourage - поощрять, поддерживать; вселять надежду
Engine - машина, двигатель; оборудовать
Enormous - громадный, огромный (о разности)
Enzymes - энзимы
Equilibrium - равновесие
To establish - устанавливать (и как: определять, находить, обнаруживать)
Ester - сложный эфир
Esterification (Etherification) - этерификация
Ethanal (acetaldehyde) - этановый альдегид (ацетальдегид)
Ethan amide - этанамид
Ethane - этан
Ethanoic acid - этановая кислота (уксусная кислота)
Ethanol - этанол (этиловый спирт)
Ether - эфир
Ethereal - эфирный
Ethoxide - этилат
Ethoxyethane - диэтиловый эфир
Ethyne (acetylene) - этин (ацетилен)
To evolve - развивать (способности), развертывать (план), выделять, испускать, издавать, эволюционировать
Example - пример, образец; случай; служить примером
Excellent - превосходный, отличный
Exceptionally - исключительно, необычно, неповторимо
Excess - избыток

To exercise - упражняться; использовать, осуществлять
Exhalation - выдох; испарение, выделение (газа, пара); пар, туман
To exhale - выделяться, испаряться, выделять
Exhaust - выхлоп, выхлопная (труба)
To expand - увеличиваться, расширяться
Explosive - взрывчатое вещество
External - внешний
Extinction - затухание, потухание, тушение
To extract - экстрагировать, извлекать
Extremely - весьма
Fairly - справедливо; довольно; в известной степени; сносно
To fall - падать
Fat - жир; растительный жир; жирный
Fatty acids - жирные кислоты
To favor (favour) - благоприятствовать
Feasibility - возможность
Feldspar - полевой шпат
Fermentation - ферментация
Ferromagnetic - ферромагнитный
Ferrous alloys - сплавы черных металов
Fertilizer - удобрение
Fibrous - волокнистый
To fill - наполнять, насыщать, заполнять
To find- находить
Fine particles - тонкодисперсные частицы
Fire - extinguisher - огнетушитель
Flakes - хлопья
Flake - слой
To flake - падать, расслаиваться
Flame - пламя
Flame blow off - срыв пламени
Flammability - воспламеняемость, огнеопасность
Flammable - воспламеняемый, огнеопасный
Float - пробка, поплавок;
To float - плавать, всплывать
Flow rate - скорость потока
Flow reactor - поточный реактор
Fluid - жидкость, жидкий
Fluorescence - флюоресценция
Fluoride - фторид
Fluorine - фтор
Fluorite - флюорит
Flux - флюс
Focus - фокус, внимание
Forest -лес
To form - образовывать
Fossil fuel - ископаемое топливо
Framework - структура
Francium - франций
Fuel - топливо
Fuel-rich flame - пламя, обогащенного топлива
Fullerene - фуллерен
Fullerite - фуллерит
Fume - дым, пар
To fuse - расплавлять, плавить
Fusible alloys - плавкие сплавы
Fusion - плавка, расплавление
Gap - промежуток, интервал, зазор
Gasoline - бензин
Gel - гель
Gemstone - драгоценный камень
Geodesy - геодезия
Geodetic - геодезический
Getter - геттер, газопоглотитель
Giant - гигантский
To give - давать
To give off - выделять

