**МИНИСТЕРСТВО ОБРАЗОВАНИЯ И НАУКИ РК**

**КАЗАХСКИЙ НАЦИОНАЛЬНЫЙ УНИВЕРСИТЕТ ИМ. АЛЬ-ФАРАБИ**

**Методическая разработка по английскому языку**

**для студентов факультета Химии и Химической технологии**

**Simple Chemistry**

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Аннотация

Методическая разработка предназначена для студентов химического факультета, а также для преподавателей, ведущих занятия по химии на английском языке. Целью методической разработки является формирование и развитие компетенций, необходимых для использования английского языка в сфере профессионального общения. Данная разработка состоит из 15 уроков. Каждый урок состоит из материала по общей грамматике, текста по специальности, словаря и грамматических упражнений. Данная разработка позволяет расширить словарный запас обучающегося по химической лексике, усовершенствовать знания по общей грамматике английского языка и развить навыки чтения и перевода текстов по специальности.

Summary

The manual has been written for students of chemical specialties and teachers who deliver classes on chemistry in English. The manual is aimed at developing competences necessary for the use of English in the sphere of professional communication. This manual includes 15 units. Each unit contains the material on general grammar, the text on specialty, vocabulary and grammar exercises. This manual allows enlarging a leaner’s vocabulary on chemical lexis, improve the knowledge of General English grammar and develop the skills to read and translate the texts on specialty.

**Introduction**

The manual was created based on the pedagogical principle: “simple –to- complex”. The manual includes 15 units. Each unit contains general grammar material, two chemical texts with vocabularies and grammar exercises. The manual is designed for the first-year students of chemical faculties and school teachers of chemistry. It can be used for the English learners of Pre-Intermediate level. All text material was adjusted to the unit grammar. All grammar material is given in English. The authors give detailed explanations and extensive vocabularies for the texts contained in the units. All texts were carefully selected and adopted by the authors. The exercises in each unit were developed using the unit vocabulary which includes terminological lexis and lexis widely-used in chemical contexts and corresponding grammar material. One unit is devoted to the reading of chemical equations and formulas. This unit contains very useful information for school teachers of chemistry. We gave detailed explanations on the reading of chemical equations, formulas and some mathematical symbols. At the end of the manual the authors included very helpful information. This information comprises the tables of chemical elements and Greek symbols in English with transcription, the table of irregular verbs and the examples of the comments on the chemical reactions in English. Using these comments a teacher of chemistry or a student of a chemical faculty can make up chemical equations in English. The main advantage of the manual is that it shows how simple grammar can function in chemical texts.

**Unit 1**

**Present Simple**

Positive sentences

|  |  |
| --- | --- |
| I, you, we, they  He, she, it | read  reads |

We add **-s** after **he, she, it:** I start → he start**s.**

If the verb ends in **-*ch, -o, -sh, -ss*** we add ***-es*:** I watch → he watch**es,**  I go → he go**es.**

If the verb ends -**y** we add *-****ies*:** I study → he studies.

Negative sentences

|  |  |  |
| --- | --- | --- |
| I, you, we, they  he, she, it | do not (don’t)  does not (doesn’t) | Read  read |

Questions (general)

|  |  |  |
| --- | --- | --- |
| Do  Does | I, you, they, we  he, she, it | Read  read |

Questions (special)

|  |  |  |  |
| --- | --- | --- | --- |
| What  How long  How  How much  Whom  When  Where  Why | Do    Does | I, you, we, they    he, she, it | read |

Questions to the subject

|  |  |
| --- | --- |
| Who  What | reads  dissolves |

When we put the questions to the subject we always use the verb in singular and we don’t use an auxiliary verb.

For example: **We** read it every day.

**Who reads** it every day?

**Verb to be**

The verb **to be** is the most important verb in the English language. It is difficult to use it because it is an irregular verb in all of its forms.  In the simple present tense, **to be** is conjugated as follows:

#### Affirmative forms of the verb to be

|  |  |  |
| --- | --- | --- |
| Subject Pronouns | Full Form | Contracted Form |
| I | am | 'm |
| You | are | 're |
| he/she/it | is | 's |
| We | are | 're |
| You | are | 're |
| They | are | 're |

#### Interrogative forms of the verb to be (or the forms of general questions):

|  |  |
| --- | --- |
| Am | I? |
| Are | you? |
| Is | he/she/it? |
| Are | we? |
| Are | you? |
| Are | they? |

#### Interrogative forms with question words (or the forms of special questions):

#### Question word + to be verb + noun

#### We use this formula when we put the question to the object, adverbial modifier of place or time.

#### For example:

#### Oxygen is soluble in water.

#### Where is oxygen soluble?

#### This acid is an azeotrope at ambient temperature.

#### When is this acid an azeotrope?

#### Question word + to be verb

#### We use this formula when we put the question to the subject.

#### For example:

#### Oxygen is a chemical element.

#### What is a chemical element?

#### *Note: when we put the questions to the subject we must use only singular.*

#### *Acids are red substances*

#### *What are red substances – is incorrect*

#### *What is red substances - is correct*

#### When we want to put the question to the adjective we must use the following structure:

#### Question word (what) + noun + to be verb

#### For example:

#### Nitric acid is a powerful agent.

#### What agent is nitric acid? or

#### We use it at normal temperature.

#### At what temperature do we use it?

#### After the question word what we must put the noun that is the part of nominal predicate.

If we want to put the question to the adjective designating **colour, size, height, weight** we should use the question word **what,** for example: What colour is this metal ?

#### Negative Forms of the verb to be:

|  |  |  |
| --- | --- | --- |
| Subject Pronouns | Full Form | Contracted Form |
| I | am not | ‘m not |
| You | are not | aren't |
| he/she/it | is not | isn't |
| We | are not | aren't |
| You | are not | aren't |
| They | are not | aren't |

When we use Present Simple:

* We use this tense when we talk about the actions that take place every day. At that we use such adverbs as **always, frequently, often, every day/week/month/year,** **sometimes, seldom and rarely**: I go fishing every day.
* We use this tense when we talk about well-known-facts: She comes from France. Water contains oxygen and hydrogen.

**The place of adverbs in the sentences**

***Always, often, sometimes, seldom, rarely:***

Positive sentence: I always (often, sometimes, seldom, rarely, frequently) play football.

Question: Do you always (often, sometimes, seldom, rarely, frequently) play football?

Negative sentence: I don’t always (often, sometimes, seldom, rarely, frequently) play football.

***Every day/week/month/year***

Positive sentence: I go to work every day.

Question: Do you go to work every day?

Negative sentence: I don’t go to work every day.

***The adverb sometimes can be placed at the beginning of positive sentences: Sometimes I listen to music.***

**Vocabulary**

nitric acid – азотная кислота

reaction – реакция

a substance – вещество

corrosive – коррозионный

a color – цвет

colorless − бесцветный

an odour – запах

odorless − без запаха

acrid – едкий

commercially available – имеющиеся на рынке

a mineral acid – минеральная кислота

an azeotrope – азеотроп

to be known – известно

pure – чистый

a compound – соединение

boiling point – температура кипения

melting point (m.p.) – температура плавления

solid – твердый, твердое тело

hydrate – гидрат

monohydrate – моногидрат

trihydrate – тригидрат

to undergo – подвергать

to give rise – вызывать

a variation – изменение

vapor pressure – давление пара

above – над

a liquid – жидкость

because – из-за

to produce – образовывать, получать

to dissolve – растворяться

dissolved – растворенный

low - низкий

partly – частично

completely – полностью

thermal decomposition – распад под действием тепла

to contain – содержать

fuming nitric acid – дымящаяся азотная кислота

to use - использовать

explosive industry – производство взрывчатых веществ

volatile – летучий

approximate – приблизительный

anhydrous acid – ангидрит кислоты, безводная кислота

[red fuming nitric acid](https://en.wikipedia.org/wiki/Red_fuming_nitric_acid) – красная дымящаяся азотная кислота

a substantial quantity – значительное количество

to leave – оставлять

reddish-brown – красновато – коричневый

due to – из-за

a reagent – реагент

a concentration - концентрация

nitration – нитрирование

an addition – добавление

nitro group – нитро группа

an organic molecule – органическая молекула

an ambient temperature – комнатная температура

an oxidizing agent - окислитель

powerful – сильный

density – плотность

nitrogen −азот

nitrogen oxide – оксид азота

soluble – растворимый

non-negligible – значительный, существенный

negligible –не существенный

variation – изменение

fume – дым, дымиться

to include – включать

molecule – молекула

zinc – цинк

some – некоторый

in – в

for – для

in the process of – в процессе

strong – сильный, прочный

ambient temperature – комнатная (наружная) температура

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

**Nitric acid**

Nitric acid ([H](https://en.wikipedia.org/wiki/Hydrogen)[NO3](https://en.wikipedia.org/wiki/Nitrate)) is a highly [corrosive](https://en.wikipedia.org/wiki/Corrosive) [mineral acid](https://en.wikipedia.org/wiki/Mineral_acid). The pure compound is colorless. Commercially available nitric acid is an [azeotrope](https://en.wikipedia.org/wiki/Azeotrope). The boiling point of nitric acid is120.5 °C at 1 atm. The melting point of nitric acid is −42 °C (−44 °F; 231 K). Odour is acrid. Two solid hydrates are known; the monohydrate (HNO3·H2O) and the trihydrate (HNO3·3H2O). Chemists undergo nitric acid [thermal](https://en.wikipedia.org/wiki/Thermal) decomposition: 4 HNO3 → 2 H2O + 4 NO2 + O2. This reaction gives rise to some non-negligible variations in the vapor pressure above the liquid because the nitrogen oxides which this reaction produces dissolve partly or completely in the acid. Nitric acid is the primary reagent for [nitration](https://en.wikipedia.org/wiki/Nitration). The nitration is the addition of a [nitro group](https://en.wikipedia.org/wiki/Nitro_group) to an [organic molecule](https://en.wikipedia.org/wiki/Organic_molecule). Nitric acid is normally a [strong acid](https://en.wikipedia.org/wiki/Strong_acid) at ambient temperatures. Nitric acid is the powerful oxidizing agent. The concentration of available commercial nitric acid is 68 %. The density of concentrated nitric acid is 1.42 g/mL. Fuming nitric acid contains 90% of HNO3  and has a density of 1.50 g/mL.

We use this acid in the explosives industry. It is not as volatile and not as corrosive as the anhydrous acid and has the approximate concentration of 21.4 mole.

[Red fuming nitric acid](https://en.wikipedia.org/wiki/Red_fuming_nitric_acid), or RFNA, contains substantial quantities of dissolved nitrogen dioxide (NO2). It leaves the solution with a reddish-brown color. Due to the dissolved nitrogen dioxide, the density of red fuming nitric acid is low.

**Ex. 2 Answer the questions**

1. What is nitric acid?

2. Is it an azeotrope?

3. What is the concentration of commercially available nitric acid?

4. Is it a primary reagent for nitration?

5. What do chemists undergo nitric acid ?

**Ex. 3 Put the verbs in the brackets in the correct form in Present Simple.**

1. Nitric acid (to contain) \_\_\_\_ nitrogen oxide.
2. Nitric acid ( to have) \_\_\_\_ an odour.
3. Nitric acid (to be) \_\_\_ a substance.
4. Concentrations (to be) \_\_\_ very high.
5. This reaction (to produce) \_\_\_ an oxide.
6. The density (to be) \_\_\_ unknown.
7. What (to be) \_\_\_\_ a red substance ?

**Ex. 4 Put the questions to the bold-typed words.**

1. **Nitric acid** ([H](https://en.wikipedia.org/wiki/Hydrogen)[NO3](https://en.wikipedia.org/wiki/Nitrate)) is a highly [corrosive](https://en.wikipedia.org/wiki/Corrosive) [mineral acid](https://en.wikipedia.org/wiki/Mineral_acid).
2. **Two solid hydrates** are known.
3. **This reaction** gives rise to **the variation.**
4. **This reaction** produces **vapor above the liquid.**
5. **We** undergo **this acid thermal decomposition.**
6. Nitric acid is normally a [strong acid](https://en.wikipedia.org/wiki/Strong_acid) **at ambient temperatures**.
7. Nitric acid is a **powerful** oxidizing agent.