To give rise - приводить к образованию
To govern - управлять
Glue - клей, клеить
Graphite - графит
Greenhouse effect - парниковый эффект
Greenhouse gas - тепличный газ
Grinding - измельчение
Gunpowder - порох
Gypsum - гипс
Haematite - красный железняк
Hafnium - гафний
Halloysite - галлозит (алюмосиликат)
Halogen - галоген
Halon - галлон (газообразное вещество углерода с галогенами)
Hard - твердый
Hardness - твердость
Hay - сено
Hazardous - опасный
Haze - легкий туман, дымка, мгла
Heat - тепло
Heating - нагревание
Heat - resisting alloy - жаростойкий сплав
Hemihydrate - полугидрат
Hence - следовательно
Heptahydrate - гептагидрат
Heterogeneous - гетерогенный
Hexagon - гексагональный
Hexahydrate - гексагидрат
Hexaquocopper (II) - гексааквомедь (II)
High - speed tools - высокоскоростные приборы
High-strength alloy - высокопрочный сплав
High - temperature equipment - оборудование, предназначенное для работы в условиях высокой температуры
Hole - дыра, отверстие, яма
Homogeneous - гомогенный
Human-induced damage - вред (ущерб) наносимый человеком
Hybrid - гибрид
Hydrocarbon - углеводород
Hydrocarbon flame - углеводородное пламя
Hydrochloric acid - хлористоводородная (соляная) кислота
Hydrogen bond - водородная связь
Hydrogen bromide - бромид водорода, бромистый водород
Hydrogenation reaction - реакция гидрогенизации
Hydrogencarbonate - гидрокарбонат (бикарбонат - о солях угольной кислоты)
Hydrogentartrate - гидротартрат (гидрооксалат, кислый щавелевокислый - о солях щавелевой кислоты)
To hydrolyse – гидролизовываться, подвергаться гидролизу
Hydrolysis - гидролиз
Hydroscopic - гигроскопический
Hydroxide - гидроксид (анион или об основаниях)
Hydroxyl group - гидроксильная группа
Igneous - огненный, пирогенный
Ignition - воспламенение, сжигание
Ilmenite - ильменит
To impart - давать, придавать, сообщать, передавать
Impermeable - непроницаемый, герметичный
Impurity - примесь

Incandescence - белый накал, накаливание
Inception - начало
Incidence - сфера действия, охват
To include - включать, содержать в себе, включать
Incomplete - неполный
To incorporate - включать
To increase -увеличивать
To induce - индуцировать, вызывать
Industrially - на производстве
Industrial atmosphere - производственная воздушная зона
Inefficiency - неспособность, неэффективность
Inevitable - неизбежный, неминуемый
Inflammable - легко воспламеняющийся, горючий
Inflammatory - возбуждающий
Informally -неформально, неофициально
Infrared spectroscopy - инфракрасная спектроскопия
To ingest - глотать
To inhale - вдыхать
Inherent - присущий, свойственный
Inhibition - ингибирование, торможение
Inner - внутренний
To insert - вставлять, помещать
Insertion - вставление, включение
Inside - внутренняя сторона; внутри; внутренний
Instead - вместо
Insulating - изоляционный
Intensity - интенсивность, глубина, сила
Intensive - интенсивный
Interaction - взаимодействие
Interchange - обмен, чередование; обмениваться, чередоваться
Interface - контактная поверхность, поверхность раздела, граница раздела
Intermediate -промежуточный, промежуточное соединение, полупродукт
Interstitial - промежуточный
Intricate - запутанный, сложный, затруднительный
To introduce - вводить, вставлять
Invar - сплав железа с никелем
To invent - изобретать
To investigate - исследовать
Iodate - иодат
Iodide - иодид
Iodine - иод
Ionization energy - энергия ионизации
Iridescent - радужный, переливчатый
Iron - железо
To isolate - изолировать, обособлять, отделять
To issue - вытекать, исходить, выпускать
Ketone - кетон
Kaolin - каолин
Kaolinit - каолинит
Kainite - каинит
Kettle - чайник, котел, котелок; котловина(геол.)
Lamella - ламель, пластинка; тонкий слой
Laminar flow - ламинарный поток
Lanthanum - лантан
Lanthanoids - лантаноиды
Laser -лазер
Lattice - решетка (кристаллическая)
Layer - слой
Lawrencium - лоуренсий