**Ex. 5 Put the words in a right order.**

1. Is / soluble / water / nitric acid / in.
2. Nitric acid / we / thermal decomposition / undergo.
3. Nitrogen oxide / partly / dissolves.
4. Contains / the substantial quantities of nitrogen oxide / this acid.
5. It / a reddish / has / colour.
6. People / nitric acid / explosive industry / in / use.
7. Nitric acid / doesn’t / a high concentration / have.

**Ex. 6 Translate the following sentences from English into Russian or Kazakh.**

1. Nitric acid is colourless.
2. An azeotrope has an acrid odour.
3. Who uses nitric acid in explosive industry ?
4. The nitration includes the addition of nitro group into an organic molecule.
5. The density of the acid is very low.
6. Fuming acid doesn’t contain this substance.
7. Nitric acid is a compound.
8. Nitric acid doesn’t dissolve completely.

**Ex. 8 Read and translate the text**

**How we make sulfuric acid**

We often use the reaction of sodium metabisulfite with acid in the making of sulfuric acid. This reaction provides a convenient source of sulfur dioxide. It usually prevents the clogging of tubes by the sulfur vapors and soot. We convert sulfur dioxide into sulfuric acid. We do this with the help of its reaction with an oxidizer in water.

Industrially, sulfur dioxide reacts with oxygen over a catalyst to make sulfur trioxide. This is very cheap method of production. People usually use it in industry.

We sometimes use potassium metabisulfite instead of sodium metabisulfite. Chemists use both substances to sterilize winemaking mixtures. We always use the oxidizers because this reaction doesn’t work without them.

**Vocabulary**

sulphuric acid – серная кислота

convenient source – подходящий источник

sodium metabisulfite – метабисульфат натрия

the making – производство

sulfur dioxide – диоксид серы

to provide – обеспечивать

to prevent – предотвращать

clogging of tubes – забивание трубок

sulfur vapors – пары серы

soot – сажа

to convert – преобразовывать

sulfur dioxide – диоксид серы

with the help of – с помощью

oxidizer – окислитель

to react – реагировать

industrially - на производстве

a catalyst – катализатор

over –над

to make – получать

sulfur trioxide- триоксид серы

a cheap method of production – не дорогой метод производства

potassium metabisulfite - метабисульфат калия

to sterilize – стерилизовать

a mixture – смесь

winemaking mixtures - смеси, использующиеся в виноделии

**Unit 2**

**Past Simple**

Positive sentences

|  |  |
| --- | --- |
| I/ you/ we/ they/ he/ she/ it | watch + ed TV yesterday |

If the verb ends in *–* **y** we use the ending: *-***ied,** for instance: copy – cop**ied**.

But **y** doesn’t change to **i**if the ending is ***ay, / ey, / oy/ uy,*** for example: to enjoy – enjoy**ed**.

Sometimes in the verbs which ends in a vowel + a consonant: to stop, to plan, the consonant doubles: to stop – sto**pped**, to plan – pla**nned**. We double the consonant if we stress the last part of the word, for instance: prefer – prefe**rr**ed.

Negative sentences

|  |  |
| --- | --- |
| I/ you/ we/ they/ he/ she/ it | did not (didn’t) watch TV yesterday. |

Questions (general)

|  |  |  |
| --- | --- | --- |
| Did | I/ you/ we/ they/ he/ she/ it | watch TV yesterday ? |

There are two types of verbs in English: regular and irregular. Regular are formed with the help of the ending: *-***ed.**

Irregular verbs are formed in a different way. For example, the verb “to see” is an irregular verb. In Past Simple it has the following form: **to see – saw** or the verb “to write” is also an irregular verb: **to write – wrote** (see appendix 1). The negative sentences and questions with irregular verbs are formed in this way:

**Positive sentence:** I saw him yesterday.

**Negative sentence:** I didn’t see him yesterday.

**Question:** Did you see him yesterday?

Questions (special)

|  |  |  |  |
| --- | --- | --- | --- |
| What  How long  How  How much  Whom  When  Where  Why | did | I, you, we, they    he, she, it | see him yesterday? |

Questions to the subject

|  |  |
| --- | --- |
| Who  What | dissolved acid ?  dissolved in acid? |

When we use this tense:

We mainly use this tense when we talk about past actions. We use this tense with the following adverbs: **yesterday, last week/month/year, in 1990.** We use this tense when we specify the time of the action. For example: I saw him in 1980.

**Verb to be**

Positive sentence

|  |  |
| --- | --- |
| I, she, he, it | Was |
| You, they, we | Were |

Negative sentence

|  |  |
| --- | --- |
| I, she, he, it | Was not (wasn’t) |
| you, they, we | Were not (weren’t) |

Question (general)

|  |  |
| --- | --- |
| Was | I, she, it, he |
| Were | you, we, they |

***The word order of special questions with the verb “to be” in Past Simple is similar to the word order in special question in Present Simple.***

**Vocabulary**

a property – свойство

to divide into – делить на

a chemical element – химический элемент

a metal – метал

a nonmetal – не металл

a good conductor – хороший проводник

heat – тепло

electricity – электричество

to form – образовывать

an alloy – сплав

with – с

at least – по крайней мере

a [basic oxide](https://en.wikipedia.org/wiki/Basic_oxide) – основной оксид

an appearance – внешний вид

to subdivide into –подразделять на

a chemist – химик

a periodic table – периодическая система

from left to right – слева направо

[alkali metals](https://en.wikipedia.org/wiki/Alkali_metals) – щелочные металлы

[alkaline earth metals](https://en.wikipedia.org/wiki/Alkaline_earth_metals) – щелочноземельные металлы

[lanthanides](https://en.wikipedia.org/wiki/Lanthanides) – лантаноиды

radioactive [actinides](https://en.wikipedia.org/wiki/Actinides) – радиоактивные актиноиды

[transition metals](https://en.wikipedia.org/wiki/Transition_metal) – переходные металлы

specialized subcategories – специализированные подкатегории

[refractory metals](https://en.wikipedia.org/wiki/Refractory_metal) – тугоплавкие металлы

[noble metals](https://en.wikipedia.org/wiki/Noble_metal) – благородные металлы

relatively – относительно

soft – мягкий

hard – твердый

most – большинство

silvery – серебристый

high – высокий

room temperature – комнатная температура

shiny – блестящий

brittle – хрупкий

to exist – существовать

[amphoteric](https://en.wikipedia.org/wiki/Amphoteric) – амфотерный

a weakly [acidic oxide](https://en.wikipedia.org/wiki/Acidic_oxide) – слабо кислотный оксид

dull – тусклый

coloured – цветной

an open structure – решетчатая структура

to tend – иметь тенденцию к

to gain an electron – получать электрон

to lose – терять

a poor conductor – плохой проводник

to obtain – получать

to study – изучать

metalloids – металлоиды

to share an electron – отдавать электрон

to conduct – проводить

an electrical conductor – электропроводник

a thermal conductor– теплопроводник

ionization energy – энергия ионизации

to find naturally – находить в природе

a large amount – большое количество

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

**The properties of metals and nonmetals**

Chemists divide chemical elements into metals and nonmetals. All metals have a shiny appearance. They are good conductors of heat and electricity. They form [alloys](https://en.wikipedia.org/wiki/Alloy) with other metals and have at least one [basic oxide](https://en.wikipedia.org/wiki/Basic_oxide). Chemists subdivide metals into several different categories. From left to right in the periodic table, these categories include [alkali metals](https://en.wikipedia.org/wiki/Alkali_metals); [alkaline earth metals](https://en.wikipedia.org/wiki/Alkaline_earth_metals), [lanthanides](https://en.wikipedia.org/wiki/Lanthanides) and radioactive [actinides](https://en.wikipedia.org/wiki/Actinides); [transition metals](https://en.wikipedia.org/wiki/Transition_metal). Specialized subcategories such as the [refractory metals](https://en.wikipedia.org/wiki/Refractory_metal) and the [noble metals](https://en.wikipedia.org/wiki/Noble_metal) also exist. They are relatively soft. Some metals have a colour ([Cu](https://en.wikipedia.org/wiki/Copper), [Cs](https://en.wikipedia.org/wiki/Cesium), [Au](https://en.wikipedia.org/wiki/Gold)). Most metals are silvery. They have low [densities](https://en.wikipedia.org/wiki/Density) (e.g. [Be](https://en.wikipedia.org/wiki/Beryllium), [Al](https://en.wikipedia.org/wiki/Aluminum)) or very [high melting points](https://en.wikipedia.org/wiki/Refractory_metal). They are liquids at a room temperature. They are brittle (e.g. [Os](https://en.wikipedia.org/wiki/Osmium), [Bi](https://en.wikipedia.org/wiki/Bismuth)).

Nonmetals have open structures. They tend to gain electrons when they react with other substances and do not form basic oxides. **Typical nonmetals have a dull, coloured or colourless appearance. They are brittle when they are solid. They are poor conductors of heat and electricity and have acidic oxides. They tend to lose electrons when they react with other substances. They have a high density.**

Metalloids tend to share electrons when they react with other substances. They have weakly acidic or amphoteric oxides. Some metalloids conduct electricity. Most of them are gases at room temperature. They have relatively low densities. They are poor electrical and thermal conductors. They have a relatively high ionization energies. They form acidic oxides. People find them naturally in large amounts.

**Ex. 2 Answer the questions**

1. How do chemists divide chemical elements?
2. What do metals form with other metals?
3. Do nonmetals form basic oxides?
4. What do nonmetals have?
5. What appearance do nonmetals have?

**Ex. 3 Put the verbs in brackets in the correct form in Past Simple.**

1. This metal (to have) \_\_\_\_ a red colour yesterday.

2. Yesterday I (to obtain) \_\_\_\_\_ a new substance in the laboratory.

3. Two days ago I and my colleague from London (to study) \_\_\_\_\_the properties of nonmetals.

4. Last time we (to divide) \_\_\_\_ this substance into two substances.

5. This metal (not to gain) \_\_\_\_ an electron last time.

6. Yesterday this substance (to be) \_\_\_ red.

7. Last year we (to be) \_\_\_\_ students.

**Ex. 4 Put the questions to the bold-typed words.**

1**. Chemists** divided **chemical elements** into metals and nonmetals.

2. **Nonmetals** gained **electrons.**

3. **Metals** were brittle.

4. **Nonmetals** reacted **with other substances**.

5. This metal was **red.**

6. **These metals** had **low** densities.

7. **These metals** were **poor** conductors.

**Ex. 5 Put the verbs in brackets in Past or Present Simple.**

1. I (to study) \_\_\_\_ this substance every day.

2. I (to study) \_\_\_ this substance yesterday.

3. Last time this metal (to be soft) \_\_\_\_.

4. This metal (to be) \_\_\_ always soft.

5. Nonmetals often (to have) \_\_\_ open structures.

6. Last time this nonmetal (not to lose) \_\_\_\_ electrons.

7. This metal (to form) \_\_\_ oxides last time.

**Ex. 6 Translate from English into Russian or Kazakh.**

1. Chemists divided chemical elements into metals and non metals.

2. Metals have low melting and boiling points.

3. Metals didn’t react with acids.

4. Nonmetals didn’t form basic oxides.

5. What is a basic oxide?

6. Metals were brittle when they were solid.

7. Last time metals tended to gain electrons.

8. Nonmetals are poor conductors of heat.

**Ex. 7 Read and translate the text.**

The Carbon Family

**Group 14 (IVA)** consists of carbon, silicon, germanium, tin, and lead. Carbon is a non-metal, silicon and germanium are metalloids, and tin and lead are metals.

With 4 electrons in the valence shell, elements of the carbon family tend to form covalent compounds. With increasing mass and atomic radius these elements become increasingly metallic and have lower melting and boiling points.

Group 14 elements form gaseous hydrogen compounds with difficulty. These are either unstable or combustible. Lead forms oxides, sulfides, and halides in the +4 oxidation state. The +4 oxidation state predominates in carbon, silicon, and germanium; the +2 and +4 oxidation states appear in tin, and the +2 oxidation state prevails in lead.

Carbon compounds are covalent. Carbon forms double and even triple bonds with itself or other elements. It forms compounds that the heavy elements of this group do not form for example acetylene (C2H2). Silicon and the heavier elements of this group form only single bonds.

Thus carbon dioxide CO2 is a gas at normal temperatures because the double bonds between carbon and oxygen create single molecules, but silicon dioxide SiO2 forms a hard rock which is quartz because it is a covalent network solid. Each silicon atom bonds to four different oxygen atoms with single bonds, and each oxygen atom bonds with two silicon atoms.

**Vocabulary**

carbon − углерод

silicon − кремний

germanium − германий

tin − олово

lead − свинец

valence shell − валентная оболочка

to form − образовывать

with increasing − с увеличением

hydrogen compounds− водородные соединения

to form something with difficulty − образовывать что-то с трудностью

unstable − не устойчивый

combustible − возгораемый

either .. or − либо … либо

sulfides − сульфиды

halides − галиды

oxidation state − степень окисления

to prevail − преобладать

to appear − присутствовать, появляться

double bonds − двойные связи

triple bonds − тройные связи

heavy − тяжелый

acetylene − ацетилен

single bonds − одинарные связи

thus − таким образом

a hard rock − твердая порода

between − между

covalent network solid − ковалентное тесло с сетчатой структурой

each − каждый

to bond to − присоединяться

**Unit 3**

**How to read chemical formulas, equations and symbols**

**Vocabulary**

an equation – уравнение

a formula – формула

a power – степень

a degree – градус

a sign – знак

The figure before the compoud is a number of molecules we should read this way: 2МnО2 [ʹtu: ʹmᴐlɪkju:lz əvʹemʹenʹou ʹtu:]

(OH)2 – [ou eitʃ tu taimz]

Fe (II) – iron Roman two

Н+ — hydrogen ion [ʹhaɪdrɪʤən ʹaɪən] or univalent positive hydrogen ion

[ʹju:nɪˏveɪlənt ʹpᴐzətɪv ʹhaɪdrɪʤən ʹaɪən]

Cu++ — divalent positive cuprum ion [ʹdaɪveɪlənt ʹpᴐzətɪv ʹkju:prəm ʹaɪən]

Al+++ — trivalent positive aluminium ion [ʹtri:ˏveɪlənt ʹpᴐzətɪv ˏæljuʹmɪnjəm

ʹaɪən]

Сl- — negative chlorine ion [ʹnegətɪv ʹklᴐ:ʹri:n ʹaɪən] or negative univalent

chlorine ion [ʹnegətɪv ʹju:nɪʹveɪlənt ʹklᴐ:ʹri:n ʹaɪən]

Ca3+ — calcium plus three

Ca3- — calcium three negative

Sign — *or* **:** means bond and we don’t read it:



Sign = *means* **: :** two bonds and we don’t read it either :



Sign + we read like: plus, react with, if we have the plus on the both sides of equation, we read the plus on the second side as and.

Sign = we read like: to give or to form

Sign → we read: to give, to produce, to yield

Sign ↔ we read as: forms или is formed from

In the chemical equation in English we read the names of the compouds with the help of letters, for instance:

4HC1 + O2 = 2C12 + 2H2O [ʹfᴐ: ʹmᴐlɪkju:lz əv ʹeɪtʃ ʹsi: ʹel ʹplᴧs ʹou ʹtu: ʹgɪv ʹtu:

ʹmᴐlɪkju:lz əv ʹsi: ʹel ʹtu: end ʹtu: ʹmᴐlɪkju:lz əv ʹeɪtʃ ʹtu: ʹou]

Zn + CuSO4 = Cu + ZaSO4 [ʹzed ʹen ʹplᴧs ʹsi: ʹju: ʹes ʹou ʹfᴐ: ʹgɪv ʹsi: ʹju: ʹplᴧs ʹzed

ʹen ʹes ʹou ʹfᴐ:]

PC13 + 2C1 → PC15 [ʹpi: ʹsi: ʹel ʹθri: ʹplᴧs ʹtu: ʹmᴐlɪkju:lz əv ʹsi: ʹel ʹgiv ʹpi: ʹsi:

ʹel ʹfaɪv]

Also we can read chemical compounds in the equations using their names, for example:

C + O → CO – carbon plus oxygen yields carbon oxide

**Powers**

х2 – x squared, x square

x3 – x cubed, x cube

5 3 – five to the third power, the third power of five, five cubed

5-4 – five to the minus fourth power, the minus power of five

52 – five to the second power, the second power of five, five squared

The square root of four is two

The square root out of four is (equals) two

The cube root of twenty seven is three

The fourth root of sixteen is two

The square root of *a*

The cube root of *a*

The fifth root out of *a* square

The fifth root out of *a* to the power seven, to the seventh power

square root (out) of [ʹskwɛə ʼru:t (aut) ev] корень квадратный из

cube root (out) of [ʹkju :b ʹru:t (aut) əv] корень ку­бический из

n-th root (out) of [ʹenθʹru:t(aut) əv] корень n-й степени

**Mathematical sings**

**+** plus [plᴧs] 1.плюс; 2. знак плюс; 3. положитель­ная величина; 4.

добавочный, дополнительный

**-** minus [ʹmaines] 1. минус; без; 2. знак минус; 3. от­рицательная

величина; отрицательный

plus or minus [ʹplᴧs ᴐ: ʹmaɪnǝs] плюс минус

minus or plus [ʹmaɪnes ᴐ: ʹplᴧs]

**=** 1. sign of equality [ʹsaɪ n ov i:ʹkwᴐlɪtɪ] знак равен­ства; 2. equals, (is) equal to [ʹ:kwəlz], [izʹi:kwel tu] равняется, равно

**≠** (is) not equal to [iz nᴐt ʹi:kwəl tu] неравно

**~** difference [ʹdɪfrəns] разность

≈ approximately equal [əʹprᴐksɪmɪtli ʹi:kwəl] приблизительно равно

approaches [əʹproutʃɪz] достигает значения similar to [ʹsɪmɪlə tu] подобный

**>** greater than [ʹgreɪtə æn] больше (чем)

**>** not greater than [not ʹgreɪtə æn] не больше (чем)

**<** less than [ʹIes æn] меньше (чем)

not less than [nᴐtʹles æn] не меньше (чем)

equal or greater than [ʹi:kwəl ᴐ: ʹgreɪtə æn] боль­ше (чем) или

равно

equal or less than [ʹi:kwəl ᴐ: ʹles æn] меньше (чем) или равно

m2 – square meter

m3 – cubic meter

s2 – second squared

kg/m3 – kilogram per cubic meter

cm – centimeter

l – liter

km – kilometer

T – tone

N – Newton

Pa – Pascal

Mol – mole

s – second

10o C – 10 degrees Centigrade (Celsius)

10 K – 10 Kelvins

−10o – 10 degrees below zero

+ 10o – 10 degrees above zero

−10 K – minus 10 Kelvins

10o F – 10 degrees Fahrenheit

**[ ]** brackets, square brackets [ʹbrækɪts, ʹskwɛə ʹbrækɪts] pl. квадратные

скобки

**( )** parentheses, round brackets [pəʹrenθɪsi:z, ʹraund ʹbrækɪts] pl.

круглые скобки

**{ }** braces [ʹbreɪsɪz] pl. фигурные скобки

y over x

**Ex. 1 Read the following chemical equations**

Cu + 2H2SO4  = CuSO4 + SO2 + 2H2O

H2O + SO3 = H2SO4

Be2 C + 4H2O = 2 Be (OH)2 + CH4

CaO + H2O = Ca (OH)2

Ca3N2 + 6H2O = 3 Ca (OH)2 + 2NH3

2NO + O2 = 2 NO2

2SO2 + O2 ↔ 2SO3

2KHSO4 = H2O + K2S2O7

(NH4)2S2O8 + 2Ag = Ag2SO4 + (NH4)2SO4

Na2S2O3 + 4Cl2+5H2O = 2H2SO4 + 2NaCl + 6HCl

SO2 + Cl2 = SO2Cl2

SO2Cl2 + 2H2O = 2H2SO4 + 2 HCl

SO2+KMn + KOH → K2SO4 + MnO2

S + KMnO4 + KOH → K2SO4 + MnO2

H2S + KMnO4 + KOH → K2SO4 + MnO2

3SO2 + 2 KMnO4 + KOH → 2 KSO4 + 2 MnO2

**Ex. 2 Read the following SI unites and chemical formulas**

kg/m3, kg/m2, 10-5, cm3, m /s2, l/s2, mm3, l2, mm/g, g3, H2O, S(II), Cu (III), KSO2, HCl, H2S, CaO, SiO, 2H2S, MnSO3, MgO, Cr (OH)2, Cr (OH)6, Ca(HCO)2, MgCO3, C6H6, C2H2OH, ZnCl, FeO, Li2O2, H+, Ca-, Cl+++.

**Ex. 3 Read the following mathematical symbols**

a-5, x3, y2, ( ), { }, [ ], 12o C, 13oF, 14 K, - 13oC, +13oC, , bc, dm, c d, c ≈ v, m + d = s, d – k = f, , , , 65, 7-3, 197,

**Ex 4. Correct the mistakes**

g3 – gram cube

mm/g – millimeter with gram

2Zn + C →CO + Zn – zinc 2 plus carbon and takes carbon oxide and zinc

– the root five of five

11o C – eleven degree

11o F – eleven zero

f+ g = t – f and g gives t

14-10 – fourteen to the minus ten degree

Cu + O → CuO – copper and oxygen give copper oxygen

Ca (III) – calcium three

4 **>**  3 – four bigger than three

2 **<** 5– two smaller than five

x2 – x two

5 + 4 = 9 – five plus four loses nine

TiO2 – ti: ai sekqnd ou

Mn2O7 – em en sekqnd ou sevn

Cl- – chlorine minus

Ca+++ – calcium three pluses

(OH)2 – ou eitʃ tou

s2 – square second

**Ex. 5 Match the first column with the second one**

|  |  |
| --- | --- |
| g/s | eks to the minus fifth power |
| ZnO + C →CO + Zn | di is less that si |
| Zn (IV) | Newton |
| x-5 | Zinc oxide plus carbon and yields carbon oxide and zinc |
| d **<** c | Vanadium oxide |
| VO | Zinc Roman four |
| N | gram per second |

**Ex. 6 Write the following formulas and equations in words**

Н+

Cu+

Cd+++

Al++

Ca (OH)2

BaCO3 + Na2SO4 →BaSO4 + Na2CO3

ZnS + 2HCl = ZnCl2 + H2S

d-6

g8

kg / l

7oF

8oC

P2O5 + C → P + CO

HNO3 + Cu → Cu (NO3)2 + NO + H2O

K2Cr2O7 + H2S + H2SO4 → Cr2(SO4)3+ S + K2SO4 + H2O.

**Ex. 7 Write the following expressions in formulas**

Eks cubed

Eks squared

Eight is greater than seven

Eleven degrees Celsius

Four molecules of water plus carbon dioxide

Calcium oxide

Gramm per liter

The tenth power of seven

Cubic meter

Square centimeter

Negative calcium ion

The square root of seven

Magnesium permanganate reacts with water

Trivalent positive aluminum ion

Y over a

Sodium Chloride plus hydrogen

Ten minus seven is equal to three

Second squared

Ten plus seven is equal to seventeen.

**Additional Grammar**

**Grammar: So, such, too, enough**

**Too**  
**Use:**  
**Too** means there is a lot of something. It shows a **negative opinion**.   
**It’s too hot =** Itis very hot and I don’t like it.

**Form:**  
You can use **too** before an adjective.  
**It’s too cold. My trousers are too small.**

You can also use it before an adverb,  
**You walk too fast. James speaks too quietly.**

Before a noun, use **too much** (uncountable nouns) or **too** **many** (countable nouns).  
**I ate too much food.**  
**I ate too many sandwiches.**

You can also use **too much** after a verb.  
**I ate too much.**  
**Paul drinks too much.**

**Enough**  
**Use:**  
**Enough** means you have what you need.  
*We have* ***enough*** *food for everyone* = everyone has some food.  
*We* ***don’t*** *have* ***enough*** *chairs for everyone* = some people don’t have chairs.