Leach - выщелачиватель; выщелачивать
Lead - свинец
Lead-free - не содержащий свинец или не содержащий тетраэтилсвинец
Ligand -лиганд
Light - легкий
Lignite – лигнит
Lime kiln - печь для обжига извести
Limestone - известняк
Limewater - жесткая вода, известковая вода
Limonite - лимонит
Lined - линованный; облицованный; футерованный
To link - связать(-ся), связывать(-ся)
Liquid - жидкость; жидкий
Litharge - глет; оксид свинца
Lithium - литий
To lose - терять, утрачивать(например, качества)
Low-melting-point casting alloys – легкоплавкие сплавы
Lungs -легкие
Lustrous - блестящий
Lutetium - лютеций
Lyophilic sols - лиофильные золи
Lyophobic sols - лиофобные золи
Lyophohic sols - лифоичные золи
Magnesium - магний
Magnetite - магнетит
Magnitude - величина
Main - основной, главный
Mainly - главным образом
Malleable iron - ковкий чугун
Mammal - млекопитающее
Manganate(VII) (permanganate) - манганат(VII) (перманганат - о соединениях марганца (VII))
Manganese - марганец
Manufacture - производство, обработка, изготовление
Manure - удобрение, навоз
Marble - мрамор
Marine – морской
To measure - измерять, мерить, отмерять
To melt - таять; плавить(-ся)
Melting point(m.p.) - температура плавления (т.п.)
Member - член
Membrane - мембрана, пористая перегородка
Mercury - ртуть
To be mentioned - быть упомянутым, быть названным
Mesoporous - среднепористый
Methanal (formaldehyde) - метановый альдегид(формальдегид)
Methane - метан
Methanides - метаниды
Methanoate - метанат (о соединениях, солях метановой, муравьиной кислоты)
Methanoic acid (formic acid) - метановая кислота(муравьиная кислота)
Methanol - метанол
Methylamine - метиламин
Methylene - метилен(радикал)
Methylethylamine - метилэтиламин
Microgravity - микрогравитация
Migrate - мигрировать, переселяться, перемещаться
Mine - рудник; шахта; копь; прииск; залежь; пласт; мина; производить горные работы
Minor - незначительный, второстепенный
Miscible - способный смешиваться, легко смешивающийся

Mist - легкий туман, дымка, мгла, пасмурность
To mix - смешивать
Mixture - смесь
To moderate - умерять, сдерживать; усреднять
Modification - видоизменение, модификация, изменение
Moist - сырой, влажный
Moisture - влага; сырость; влажность
Molten - расплавленный
Monoxide - монооксид
Montmorillonite - монтмориллонит(минерал)
Mordant - едкий; протрава, кислота, употребляемая при гравировании
Mortality - смертность
Mortar - ступка
Mortar and pestle – ступка и пестик
Nanotubes - нанотрубки,
Natural (gas) - природный (газ)
Negative - отрицательный
Nettle - крапива, обжигаться крапивой
Neutron - нейтрон
Nitrate - нитрат (соли азотной кислоты)
Nitre - селитра
Nitric acid - азотная кислота
Nitride - нитрид (нитриды металлов)
To nitrify -нитрифицировать
Nitrile - нитрил
Nitrite - нитрит
Nitrogen - азот
Nitrogen cycle - азотный цикл
Nitrogen-fixing bacteria - бактерия, связывающая азот
Nitrous acid - азотистая кислота
Noble gas - благородный газ
Non-ferrous - цветной (о металлах)
Non-ferrous alloys - сплавы цветных металлов
Non-flame system - не пламенная система (не дающая пламя система)
Non-premixed flame - пламя без предварительного смешивания горючих компонентов
Nonstoichiometric - нестехиометрический
Nuleophiles - нуклеофилы
Nucleus (pl. nuclei) - ядро
Novel - новый
To observe - наблюдать
To obtain - получать, получить (что-либо в лаборатории)
To occur - встречаться, появляться
To occupy- занимать, занять, завладеть, оккупировать
Odourless - без запаха, непахнущий
Oil - масло, нефть, смазка
Olefinic group - олефиновая группа
Olivine - оливин (минерал)
Ore - руда
Origin - источник, оригинал; начало; первопричина; происхождение
Orthophosphate - ортофосфат
Osmium tetroxide - тетроксид осмия
To outperform - превосходить, превзойти
Overall - полный, от начала до конца
Overhead power cable -подвесной энергосиловой кабель
To overlap - частично покрывать
Oxidation - окисление (реакция)
Oxidation state - степень окисления
To oxidize - окислять(-ся)
Oxidizing acid - окисляющая кислота
Oxoacid - оксокислота
Oxygen - кислород
Ozone - озон
To ozonize - озонировать