**Form:**   
Write **enough** before a noun.  
*We have enough chairs.*

But write it after an adjective or verb.  
*Are you warm enough?  He’s qualified enough. She isn’t tall enough to be a model.*  
  
*You don’t work hard enough. Are you sleeping enough?*

Sentences with **enough** are sometimes followed by **to + verb infinitive.**  
*I’m not tall enough to reach the book.*  
*I haven’t got enough money to buy that coat.*

**So**  
**Use:**  
**So** means very.  
*It’s* ***so*** *hot!*  
  
**Form:**  
**So** is generally used before an adjective or an adverb.  
*He’s* ***so*** *funny! He plays the piano* ***so*** *well!*

However, in modern English, it is increasingly being used before nouns and verbs.  
*That dress is* ***so*** *last year!* (= That dress is last year’s fashion)  
*I’m* ***so*** *going to shout at him when I see him!* (so = really)

**So** can be used with a **that** clause, to show a **result** of the first clause.  
*I was* ***so*** *hot* ***that*** *I couldn’t sleep.*  
**Such**  
**Use:**  
**Such** also means very. **Such** isused before anadjective and noun.  
*They are* ***such*** *nice children.*   
**Form:**  
**A / an,** if necessary, go **after** such, not before.  
~~That’s a such pretty dress~~. => That’s **such** a pretty dress!

Like **So, Such** can be used with a **that** clause, to show a **result** of the first clause.  
*It was* ***such*** *a nice day that we decided to go to the park.*

Common mistakes

1) Some students use **too** with a positive meaning. But you should use **so** or **very** here.  
*~~It’s too hot! I love the summer!~~* => *It’s* ***so*** *hot! I love the summer!*

2) Some students write **enough** in the wrong place.   
*~~Do we have sugar enough?~~* => *Do we have* ***enough*** *sugar?*

**Practical test**

1. Which sentence is incorrect?

a) This substance is too brittle.

b) Don’t add too much acid!

c) This substance too is dull.

2. Which sentence is correct ?

a) This equation is such a difficult.

b) Do we have acid enough?

c) This metal is such a good conductor of electricity.

3. Which word goes in space: This substance produced too …. smoke.

a) much

b) many

c) any

4. Which word goes in space: This acid is …harmful.

a) such

b) so

c) enough

5. Which sentence is incorrect ?

a) This substance produced smoke enough.

b) This substance doesn’t react well enough with sulhpuric acid.

c) This equation is too difficult for me.

6. Which word goes in space: Chemistry is …. an interesting science

a) an

b) such

c) so

7. Which sentence is incorrect ?

a) The density of metalloids is much low.

b) Metalloids don’t have enough electrons.

c) Metalloids conduct enough electricity.

**Unit 4**

**Future Simple**

Positive sentences

|  |  |
| --- | --- |
| I/ you/ we/ they/ he/ she/ it | will + infinitive (be, read, write and etc.) |

Negative sentences

|  |  |
| --- | --- |
| I/ you/ we/ they/ he/ she/ it | will not (won’t) + infinitive (be, read, write and etc.) |

Questions

|  |  |  |
| --- | --- | --- |
| Will | I/ you/ we/ they/ he/ she/ it | infinitive (be, write, read, and etc.) ? |

***The short form of Future Simple is the following: I, you, they, we, he, she, it’ll. For example:***

***I’ll meet her tomorrow.***

When we use this tense:

* When we talk about future **(next week / month/ year, tomorrow):** I will do it next week.
* At the moment of speaking: The phone is ringing. I will answer it.
* When we offer to do something: You lost your book yesterday. I will help you to find it.
* We use after the following phrases:

I think

I don’t think

Probably

I am not sure

I am sure

I expect.

* When we agree to do something: Could you check my essay please? Ok, I will read your essay in the evening.
* When we promise to do something: I promise I won’t tell him about this accident.
* When we ask somebody to do something: Will you repeat this word

again ?

*We use* ***shall*** *when we want to do things for other people: You look very hungry. Shall I make something for dinner?*

*When we suggest something: It is a wonderful evening. Shall we go for a walk?*

**To be going to**

Positive sentences

|  |  |  |
| --- | --- | --- |
| I  We/ you/ they  He/ she/ it | am  are + going to  is | + infinitive (to read, to write) |

Negative sentences

|  |  |  |
| --- | --- | --- |
| I  We/ you/ they  He/ she/ it | am  are not + going to  is | +infinitive (to read, to write) |

Questions

|  |  |  |  |
| --- | --- | --- | --- |
| Am  Are  Is | I  you/ we/ they  he, she, it | + going to | + infinitive (to read, to write, etc) |

We can also use the short form of **to be** (I’m, you’re, they’re, we’re, he’s, she’s, it’s), for example:

I’m going to write a letter to my sister.

When we use this construction:

* When we talk about our plans (what we decided to do): Next summer I am going to visit Paris.
* When we make predications using the information we have: Look at the sky! It is very cloudy. It is going to rain.
* In science sphere we use this construction when we make scientific predictions about changes or processes which we will see during experiments. For example: As you see this solution is going to change its color.

***But we don’t say:* I am going to go to Paris *instead we say* I am going to Paris.**

**Vocabulary**

calculation – расчет

to calculate – рассчитывать

solution – раствор

but – но

amount – количество

[solute](http://chemistry.about.com/od/chemistryglossary/g/solute.htm) – растворенное вещество

to dissolve – растворять

[solvent](http://chemistry.about.com/od/chemistryglossary/a/solventdef.htm) –растворитель

after that – после этого

then –затем

add – добавлять

to become – становиться

to exist – существовать

another phase – другая фаза

ethanol – этанол

water – вода

small – небольшой

to identify – определять (вещество, состав вещества, соединения)

to be ready – быть готовым

to determine – определить

to express – выражать

a volume − объем

**percent composition by mass** – **процентное содержание на массу**

**volume percent** – **процент по объему**

**mole fraction** – **молярная доля**

**molarity** –  **молярность**

**to divide by** – **делить на**

**to multiply by** – **умножить на**

**preparation** –  **приготовление**

**to prepare a solution** – **приготовить раствор**

total number – общее число

mol – моль

chemical species– химические вещества, химические соединения

per – на ( при расcчетах)

mole fraction – молевая фракция

to turn red – краснеть

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

**How I will calculate concentration**

Hello, my name is Tim. I am a teacher. I am teaching chemistry at school. Tomorrow I will calculate the concentration of a chemical solution. The calculation of the [concentration](http://chemistry.about.com/od/chemistryglossary/g/concentration.htm) of a chemical [solution](http://chemistry.about.com/od/chemistryglossary/a/solutiondef.htm) is a difficult task. What is concentration? Concentration is the amount of [solute](http://chemistry.about.com/od/chemistryglossary/g/solute.htm) which I will dissolve in a [solvent](http://chemistry.about.com/od/chemistryglossary/a/solventdef.htm). A solute is a solid which I will add to a solvent. My solute will exist in another phase. Then I will add a small amount of ethanol to water. The ethanol will be the solute and the water will be the solvent. After that I will add a small amount of water to a large amount of ethanol, and the water will become the solute. I will identify the solute and solvent in a solution. Then I will be ready to determine its concentration. I will express concentration with a help of **percent composition by mass**, **volume percent**, **mole fraction**, **molarity**, **molality**.

Percent composition by mass is the mass of the solute which I will divide by the mass of the solution (mass of solute plus mass of solvent) and multiply by 100. I will use volume percent. The volume percent will help me in the preparation of the solution. Mole fraction is the number of moles of a compound which I will divide by the total number of moles of all chemical species in the solution. Molarity is the number of moles of solute per liter of solution.

**Ex. 2 Answer the questions**

1. What is a concentration ?
2. Will solute exist in another phase?
3. Why will Tim use volume percent?
4. What is mole fraction?
5. What will Tim identify in the solution?

**Ex. 3 Put the verbs in brackets in Future Simple.**

1. We (calculate) \_\_\_\_\_ concentration.
2. I (not to determine) \_\_\_\_\_ the mole fraction.
3. I (to be not ready) \_\_\_\_ to identify the solute.
4. I (to prepare) \_\_\_\_\_\_ this solution tomorrow.
5. Water (turn) \_\_\_\_\_ red.
6. I (not to dissolve) \_\_\_\_ this substance.
7. When \_\_\_\_\_ you (to identify) \_\_\_\_\_ this substance ?

**Ex. 4 Put the questions to the bold-typed words.**

1. **I** will identify **the composition of this compound.**
2. **She** will dissolve **ethanol in water**.
3. **This solution** will turn red soon.
4. **This solute** will be of a **red** color.
5. **I** am going to express this concentration **.**
6. I am going to calculate **volume percent.**
7. **Molarity** will be the main parameter **here.**

**Ex. 5 Put verbs in brackets in *to be going* to or *Future Simple.***

1. I think I (to do) \_\_\_\_ this experiment.
2. Look! The substance (to turn) \_\_\_ brown.
3. The solution (to change) \_\_\_ its color soon.
4. I expect Magnesium oxide (to be) \_\_\_ stable.
5. I decided this problem. I (to finish) \_\_\_ my work next week.
6. As you see now, magnesium hydroxide (to transform) \_\_\_ into hydroxide.
7. I am sure he (to come)\_\_\_ soon.

**Ex. 6 Translate from English into Russian or Kazakh.**

1. A solute is a solid which we are going to add to the acid.

3. The substance will not change its colour.

4. Who will identify the solute and solvent in a solution?

5. The molarity helps to determine the concentration.

6. I will prepare the solution of nitric acid.

7. I think the mole fraction is high in this solution.

8. I expect that my chemical species will react with this substance.

**Ex. 7 Read and translate the text**

**How I am going to obtain magnesium oxide**

Hello, my name is Sam. I am a teacher of chemistry. Next week I am going to obtain a chemical compound. I am going to obtain magnesium oxide. I am going to calcinate carbonates in a porcelain crucible. Decomposition is going to be at 300 oC and is going to complete at red heat:

MgCO3 = MgO + CO2

Decomposition will complete if the release of carbon oxide (IV) doesn’t take place during the interaction with muriatic acid.

Magnesium oxide will be of a white color. It is going to attract moisture from air. It is going to transform into hydroxide. I am going to keep it in the tightly-closed flask or vacuum-sealed ampoule. Magnesium oxide which I am going to calcinate at 1000 – 1200o C is going to be more stable.

**Vocabulary**

magnesium oxide – оксид магния

to obtain – получать

to calcinate - обжигать, кальцинировать

carbonate – карбонат

porcelain crucible – фарфоровый тигель

to complete – закончиться, завершиться

red heat – температура красного каления

decomposition – разложение

release – выделение

to take place – происходить

interaction – взаимодействие

carbon oxide – оксид углерода

muratic acid – хлороводородная кислота

to attract – притягивать

moisture – влага

tightly – closed flask – плотно-закрытая склянка

to keep – хранить

vacuum - sealed ampoule – запаянная ампула

stable – устойчивый

**Unit 5**

**Present Continuous**

Positive sentences

|  |  |  |
| --- | --- | --- |
| I  You/ we/ they  He/ she/ it | Am  Are  is | Participle 1 (V+ing) |

For example: I am reading.

The short form:

I’m reading.

We/they/you’re reading.

He/she/it’s reading.

If the verb ends in *-* ***e***, this letter disappears, for instance: to make – making.

If the verb ends in *-****ie*,** it will have the ending *–* ***ying*,** for instance: to lie – lying.

If the verbs ends in a vowel + a consonant: to stop, to plan, to swim, to run, to get the consonant doubles: to stop – stopping, to plan - planning, to run – running, to get – getting, to swim – swimming. We double the consonant if we stress the last part of the word, for instance: prefer – preferring, to begin – beginning.

Negative Sentences

|  |  |  |
| --- | --- | --- |
| I  You, we, they  He, she, it | Am  Are not +  Is | Participle 1 (V+ing) |

For example: I am not reading.

The short form: He /she/it isn’t reading.

You/we/they aren’t reading.

Questions

|  |  |  |
| --- | --- | --- |
| Am  Are  is | I  You/we/they  He/she/it | Participle 1 (V+ing) |

For example: Are you reading ?

When we use this tense:

* We use Present Continuous when we talk about the actions which happen now, at this moment: I am reading a book now.
* We use this tense when we talk about the actions that take place **today, these days, this month / year/week**: I am attending English courses this month.