Palladium - палладий
Paraffin oil - парафиновое масло, керосин
Paraffin wax - парафиновый воск
Partially - частично
Particle - частица
Pass - проход; проходить (дальше, мимо и т.д.); переход
Passage - прохождение
Paste electrode - пастовый электрод, пастообразный электрод
Peat - торф
Pectate - пектат
Pentagon - пентагональный
Pentlandite - пентландит (минерал)
Perchloric acid - хлорная кислота
Permanent - постоянный, долговременный
Permian - Пермский
To permit - разрешать, позволять
Peroxide - пероксид
Persuasive - убедительный
To perturb - возмущать
Petroleum - (природная, сырая) нефть; нефтяная (промышленность)
Pewter - пьютер (сплав на основе олова со свинцом)
Pi-bonding - связь с участием p-электронов
Pig-iron - чугун в чушках
Pink - розовый
Pinkish - розоватый
Phase - фаза
Phosphorus -фосфор
Photosynthesis - фотосинтез
Plagioclase - плагиоклаз (минерал)
Planar - плоский, плоскостной, планарный(лазер)
Plant - растение; рост; сажать; ставить, устанавливать (прочно)
Plaster - пластырь; штукатурка; мазать, намазывать; пачкать; затвердевать (как гипс)
Plastic - пластик, пластмасса; пластичный
Platinum - платина
Platy - плоский, пластинчатый (о структуре)
Poisonous - ядовитый
To polarize - поляризовать
Pole -полюс
Polycation - поликатион
Polyhedral - полиэдрический
Polymer - полимер
Polymer modified electrodes - электроды с модифицированной полимером поверхностью
Porosity -пористость
Porous - пористый
Potash - карбонат калия
Potassamide - амид калия
Potassium - калий
Potassium bromide - бромид калия
Potassium hydroxide - гидроксид калия
Pottery - керамика, гончарные изделия
Potting - производство глиняных или керамических изделий
Powder - порошок
Precipitate - осадок, осаждать
Precipitation - осаждение
Preferred - преимущественный
Prehistoric - доисторический
Premixed flame - пламя предварительно смешанных горючих компонентов
Preparation - приготовление
Pressure - давление
To prevent - предотвращать
Previously - предварительно

Primary alcohols - первичные спирты
Primary amides - первичные амиды
To produce - производить, получать (на производстве)
To promote - способствовать
To propagate - распространять
Propanamide - пропан амид
Propane - пропан
Property - свойство
Proton - протон
Proton-acceptor - акцептор протона
To prove - доказывать, доказать
To provide - обеспечивать
Pungent - едкий, жгучий
Pure - чистый
To purify - очищать, чистить
Purite - пирит
Purple - пупрупрный
Pyridine- пиридин
Pyrometry - пирометрия
Pyroxene - пироксен (минерал)
Quantitative - количественный
Quaternary ammonium compounds - четвертичные аммониевые соединения
Radium - радий
Radius - радиус
Rainwater - дождевая вода
Range - ряд, линия, область; выстраиваться в ряд, располагать в порядке
Rate - скорость
Rate-controlling - скорость - контролирующий
Rather - лучше, скорее, предпочтительнее
Ratio - отношение (соотношение)
Raw - сырой, необработанный
Raw materials - сырье
Reactant - реагент, вещество участвующее в реакции
Reactive - химически активный
Reactivity - реакционная способность
Readily - быстро, сразу, с готовностью, охотно
Reagent - реагент, реактив (химическое соединение)
Reagent paper - лакмусовая бумага
To reduce - восстанавливать (в химической реакции)
Reducing agent - восстановитель
Reduction - восстановление
To refer to - относиться, ссылаться
Refinery - очистительный завод
To reflect - отражать(-ся)
Reforming - риформинг (нефтепродуктов)
Refractive - преломляющий
Refractory - огнеупорный материал; тугоплавкий, огнеустойчивый материал; огнеупор
Refrigeration - охлаждение, замораживание
To regard - рассматривать, иметь отношение, считать, касаться
Relative atomic mass (r.a.m.) - относительная атомная масса
To release - освобождать, высвобождать; отпускать, выпускать
To remain - оставаться
Removal – перемещение, устранение
Replication - копия, копирование; возражение, ответ
To reproduce - воспроизводить
To require - требовать
To resemble - быть похожим
Reserve - резерв, запас; запасать, сберегать
Reservoir - запас, источник; хранилище, резервуар