**But we don’t use the following verbs in Present Continuous.**

To want - хотеть, to like - нравиться, to love - любить, to hate – ненавидеть, to need – нуждаться, to prefer – предпочитать, to know – знать, to realize - осознавать, to suppose - предполагать, to mean – означать, to understand - понимать, to believe - верить, to remember – помнить, to belong to - принадлежать, to contain - содержать, to consist of - состоять, to depend (on) – зависеть, to seem – казаться, to see – видеть, to hear – слышать, to smell - нюхать, to taste - пробовать

We use these verbs only in Present Simple.

**We don’t use the verb *“to have”* in Present Continuous in the meaning *“to posses”*:**  Now I have a new house.

**We use the verbs *“to look”* and *“to feel”* in Present Simple and Present Continuous when we talk how somebody feels or looks now:** You look well today. Or You are looking well today.

If we use the verb **“to think”** in the meaning of **“to believe”** in a complex sentence we will use this verb in Present Simple: **I think** she is wrong.

But when we talk about a mental process, we use this verb in Present Continuous: I **am thinking** of him.

**To be polite / To be being polite.**

**We say *to be polite* if this person is always polite:** Jane is very polite person. She is never rude with other people.

**We say *to be being polite* if this person behaves himself/herself in a polite way only at this moment:** Usually Ken is very rude, but today he is being very polite.

**But we don’t use *to be being + Participle 1* when talk about weather and a physical state of a man, the location of a person or thing, physical state of a substance, liquid or compound:**

Today is very cold.

I am very exhausted.

The solution of calcium hydroxide is very cold.

I am at home now.

**Present Continuous for future**

We use present continuous for future when talk about something which we planned and will do it for certain. In Russian this tense is translated as a future.

For example: Tomorrow I am visiting my friend who is at the hospital now. – Завтра я навещу своего друга, который сейчас лежит в больнице.

**Vocabulary**

bond − связь

equal − равный

near-equal − почти равный

sharing of electrons − равное или почти равное распределите электронов

to share − распределять, делиться

between − между

bonded atoms − связанные атомы

to make sense − иметь смысл

to occur − встречаться, происходить

difference in − разница в

electronegativity − электроотрицательность

to indicate − указывать

covalent bond − ковалентная связь

non-polar − не полярный

polar − полярный, дипольный

unequal − не равный

when − когда

typically − обычно

a rule − правило

ionic bond − ионная связь

complete transfer − полный перенос

to transfer − переносить

at all − совсем

to consist of − состоять из

generally − как правило

to create − создавать

great − большой

to attract − притягивать

to take − забирать

to attract the electrons enough − притягивать достаточно электронов

to measure − измерять

ammonia − аммиак

to observe − наблюдать

to turn black − чернеть

impurity − примесь

pressure − давление

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

**Bonds**

There are three types of bonds in chemistry. Non-polar covalentbonds occur when there is equal or near-equal sharing of electrons between the two bonded atoms. This makes sense because covalent bonds are the sharing of electrons between two atoms. Molecules such as Cl2, H2 and F2 are good examples. Typically, a difference in electronegativity between 0.0 and 0.4 indicates a non-polar covalent bond.

Polar covalentbonds occur when there is unequal sharing of the electrons between the atoms. Molecules such as NH3 and H2O are examples of this. The typical rule is that bonds with an electronegativity difference between 0.5 and 1.7 are polar bonds.

Ionicbonds occur when there is complete transfer of the electrons in the bond. This bond does not contain atoms at all, but consists of two ions. Substances such as NaCl and MgCl2 are examples. Generally, the differences in electronegativity which are equal to 1.8 or greater create ionic bonds. The difference in electronegativity is so great that one atom attracts enough electrons to "take" them from the other atom.

**Ex. 2 Answer the questions**

1. How many types of chemical bonds do you know?

2. When do we occur ionic bond?

3. What are the examples of ionic bond?

4. What does difference in electronegativity between 0.0 and 0.4 indicate?

5. What is covalent bond?

**Ex. 3 Put the verbs in brackets in Present Continuous.**

1. Is this atom (to attract) \_\_\_ electrons?
2. Nitric acid (to react) \_\_\_\_ with sulphuric acid now.
3. I (to measure) \_\_\_\_ a concentration at this moment.
4. They (to prepare)\_\_\_\_ this solution now
5. We (to produce ) \_\_\_\_ ammonia now.
6. I (not to dissolve) \_\_\_ this substance at this moment.
7. Who (to identify) \_\_\_\_ this substance now?

**Ex. 4 Put the questions to the bold-typed words.**

1. **The atom** is attracting **electrons** **now.**
2. **I** am identifying **the type of bond**.
3. **I** am observing the sharing of **electrons** now.
4. This solute **is turning black** now.
5. This atom **is transferring** electrons now.
6. **This substance** is changing **its colour** at this moment.
7. **Electronegativity** is changing now.

**Ex. 5 Put verbs in brackets in Present Continuous, Present Simple or Past Simple.**

1. I (to obtain) \_\_\_\_ this acid at this moment.
2. The atom (to attract) \_\_\_\_\_ the electrons last time.
3. The ionic bond (to consist of) \_\_\_\_ two electrons.
4. The substance which we (to obtain) \_\_\_ two days ago (not to contain impurities) \_\_\_\_ now.
5. The sharing of electrons (not to depend)\_\_\_ on temperature and pressure.
6. I (to study) \_\_\_\_ the properties of metals at this moment.
7. Ionic bond (to occur) \_\_\_ when there is complete transfer of electrons.

**Ex. 6 Translate from English into Russian or Kazakh.**

1. This bond does not contain atoms.

3. All the time I observe the transfer of electrons in ionic bond.

4. This doesn’t make sense at all.

5. These differences in electronegativity create ionic bond.

6. Polar covalent bonds usually occur when there is an unequal sharing of electrons.

7. In covalent bonds I don’t see sharing of electrons.

8. We shared electrons between two atoms.

**Ex.7 Read and translate the text.**

**The preparation of silver nitrate**

Hello my name is Andrew. I am working at school. I am working as a teacher of chemistry. Now I will tell you about silver nitrate. I will tell you how to prepare it in the laboratory.

Silver nitrate is present as a complex compound in the solution partially:

2AgNO3 ↔ Ag [Ag (NO3)2]

During electrolysis of silver nitrate the release of metal takes place on the cathode partially.

Now I am preparing the solution of silver nitrate *c* (AgNO3) = 0, 5 - 1 mole /L in the amount of 20-50 mL. I am cooling this solution. I am using a glass cup as an electrolytic cell. Now I see the release of black lustrous crystals of the composition 2Ag3O4 ⋅AgNO3. I am removing them from anode. I am washing them with cold water on a glass filter. I will keep this substance for a long time. I will dry them in the air. I will heat a substance at the temperature of 165 – 170 o C. I see now how oxygen is detaching and forming 3Ag2O⋅AgNO3.

**Vocabulary**

silver nitrate - нитрат серебра

to be present - присутствовать

precipitate - осадок

during - во время

electrolysis - электролиз

laboratory assistant - лаборант

research institute - исследовательский институт

complex compound -сложное соединение

to cool - охлаждать

glass cup - стеклянная чашка

electrolytic cell - электролизер, электролитическая ячейка

lustrous - блестящий

composition - состав

cathode - катод

anode - анод

to remove - удалять

from - с, от

glass filter - стеклянный фильтр

for a long time - в течение долгого времени

to dry - сушить

to heat - нагревать

oxygen – кислород

to detach - отщепляться

**Unit 6**

**Present Perfect**

Positive sentence

|  |  |  |
| --- | --- | --- |
| I/ You/ we/ they  He/ she/ it | Have  Has | Participle 2(Ved )(V3) |

For example: I have read the book.

She has finished her work.

Negative sentences

|  |  |  |
| --- | --- | --- |
| I/ You/ we/ they  He/ she/ it | Have not (haven’t)  Has not (hasn’t) | Participle 2 (Ved )(V3) |

For example: I haven’t read the book.

She hasn’t finished her work.

Questions

|  |  |  |
| --- | --- | --- |
| Have  Has | I/ You/we/they  He/she/it | Participle 2  Ved (V3) |

For example: Have you read this book ?

Has she finished her work ?

Short form: I/you/we/they’ve

He/she/it’s

When we use this tense:

* When we link the past with the present: Stan has written many letters to his sister. (He wrote many letters at some period of time before now and he may write more letters).
* When we don’t’ specify the time: I have passed my exam. But if we specify the time we use Past Simple: I passed my exam two days ago.
* When we use expressions which show that time is not finished **(this week, this month, this year, today, this morning/evening):** I haven’t seen him this month.
* We use Present Perfect after the following expression:

**Already -** уже: I have **already** finished my letter to my farther.

**Just:** She has **just** left.

**Yet -** еще, уже (we use it only in questions and negative sentences): I haven’t seen her today **yet**. Or: Have you read this book **yet** ?

**Recently** - недавно: **Recently** he has received a letter from his Australian relatives.

**Lately**  - в последнее время: The city has changed a lot **lately.**

**Before** - до, раньше: I haven’t heard about him **before.**

**For ages** - целую вечность: I haven’t’ seen you for ages.

**Since** - с тех пор: I haven’t met him **since** school.

**For three weeks, for a month, for a year -** в течение трех недель, месяца,года: I haven’t seen him **for three months.**

**Never** - никогда: I have **never** read this book.

**Ever** - когда-либо (questions): Have you **ever** eaten ice-cream?

**All my life** - всю свою жизнь: **All my life** I have hated this man.

We use **ever** and **never** when we talk about a person’s experience.

* We use Present Perfect when we talk about living people. If a person doesn’t exist anymore we use Past Simple: Mozart wrote beautiful music.
* We use Present Perfect when talk about repeated actions: I have visited Japan five times.
* In the stories and descriptions we use Present Perfect only at the beginning.

Vocabulary

demineralized water − деминерализованная вода

ionite filter − ионитовый фильтр

to pass through − пропускать через

anionite − анионит

cationite − катионит

a medium (pl. media) −среда

acid medium − кислая среда

to link − связывать

to be inferior to − уступать

by quality − по качеству

a setup − установка

ion exchange resins − ионообменные смолы

quartz − кварц, кварцевый

to place − помещать

to sample − брать пробу

a sample – образец

tap water − водопроводная вода

three-way tap − трехходовой кран

using − при помощи

to titrate − титровать

in order to − чтобы

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

**How I have obtained demineralized water**

My name is Chris. I am a teacher of chemistry. I have just finished my laboratory work. My laboratory work was about how to obtain demineralized water. In order to obtain demineralized water I used ionite filter. I passed tap water through cationite which linked cations. As a result I obtained the water which had acid medium. Then I passed this water through anionite which linked anions. The water which I passed through both ionites was demineralized water. The water which I have obtained isn’t inferior to distilled water by quality.

However my friend Aleck has obtained demineralized water with the help of the laboratory setup. He built this setup by himself. His setup consisted of two colons. These columns were quartz. The height of columns was 70 cm and their diameter was 5 cm. He placed 550 grams of ion exchange resins in the columns. In one column he placed anionite. In other column he placed cationite. He passed water through cationite. Then he directed it into the column with anionite. He sampled water using three-way tap. After that he titrated it by NaOH solution.

**Ex.2 Answer the following questions.**

1. What did Chris want to obtain?

2. What medium did the water which Chris obtained have ?

3. What filters did Chris use?

4. Who is Alec?

5. How did Alec sample the water?

**Ex.3 Put the verbs in Present Perfect.**

1. Fanny (to do) \_\_\_ just a very interesting experiment.

2. I (to prepare) \_\_\_\_ the solution.

3. I (not to sample) \_\_\_ water yet.

4. (to titrate) you the solution yet ?

5. I (to wash) already all dishes.

6. I (to use) tap water in this experiment.

7. She (to place) 50 grams of cationite.

**Ex.4 Put the questions to the bold-typed words.**

1**. Chris** has measured **the temperature**.

2**. He** has titrated **NaOH** solution.

3. **I** haven’t used **three-way tap.**

4. **She** has passed **water** through **anionite.**

5**. Cationite** has linked **cations.**

6. I have placed **50 grams** of this substance **into the flask.**

**7. I** have obtained **water.**

**Ex. 5 Put the following sentences in Present Perfect using *already* and *yet*.** For example:

I did this experiment three days ago. – I have already done this experiment.