Residence - проживание, пребывание, длительность пребывания
Resin - смола
Resistance - сопротивление, противодействие
Resistant - сопротивляющийся; стойкий, прочный
Resonance - резонанс
Respiration - дыхание, вдох
Responsible - ответственный, надежный
To restrict - ограничивать
Reversible - обратимый
Rhodium - родий
Rigid gel - устойчивый гель; жесткий, неподатливый гель
Ring - кольцо, окружать; звон, звенеть
To rise - восходить, подниматься; повышение, степень подъема
Risk - риск; рисковать
To roast - обжигать, прокаливать
Rock - камень, порода, скала; качание, колебание
Root - основание, корень; причина, источник
Roughly - примерно, приблизительно
Route - дорога, путь
Rubber -резина, каучук; покрывать резиной; резиновый
Rubidium - рубидий
Safety - безопасность
Salicylate - салицилат (соль или эфир салициловой кислоты)
Sand - песок, гравий
Saturation - насыщение
Scandium - скандий
Screen - экран, щит, доска; производить проверку
Scrutiny - тщательное изучение
Scum - пена, накипь, шлак; снимать пену; снимать накипь
To seal - запечатывать
Seawater - морская вода
Secondary alcohol - вторичный спирт
Sedative - седативный, успокаивающий
Selective - выборочный, селективный
Semiconductor - полупроводник
Sensitivity - чувствительность
Shallow - поверхностный, неглубокий
Shape - вид, форма
Sheen - пластина
Shock tubes - ударные трубки
Short atmospheric life -time particles - короткоживущие атмосферные частицы
Siderite - сидерит
Significant - существенный, значительный
Silent - тихий, бесшумный
Silicate - силикат
Silicon- кремний
Silver - серебро
Silvery - серебристый
Single - единичный, один, единственный
Single charge - единичный заряд
Sinking - оседание
To be situated - находиться
Size - размер, размерный
Skin - кожа, шкура, наружный слой, оболочка
Slag - шлак (металл), пористая губчатая лава
To slake - гасить пламя, гасить известь
Slippery - скользкий
Slit-Shaped - щелеообразный
Smaltite - смальтит (минерал)