Did you write a letter to your mother yesterday? – Have you written a letter to your mother yet?

I didn’t pass the water through column last time. – I haven’t passed the water through column yet.

1. I passed solution through anionite three days ago.

2. I didn’t place ionite in the second column last time.

3. I placed ion exchange resins in the solution yesterday.

4. Did you obtain deminiralized water last time ?

5. Yesterday I used this filter.

6. Did you use quartz filters yesterday?

7. I built this setup last month.

**Ex. 6 Put the verbs in brackets in Past Simple or Present Perfect.**

1. Yesterday the colour of the solution (to be) different.

2. I (to finish)\_\_\_\_\_ my experiment.

3. Magnesium (to turn)\_\_\_\_ just red.

4. When you (carry out)\_\_\_\_ this experiment?

5. Two days ago I (to obtain)\_\_\_\_ germanium oxide.

6. I already (to study)\_\_\_\_ the properties of this metal.

7. Last time I (to determine)\_\_\_\_ the new characteristics of ionic bond.

8. These two substances (not to react)\_\_\_\_ with each other yesterday.

Ex. 7 Read and translate the text

Electron shells

We subdivide each **shell**  into **subshells**. They are made up of **orbitals**, each of which has electrons with different angular momentum. Each orbital in a shell has a characteristic shape, and is named by a letter. They are: **s**, **p**, **d**, and **f**. In one-electron atom (e.g. H, He+, Li+, etc.) the energy of each orbital within a particular shell is identical. When there is more than one electron, they interact with one another and split the orbitals into different energies. Within any particular shell, the energy of the orbitals depends on the angular momentum. The simplest orbital in the atom is the 1s orbital. It has no radial or angular **nodes**: the 1s orbital is simply a sphere of electron density. The s orbital holds two electrons, as long as they have different spin quantum numbers. Starting from the 2nd shell, there is a set of p orbitals. Each orbital accommodates two electrons. The first set of d orbitals is the 3d set. The angular momentum quantum number is 2, so each orbital has two **angular nodes**. There are 5 choices for the magnetic quantum number, which gives rise to 5 different d orbitals. Each orbital holds two electrons. The first set of f orbitals is the 4f subshell. There are 7 possible magnetic quantum numbers, so there are 7 f orbitals. There are 14 f electrons because each orbital holds two electrons (with opposite spins).

**Vocabulary**

an electron shell − электронная оболочка

a subshell − подоболлочка

an orbital − орбиталь

a shape − форма

within − внутри

identical − одинаковый

particular − определенный

to interact with − взаимодействовать

to split into − расщеплять, раскалывать

to depend on − зависеть от

angular momentum − кинетический момент, момент вращения

angular − угловой

a radial node − радиальный узел

a node − узел

electron density − плотность электронов

a point − точка

to hold, to accommodate − вмещать

spin quantum number − спиновое квантовое число

spin − спин

starting from − начиная с

a set − ряд

quantum magnetic number − квантовое магнитное число

to give a rise − образовывать

different − разный

**Unit 7**

**Past Continuous**

We form the Past Continuous in this way:

*Positive*

I, he, she, it **was waiting**

You, we, they **were waiting**

*Negative*

I ,he, she, it **was not /wasn’t waiting**

You, we, they **were not /weren’t waiting**

*Questions*

**Was**I, he, she, it **waiting?**

**Were** you, we, they **waiting?**

When we use the Past Continuous:

* 1. We use it for an action or situation that was in progress at a particular time in the past.

For example: I **was playing** football at 7 o’clock p.m.

2. We can use **when** or **while** before the Past Continuous. For example: I met her **when/while** we **were working** for the same company.

**Vocabulary**

matter - вещество

state – состояние

solid –твердый

volume – объем

shape- форма

force – сила

attraction –притяжение

strong –сильный

liquid – жидкость

weak- слабый

gas – газ

neither … nor… – ни …ни…

definite – определенный

negligible –незначительный

to dissociate – отделять

ion –ион

composition –состав

pure – чистый

substance – вещество

to make up – составлять, состоять из

to observe –рассматривать

to occur – происходить

naturally – естественно

periodic table –периодическая таблица

tabular representation – представлено в виде таблицы

compound – соединение

to consist of –состоять из

bond –связь

ratio – соотношение, пропорция

mixture –смесь

mechanical means –механические средства

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

**Classification of Matter**

We can classify the matter by its state.

* Solids have a set volume and shape. The inter molecular force of attraction for solid matter is very strong.
* Liquids have a set volume, but change shape. The inter molecular force of attraction for liquid matter is weaker than solid matter.
* Gases have neither definite volume nor shape. The inter molecular force of attraction for gaseous matter is negligible.
* Plasma which are usually gaseous state of matter in which a part or all of the atoms or molecules are dissociated to form ions.

We can also classify the matter by its chemical composition.

* An element is a pure substance made up of atoms with the same number of protons. As of 2011, 118 elements have been observed, 92 of which occur naturally. Carbon (C), Oxygen (O), Hydrogen (H) are the examples of the elements.
* The periodic table is a tabular representation of the known elements.

* A compound consists of two or more chemical elements that are chemically bonded together. Water (H2O) and table sugar (C12H22O11) are examples of chemical compounds. The ratio of the elements in a compound is always the same. For example in water, the number of H atoms is always twice the number of O atoms.
* A mixture consists of two or more substances (element or compound) mixed together without any chemical bond. Salad is a good example. We can separate the mixture into its individual components by mechanical means.

**Ex.2 Answer the questions.**

1. Can we classify the matter by its state?

2. What states of matter do you know?

3. Describe solids, liquids, gas and plasma.

4. What are the examples of the elements?

5. How many elements does the compound consist of?

**Ex. 3 Put the verbs in brackets in the correct form in Past Continuous.**

1. It ( snow) \_\_\_ when I left home .
2. I tried to explain my problem to her, but she (not listen) \_\_\_.
3. He (talk) \_\_\_ on the phone when I arrived.
4. A lot of people (wait) \_\_\_ for 7.30 bus last night.
5. I (live) \_\_\_ in London when I met them.
6. At the end of the first half of the game, they (win) \_\_\_.
7. Which hotel (you / stay) \_\_\_\_ in when you lost your passport?

**Ex. 4 Put the questions to the bold-typed words.**

1. **George** was reading a newspaper.
2. Sue and Liz **were playing** table tennis.
3. **I** saw it was raining.
4. She was listening to the radio **at 3 o’clock yesterday afternoon.**
5. They were studying **at the University** in 2011.
6. The student was drawing a portrait the whole afternoon **3 days ago**.
7. He wasn’t driving too fast when **he saw a child**.

**Ex. 5 Put the verbs in brackets in the correct form in the Past Continuous or Past Simple.**

1. The police (arrive) while I (have) breakfast.

2. The storm (start) while they (drive) home.

3. I (see) an accident while I (wait) for the bus.

4. Mary (go) to several concerts while she (stay) in London.

5. He (have) supper when the police (arrive).

6. My father (cook) the dinner when he (burn) his fingers.

7. They (prepare) to leave when they (hear) the news.

**Ex.6 Translate from English into Russian or Kazakh.**

1. Solids have a set volume and shape.

2. Liquids have a set volume, but change shape.

3. The inter molecular force of attraction for gaseous matter is negligible.

4. An element is a pure substance made up of atoms with the same number of protons.

5. The periodic table is a tabular representation of the known elements.

6. A compound consists of two or more chemical elements that are chemically bonded together.

7. A mixture consists of two or more substances (element or compound) mixed together without any chemical bond.

**Ex.7 Read and translate the text.**

**Types of Mixtures.**

There are many kinds of mixtures. We classify them by the behavior of the phases or substances that we mix. A homogeneous mixture is uniform, which means that any given sample of the mixture will have the same composition. Air, sea water, and carbonation dissolved in soda are all examples of homogeneous mixtures, or solutions. No matter what sample you take from the mixture, it will always be composed of the same combination of phases. Chocolate chip ice cream is not homogeneous—one spoonful taken might have two chips, and then another spoonful might have several chips.

An example for a homogeneous mixture is a solution. The substance that gets dissolved is the **solute**. The substance that does the dissolving is the **solvent**. Together they make a **solution**. If you stir a spoonful of salt into a glass of water, salt is the solute that gets dissolved. Water is the solvent. The salty water is now a solution, or homogeneous mixture, of salt and water.

When we mix different gases, they always form a solution. The gas molecules quickly spread out into a uniform composition.

**Vocabulary**

mixture – смесь

to classify –классифицировать

behavior – поведение

phase –фаза

substance –вещество

to mix – смешивать

homogeneous mixture – однородная, гомогенная смесь

uniform –равномерный

sample –образец

composition – состав

air – воздух

sea – море

water – вода

сarbonation - насыщение углекислотой

to dissolve – растворять

soda -сода

example – пример

solution – раствор

no matter what sample – не имеет значения какой образец

combination - состав, cоединение

chocolate – шоколад, шоколадный

chip – кусок

ice cream – мороженое

one spoonful – одна ложка

solute –растворенное вещество

solvent –растворитель

to stir – размешивать

salt –соль

glass of water –стакан воды

to mix – смешивать

different – разный

to form – формировать

molecule –молекула

quickly –быстро

to spread out -распространяться

heterogeneous – неоднородный, гетерогенный

concrete –бетон, конкретный

soil –почва

blood –кровь

salad – салад

### Unit 8

Past Perfect

We form the Past Perfect with had and a Past Participle (finished, gone).

*Positive*

I.you,he, she, it, we, they had gone

*Negative*

I.you,he, she, it, we, they hadn’t gone

*Questions*

Had I,you,he, she, it, we, they gone?

For example: Steve had gone home when I phoned him.(First Steve went home. Later, I phoned him.)

When we use the Past Perfect.

We use the Past Perfect for something that happened before something else in the past. We use the Past Perfect for the things that happened first; we use the Past Simple for the things that happened later. For example: When I got home, I saw that the letter had arrived. (First, the letter arrived. Later I got home and saw it.) When he had finished his homework, he went to bed. (First, he finished his homework. Later, he went to bed.) He couldn’t pay the bill because he had left his wallet at home. (First, he left his wallet at home. Later, he couldn’t pay the bill.)

**Vocabulary**

chemical bonding – химическая связь

mixture – смесь

to separate – отделять

mechanical means – механические средства

heterogeneous – неоднородный, гетерогенный

salad – салат

piece – кусочек

to pick out – взять

simple – простой

to sift – просеивать, выбирать

through – через

to pick out – выбирать

radish – редиска

to contain – содержать

particle – частица

too – тоже

liquid – жидкость

manually – вручную

must – должен

to use - использовать

sophisticated method - сложный метод

to imagine – представить себе

sandbox – песочница

bit – частица, кусочек

broken glass – битое стекло

need – необходимость

to sort – сортировать

filter – фильтр

particle – частица

glass chip – кусок стекла

mesh filter – сетчатый фильтр

let – позволять

to pass – проходить

to use – использовать

purification methods – методы очищения

dialysis tubing – метод диализа

fine filter – мелкий фильтр

dissolved glucose – растворенная глюкоза

Ex.1 Read and translate the text

**Methods for Separating Mixtures**

Because there is no chemical bonding in a mixture, we can separate the phases by mechanical means. In a heterogeneous mixture like a salad, we can easily pick out and separate the pieces. It is as simple as sifting through the salad and picking out all the tomatoes and radishes, for example. However, many mixtures contain particles that are too small, liquids, or too many particles to be separated manually. We must use more sophisticated methods to separate the mixture.

* + 1. Filtration

Imagine you have a sandbox, but there are bits of broken glass in it. All you would need is some sort of filter. The sand particles are much smaller than the glass chips, so a mesh filter would let sand pass but stop the glass. We use Filtration in all sorts of purification methods. Some filters, like dialysis tubing, are such fine filters that water can pass through them, but dissolved glucose cannot.

**Ex.2 Answer the questions**

1. Why can we separate the phases by mechanical means?

2. What kind of methods must we use to separate too small particles, liquids?

3. What is smaller: sand particles or glass chips?

4. What do we use in all sorts of purification methods?

5. What fine filter do you know?

**Ex.3 Translate from English into Russian or Kazakh**

1. We can separate the phases by mechanical means.
2. In a heterogeneous mixture like a salad, we can easily pick out and separate the pieces. It is as simple as sifting through the salad and picking out all the tomatoes and radishes, for example.
3. Many mixtures contain particles that are too small, liquids, or too many particles to be separated manually. We must use more sophisticated methods to separate the mixture.

**Ex. 4 Put the verbs in brackets in the correct form in the Past Perfect**

1. I didn’t watch the film because I (see) \_\_\_ it before.

2. We couldn’t eat at the restaurant because we (not book)\_\_\_ a table.

3. He couldn’t buy it because he ( spend) \_\_\_ all his money.

4. I was very tired because I (got up) very early that morning.

5. I (forget) my pen so I had to borrow one.

6. When I got home, I switched on the answer phone. Several people (leave) \_\_\_ messages for me.

7. I (not hear) \_\_\_\_ the joke before; I laughed a lot.

**Ex.5 Put the questions to the bold-typed words**

1**. George** had never visited France before.

2. Sue had won **a gold medal** for the third time.

3. Tom **had ridden a horse** for the first time before that.

4. **She** had never run a marathon before.

5. **When Lady James appeared**, the driver had already started the car.

6. When the manager came back, Jim **had already finished his work.**

7. When Phillip phoned, **I** had already gone to bed.

**Ex. 6 Put the verbs in brackets in the correct form in the Past Perfect or Past Simple**

1. When we (finish) \_\_\_ our meal, we (go) \_\_\_ for a walk.

2. When we (do) \_\_\_ our work, we (go) home.

3. When I (do) \_\_\_ the course, I (speak) \_\_\_\_\_ English well.

4. When everyone (leave) \_\_\_, she (go) \_\_\_ to bed.

5. When he (have) \_\_\_ a glass of water, he (feel) \_\_\_ better.

6. When she (do) \_\_\_ the washing up, she (listen)\_\_\_\_ to some music.

7. When Steve (save) \_\_\_\_ enough money, he (buy) \_\_\_\_ a new motorbike.

* + 1. Ex.7 Read and translate the text.
    2. Distillation.
    3. If you take a glass of saltwater, could you drink it? Sure, if you distill it first. Distillation is the boiling of a mixture to separate its phases. Salt is a solid at room temperature, and water is a liquid. Water will boil far before salt even begins to melt. So separating the two is as simple as boiling the water until all that remains is the solid salt. If desired, we can collect, condense, and use the water vapor as a source of pure water.

We can also use distillation if we mix two liquids , but they have different boiling points. Separation of several liquids with similar boiling points can be achieved using fractionation.

Distillation can also be used if two liquids are mixed but have different boiling points. Separation of several liquids with similar boiling points can be achieved using fractionation.

**Vocabulary**

glass – стекло

saltwater – соленая вода

to drink – пить

to distill – дистиллировать

distillation – дистилляция

mixture – смесь

to separate – отделять

salt – соль

solid – твердый

liquid – жидкий

to boil – кипеть

to begin – начинать

to melt – плавиться, таять

simple – простой

to desire – желать

to collect – собирать

to condense – конденсировать

to use – использовать

vapor – пар

source – источник

pure water – чистая вода

different – разный

boiling point – точка кипения

separation – отделение

similar – подобный

to achieve – достигать

fractionation – фракционирование, разбивка

### Unit 9

### Comparative and Superlative

**Comparative adjectives**

Comparative adjectives are used to compare differences between the two objects they modify **(larger, smaller, faster, higher )*.*** They are used in sentences where two nouns are compared, like in this pattern:

**Noun (subject) + verb + comparative adjective + than + noun (object).**

The second item of comparison can be omitted if it is clear from the context (final example below).

##### For example:

* My house is **larger** than hers.
* This box is **smaller** than the one I lost.
* Your dog runs **faster** than Jim’s dog.
* The rock flew **higher** than the roof.
* Jim and Jack are both my friends, but I like Jack **better**. («than Jim» is understood)

### Superlative adjectives

Superlative adjectives are used to describe an object which is at the upper or lower limit of a quality **(the tallest, the smallest, the fastest, the highest)*.*** They are used in sentences where a subject is compared to a group of objects.

**Noun (subject) + verb + the + superlative adjective + noun (object).**

The group that is being compared with can be omitted if it is clear from the context (final example below).

##### For example:

* My house is the **largest** one in our neighborhood.
* This is the **smallest** box I’ve ever seen.
* Your dog ran the **fastest** of any dog in the race.
* We all threw our rocks at the same time. My rock flew the **highest**. («of all the rocks» is understood)

### Forming regular comparatives and superlatives

Forming comparatives and superlatives is easy. The form depends on the number of syllables in the original adjective.

###### One syllable adjectives

Add –**er** for the comparative and –**est** for the superlative. If the adjective has a consonant + single vowel + consonant spelling, the final consonant must be doubled before adding the ending.

|  |  |  |
| --- | --- | --- |
| **Adjective** | **Comparative** | **Superlative** |
| tall | taller | The tallest |
| fat | fatter | The fattest |
| big | bigger | The biggest |
| sad | sadder | The saddest |

###### Two syllables

Adjectives with two syllables can form the comparative either by adding –**er** or by **more.** These adjectives form the superlative either by adding –**est** or by **most**. In many cases, both forms are used, although one usage will be more common than the other. If you are not sure whether a two-syllable adjective can take a comparative or superlative ending, play it safe and use **more** and **most** instead. For adjectives ending in -**y**, change the -**y** to **-i** before adding the ending.

|  |  |  |
| --- | --- | --- |
| **Adjective** | **Comparative** | **Superlative** |
| Happy | Happier | Happiest |
| Tangled | more tangled | most tangled |
| Simple | Simpler | Simplest |
| Busy | Busier | Busiest |
| Tilted | more tilted | most tilted |

###### Three or more syllables

Adjectives with three or more syllables form the comparative by putting **more** in front of the adjective, and the superlative by putting **most** in front.

|  |  |  |
| --- | --- | --- |
| **Adjective** | **Comparative** | **Superlative** |
| Important | more important | most important |
| Expensive | more expensive | most expensive |

### Irregular comparatives and superlatives

These very common adjectives have completely irregular comparative and superlative forms.

|  |  |  |
| --- | --- | --- |
| **Adjective** | **Comparative** | **Superlative** |
| good | better | best |
| bad | worse | worst |
| little | Less | least |
| much/many | More | most |
| far | further / farther | furthest / farthest |

##### Examples

* Today is the **worst** day I’ve had in a long time.
* You play tennis **better** than I do.
* This is the **least** expensive sweater in the store.
* This sweater is **less** expensive than that one.
* I ran pretty far yesterday, but I run even **farther** today.

**Vocabulary**

an acid − кислота

to donate − отдавать

hydron − гидрон

hydrogen ion − ион водорода

an [electron pair](https://en.wikipedia.org/wiki/Electron_pair) − электронная пара

a Lewis acid − кислота Льюиса

a proton donor − донор протона

a Bronsted acid − кислота Бронстеда

an aqueous solution − водный раствор

[hydronium ion](https://en.wikipedia.org/wiki/Hydronium_ion) − ион гидрония

an Arrhenius acid − кислота Аррениуса

to provide − обеспечивать

to be capable of − быть способным

a sour taste − кислый вкус

to turn red − окрашивать в красный цвет

a [litmus](https://en.wikipedia.org/wiki/Litmus) − лакмус

to generalize − обобщать

a base − основание

acidic − кислотный

a chemical − химическое вещество

common − распространенный

[hydrochloric acid](https://en.wikipedia.org/wiki/Hydrochloric_acid) − соляная кислота

[acetic acid](https://en.wikipedia.org/wiki/Acetic_acid) − ацетоновая кислота

[citric acid](https://en.wikipedia.org/wiki/Citric_acid) − лимонная кислота

a pure substance − чистое вещество

a strong acid − сильная кислота

a weak acid − слабая кислота

corrosive − коррозионный

an exception − исключение

[boron trifluoride](https://en.wikipedia.org/wiki/Boron_trifluoride) − трифторид бора

a vacant [orbital](https://en.wikipedia.org/wiki/Atomic_orbital) − свободная орбиталь

a lone pair − неподеленная пара

[ammonia](https://en.wikipedia.org/wiki/Ammonia) − аммиак

boric acid − борная кислота

well-equipped − хорошо оборудованный

to prepare − приготовить

to propose − предлагать

to discuss − обсуждать

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

**What is acid?**

An acid is a [molecule](https://en.wikipedia.org/wiki/Molecule) or [ion](https://en.wikipedia.org/wiki/Ion) which is capable of donating a [hydron](https://en.wikipedia.org/wiki/Hydron_%28chemistry%29) (proton or hydrogen ion H+), or, alternatively, capable of forming a [covalent bond](https://en.wikipedia.org/wiki/Covalent_bond) with an [electron pair](https://en.wikipedia.org/wiki/Electron_pair) (a Lewis acid). The first category of acids is the proton donors or [Bronsted acids](https://en.wikipedia.org/wiki/Br%C3%B8nsted%E2%80%93Lowry_acid%E2%80%93base_theory). In the special case of aqueous solutions, proton donors form the [hydronium ion](https://en.wikipedia.org/wiki/Hydronium_ion) H3O+ and are known as [Arrhenius acids](https://en.wikipedia.org/wiki/Acid-base_reaction#Arrhenius_theory). [Bronsted](https://en.wikipedia.org/wiki/Johannes_Nicolaus_Br%C3%B8nsted) and [Lowry](https://en.wikipedia.org/wiki/Thomas_Martin_Lowry) generalized the Arrhenius theory to include non-aqueous solvents. A Bronsted or Arrhenius acid usually contains a hydrogen atom which is bonded to a chemical structure.

Aqueous Arrhenius acids have characteristic properties which provide a practical description of an acid. Acids form [aqueous solutions](https://en.wikipedia.org/wiki/Aqueous_solution) with a sour taste. They turn blue [litmus](https://en.wikipedia.org/wiki/Litmus) red, and react with [bases](https://en.wikipedia.org/wiki/Base_%28chemistry%29) and certain metals (like [calcium](https://en.wikipedia.org/wiki/Calcium)) to form [salts](https://en.wikipedia.org/wiki/Salt_%28chemistry%29). Chemicals or substances having the property of an acid are acidic.

Common aqueous acids include [hydrochloric acid](https://en.wikipedia.org/wiki/Hydrochloric_acid), [acetic acid](https://en.wikipedia.org/wiki/Acetic_acid), [sulfuric acid](https://en.wikipedia.org/wiki/Sulfuric_acid), and [citric acid](https://en.wikipedia.org/wiki/Citric_acid). As these examples show, acids are solutions or pure substances. [Strong acids](https://en.wikipedia.org/wiki/Acid_strength) and some concentrated weak acids are [corrosive](https://en.wikipedia.org/wiki/Corrosive_substance), but there are exceptions such as [boric acid](https://en.wikipedia.org/wiki/Boric_acid).

The second category of acids is [Lewis acids](https://en.wikipedia.org/wiki/Lewis_acids_and_bases), which form a covalent bond with an electron pair. An example is [boron trifluoride](https://en.wikipedia.org/wiki/Boron_trifluoride) (BF3), where boron atom has a vacant [orbital](https://en.wikipedia.org/wiki/Atomic_orbital) which can form a covalent bond by the sharing of a lone pair of electrons on an atom in a base, for example the nitrogen atom in [ammonia](https://en.wikipedia.org/wiki/Ammonia) (NH3).

**Ex.2 Answer the questions.**

1. What is acid?

2. How many categories of acids exist?

3. Why did Bronsted and Lowry generalize the Arrhenius theory?

4. What substances are called acidic?

5. What do common acids include?

**Ex. 3 Put the adjectives in brackets in Comparative.**

1. This acid theory is (important) \_\_\_\_ than that theory.

2. Ammonia is (soluble) \_\_\_ than nitrogen.

3. Nitric acid is (weak) \_\_\_ than sulphuric acid.

4. I understand the Arrhenius theory (good) \_\_\_\_ than [Bronsted](https://en.wikipedia.org/wiki/Johannes_Nicolaus_Br%C3%B8nsted) and [Lowry](https://en.wikipedia.org/wiki/Thomas_Martin_Lowry) theory.