Smell - запах, пахнуть
To smelt - плавить, выплавлять
Smoke - дым, копоть, коптить
Sodium - натрий
Soft - мягкий
Soil - почва
Sol -золь
Solar -солнечный
Solder - припой
Solid lubricant - смазывающий материал твердой консистенции
Solidification - затвердевание, твердение, застывание
Solubility - растворимость
Soluble - растворимый
Solute - растворенное вещество
Solution - раствор
Solvation - сольватация
To solve - решать, разрешать (задачу, проблему); растворять (-ся)
Solvent -растворитель
Soot - сажа
Soot formation - сажеобразование
Sparingly soluble - плохо растворимый
Spark ignition - искровой возгорание
Spatially - пространственно
Spattering - разбрызгивание
Specific gravity - удельный вес
Specimen - образец
Sponge - губка, губчатое вещество
Sprinkler system - противопожарная система
Stable - устойчивый
Stainless steel - нержавеющая сталь
Standard hydrogen half-cell - стандартный водородный электрод (полуэлемент)
Starch - крахмал
Steam - пар
Step - шаг, этап, стадия
Stinging - жгучий, острый
Stirring - помешивание, взбалтывание
Stock solution - основной раствор
Storage - хранение
Stream - поток, струя
Strength - прочность
To strike (struck, struck) - зажигать
Strong - сильный, прочный
Strontium - стронций
Subbituminous coal - бурый уголь, полубитуминозный уголь
To sublime - сублимировать
Subsequent - последующий, более поздний
Subshell - подоболочка
To be suitable for - быть подходящим, быть годным
Sulphate - сульфат(VI)
Sulphide - сульфид
Sulphide galena - галенит(минерал), сульфид свинца
Sulphite - сульфит(IV)
Sulphur - сера
Sulphuric acid - серная кислота
Sum - сумма
Superacid - суперкислота
Super oxide - супероксид
Support - поддержка; основа, подложка
To suppress - подавлять
To surround - окружать
To be susceptible to smth. - восприимчивый к чему-либо
Suspended - взвешенный
Suspended matter - взвесь
Swamp - болото
Tall tower (lime kiln) - высотная башня
Tanning -дубление
Tar - деготь

Target - мишень, цель
To tarnish - вызывать потускнение (например, реакцией окисления)
Technique - метод, способ, методика
Temperate Zone - умеренный пояс
Temporary - временный
To tend - иметь тенденцию; управлять
Tension - напряжение, напряженное состояние
Ternary - тройной, трехкомпонентный
Tertiary alcohol -третичный спирт
Tetrachloromethane - тетрахлорметан
Tetrahedron - тетраэдр
Thereby - таким образом
Thermal conductivity - термическая проводимость
Thermocouple material - материал термопар
Thorium - торий
Tiles - черепица, кафель
Tin - олово
Tinge - оттенок
Tissue - ткань
Transform - изменять, преобразовывать
Transition - переход
Transition elements - переходные элементы
Translucent - просвечивающий, полупрозрачный
Transmission - передача, сообщение, прохождение; привод; трансмиссия
Transparent - прозрачный
Trend - направление
To treat - обрабатывать
True (solution) - истинный раствор
Tunable - настраиваемый, перестраиваемый
Tungsten - вольфрам
Turbine blade - лопатка турбины
Tuyere - фурма
Type metals - полиграфический гарт (литера, шрифт)
To undergo - испытывать, подвергаться
Unique - уникальный
Univalent - одновалентный
Unknown - неизвестный
Unpleasant - неприятный
Unsaturated -ненасыщенный
Uptake - поглощение
Upward - направленный или движущийся вверх
Uranium - уран
Urea - мочевина
Urea-formaldehyde resins - мочевиноформальдегидные смолы
Utility - полезность
Validity - действительность; обоснованность, значимость
Value - значение
Valve – клапан
Vapour - пар
Various - различный
Vat - бак, цистерна, куб; наливать в бак
Vegetable matter - материалы растительного происхождения
Vehicle - транспортное средство
Velocity - скорость
Vermiculite - вермикулит (червеобразный) (минерал)
Vigorously - сильно, энергично
Virtual - фактический, действительный, эффективный
Viscose - вискоза (шелк вискозный)
Vital - жизненный
Vitriol - медный, железный купорос
Volatile - летучий, легко испаряющийся

Volcanic - вулканический
Voltage - напряжение (электрическое)
Voltammetry - вольтамперометрия (метод исследования)
War - война, борьба, антагонизм
Warming - потепление
Wax - воск
Weak - слабый
Whilst=While - пока, в то время как, когда
Whitewash - известковый раствор для побелки, побелка
Wine - вино; что-либо бодрящее
Wine stone - винный камень
To withstand - выдержать, пройти
Woody-fiber - древесное волокно
Work-hardening - механическое упрочнение
Wrought iron - сварочное железо
Xanthate - ксантат
Yarn - пряжа; нить
To yield - приводить к образованию (чего-л.), вызывать образование (чего-л.)
Yttrium - иттрий
Zinc - цинк
Zirconium - цирконий

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