5. I know about [Bronsted](https://en.wikipedia.org/wiki/Johannes_Nicolaus_Br%C3%B8nsted) and [Lowry](https://en.wikipedia.org/wiki/Thomas_Martin_Lowry) theory (much) \_\_\_ than my friend.

6. She knows acid theories (bad) \_\_\_ than her sister.

7. Arrhenius acids have (useful) \_\_\_\_ properties than [Bronsted](https://en.wikipedia.org/wiki/Johannes_Nicolaus_Br%C3%B8nsted) acids.

**Ex. 4 Put the adjectives in brackets in Superlative .**

1. Bronsted theory is (interesting) theory.

2. Which acid is (good) \_\_\_?

3. Nitric acid is (bad) \_\_\_ solvent.

4. This laboratory is (well-equipped) \_\_\_ laboratory in the university.

5. This property is (well-known) \_\_\_\_ of all physical properties.

6. Hydrochloric acid is (pure) \_\_\_\_ substance of all acidic substance.

7. This chemical is (acidic) \_\_\_\_ of all other chemicals.

**Ex. 5 Put the adjectives in brackets in Superlative or Comparative**

1. Who knows Bronsted theory (good) \_\_\_\_ than me.

2. Yesterday I obtained (many) \_\_\_\_ compounds than usually.

3. It is (cheap) \_\_\_ method to prepare sulphuric acid.

4. [Boron trifluoride](https://en.wikipedia.org/wiki/Boron_trifluoride) has (many) \_\_\_\_ vacant orbitals than other chemical compound.

5. What is (quick) \_\_\_\_ way to produce large quantities of sulphuric acid?

6. Who is ready to propose (good) \_\_\_ decision to solve this problem?

7. What is (an easily –prepared) \_\_\_\_substance, boric acid or hydrochloric acid?

**Ex. 6 Put the questions to the bold-typed words**

1. **Yesterday** we discussed **the** [Bronsted](https://en.wikipedia.org/wiki/Johannes_Nicolaus_Br%C3%B8nsted) **and** [Lowry](https://en.wikipedia.org/wiki/Thomas_Martin_Lowry) theory **at the lesson.**

2. **I** have done **this experiment**.

3. **Acid i**s more soluble than **a base**.

4. **Acid** is the most soluble chemical.

5. **I** have proposed **this method** first.

6. **Boron** forms **a covalent** bond.

7. **The sharing of electrons** happens **faster** in an acid than in a base.

**Ex. 7 Read and translate the text**

**Arrhenius theory**

[Svante Arrhenius](https://en.wikipedia.org/wiki/Svante_Arrhenius) devised the first modern definition of acids and bases. An Arrhenius acid is a substance that [dissociates](https://en.wikipedia.org/wiki/Dissociation_%28chemistry%29) in water to form hydrogen ions (H+);that is, an acid increases the concentration of H+ ions in an aqueous solution.

This causes the [protonation](https://en.wikipedia.org/wiki/Protonation) of water, or the creation of the [hydronium](https://en.wikipedia.org/wiki/Hydronium) (H3O+) ion. An Arrhenius base is a substance that dissociates in water to form hydroxide (OH−) ions; that is, a base increases the concentration of OH− ions in an aqueous solution. The Arrhenius definitions of [acidity](https://en.wikipedia.org/wiki/Acidity) and [alkalinity](https://en.wikipedia.org/wiki/Alkalinity) are restricted to aqueous solutions, and refer to the concentration of the solvent ions. Under this definition, pure H2SO4 and HCl which dissolve in toluene are not acidic and molten NaOH and solutions of calcium amide in liquid ammonia are not alkaline.

The reaction of an acid with a base is called a [neutralization](https://en.wikipedia.org/wiki/Neutralization_%28chemistry%29) reaction. The products of this reaction are a [salt](https://en.wikipedia.org/wiki/Salt_%28chemistry%29) and water.

Acid + base → salt + water

In this traditional representation we formulate an acid-base neutralization reaction as a [double-replacement reaction](https://en.wikipedia.org/wiki/Salt_metathesis_reaction). For example, the reaction of [hydrochloric acid](https://en.wikipedia.org/wiki/Hydrochloric_acid), HCl, with [sodium hydroxide](https://en.wikipedia.org/wiki/Sodium_hydroxide), NaOH, solutions produces a solution of [sodium chloride](https://en.wikipedia.org/wiki/Sodium_chloride), NaCl, and some additional water molecules.

HCl(aq) + NaOH(aq) → NaCl(aq) + H2O

The modifier (aq) in this equation is important. It indicates that the substances dissolve in water. In fact though all three substances, HCl, NaOH and NaCl are capable of existing as pure compounds, in aqueous solutions they fully dissociate into the (aquated) ions H+, Cl-, Na+ and OH-.

**Vocabulary**

modern definition − современное определение

to devise − разрабатывать

An Arrhenius acid − кислота Аррениуса

to dissociate − диссоциировать

to increase − увеличивать

to cause − вызвать

protonation − протонирование, присоединение протона

creation − создание

that is − поэтому

An Arrhenius base − основание Аррениуса

[acidity](https://en.wikipedia.org/wiki/Acidity) − кислотность

[alkalinity](https://en.wikipedia.org/wiki/Alkalinity) − щелочность

to restrict to − ограничивать

to refer to − относиться

a solvent − растворитель

under this definition − согласно этому определению

toluene − толуол

molten − расплавленный, жидкий

calcium amide − амид кальция

[neutralization](https://en.wikipedia.org/wiki/Neutralization_%28chemistry%29) − нейтрализация

a [salt](https://en.wikipedia.org/wiki/Salt_%28chemistry%29) − соль

representation − описание, представление

[double-replacement reaction](https://en.wikipedia.org/wiki/Salt_metathesis_reaction) − реакция обменного разложения

a liquid ammonia − жидкий аммиак

to formulate − формулировать

[sodium hydroxide](https://en.wikipedia.org/wiki/Sodium_hydroxide) − гидроксид натрия

sodium chloride − хлорид натрия

important − важный

aquated − гидратируемый

to indicate − указывать на

though − хотя

**Unit 10**

**As..as and not as..as**

# *As* … *as*

We use ***as +* adjective/adverb *+ as*** to make comparisons when the things we are comparing are equal in some way:

*The world’s biggest bull is* ***as big as*** *a small elephant.*

*The weather this summer is* ***as bad as*** *last year. It hasn’t stopped raining for weeks.*

*You have to unwrap it* ***as carefully as*** *you can. It’s quite fragile.*

***Not as* … as**

We use ***not as … as*** to make comparisons between things which aren’t equal:

*It’s* ***not as heavy as*** *I thought it would be, actually.*

*Rory has****n’t*** *grown* ***as tall as*** *Tommy yet.*

*She’s* ***not*** *singing* ***as loudly as*** *she can.*

*They did****n’t*** *play* ***as well as*** *they usually do.*

We can modify ***not* *as … as*** by using ***not quite as*** or ***not nearly as*:**

*The second race was* ***not quite as easy as*** *the first one.* (The second race was easy but the first one was easier.)

*These new shoes are* ***not nearly as comfortable as*** *my old ones.* (My old shoes are a lot more comfortable than these new shoes.)

We can also use ***not so … as.******Not so … as*** is less common than ***not as … as*:**

*The cycling was good but* ***not so hard as*** *the cross country skiing we did.*

**Vocabulary**

an organic reaction − органическая реакция

a redox reaction − реакция восстановления /окисления (редок реакция)

carbon −углерод

hydrogen − водород

a functional group − функциональная группа

Lewis basicity − льюисова основность

to determine − определять

electrophillic − электрофильные

nucleophillic − нуклеофильные

a region − область

an excess − избыток

to act as − вести себя как

whereas − тогда как

an area − область

a Lewis base − основание Льюиса

to attract − притягиваться

electron deficient − электроноакцепторный

species (pl.species) − молекула, разновидность, вид

to reduce − восстанавливать

to oxidize − окислять

to happen − происходить

between − между

to involve − включать

a gain of electrons − получение электронов

a loss − потеря

to transfer − переносить, передавать

a half-reaction − полуреакция

reduction − восстановление

oxidation − окисление

separately − отдельно

to balance − уравнять, расставить коэффициенты в химическом уравнении

to add together − складывать вместе

conversely − наоборот

magnesium − магний

to lose − терять

to gain −получать

however − несмотря на

to show − показывать

to burn − гореть

a concept − понятие

key − ключевой

hardly - soluble − трудно растворимый

readily- soluble − легко растворимый

slightly- soluble − слабо растворимый

scarcely- soluble − плохо растворимый

manganese − марганец

to occur − протекать

to proceed − протекать (процесс)

to predict − прогнозировать

oxygen − кислород

exactly − точно

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

**Organic and Redox reactions**

Organic reactions occur between organic molecules (molecules which contain carbon and hydrogen). There are many organic reactions. However, functional groups determine many of the characteristics of organic molecules.

Another key concept in organic reactions is Lewis basicity. Parts of organic molecules are electrophillic or nucleophillic. Nucleophillic regions have an *excess* of electrons—they act as Lewis bases—whereas electrophillic areas are electron deficient and act as Lewis acids. The nucleophillic and electrophillic regions attract and react with each other.

Redox is an abbreviation of reduction/oxidation reactions. This is exactly what happens in a redox reaction, one species is reduced and another is oxidized. Reduction involves a gain of electrons and oxidation involves a loss, so a redox reaction is a reaction in which electrons are *transferred* between species. Reactions where something is “burnt» are the examples of redox reactions, however, oxidation reactions also occur in solution.

Redox reactions are often written as two half-reactions and show the reduction and oxidation processes separately. These half-reactions are balanced and added together to form the full equation. When magnesium is burnt in oxygen, it loses electrons (it is oxidized). Conversely, the oxygen gains electrons from the magnesium (it is reduced).

**Ex. 2 Answer the questions**

1. What is an organic reaction?

2. What is the key concept in organic reactions?

3. What happens when magnesium is burnt?

4. What types of organic reactions do you know?

5. How do you understand electrophillic reactions?

**Ex. 3 Remake the following sentences using comparative constructions *as..as* and *not as..as***

For example: Magnesium is brittle. Copper is brittle too. Magnesium is as brittle as chromium.

Magnesium is brittle but copper is not brittle. Magnesium is not as brittle as chromium.

1. Reduction process is a difficult process. Oxidation is a difficult process too.

2. Organic reactions are electron-gaining reactions. Redox reactions are not electron-gaining reactions.

3. Nucleophillic regions are electron – excessive regions. Electrophillic regions are electron – excessive too.

4. Lewis acids are hard- soluble. Bronsted acids are not hard- soluble.

5. Magnesium is slightly- soluble. Manganese is not slightly-soluble.

6. Boric acid is a strong acid whereas hydrochloric acid is not a strong acid.

7. Sulfuric acid is a weak acid. Boric acid is a weak acid too.

**Ex. 4 Put in *as* or *than***

1. Organic reactions occur faster …..redox reactions.

2. Bronsted theory is as interesting …Lewis theory.

3. This concept is more important … any other concepts.

4. Nitric acid reacts with metals as easily…. Sulphuric acid.

5. These species lose electrons faster …those species.

6. This theory was more useful … your theory.

7. This equation is as balanced ….. that equation.

**Ex. 5 Put the questions to the bold-typed words**

1. **We** often write **redox reactions** **here**.

2. **Organic** reactions occur **at high temperature**.

3. **Yesterday** **we** reduced **these species**.

4. **Nucleophillic** regions have an **excess of electrons.**

5**.** Another key concept in organic reactions is **Lewis basicity.**

6. **Magnesium** loses **electrons**.

7. **This element** changes **its colour** when it burns.

**Ex. 6 Translate the following sentences from English into Russian or Kazakh.**

1. Redox is an abbreviation of reduction/oxidation reactions.

2. Oxidation proceeds faster than reduction.

3. Reduction involves a gain of electrons.

4. Oxidation involves a loss of electrons.

5. Reactions where something is “burnt» are the examples of redox reactions.

6. These half-reactions are balanced quicker than those reactions.

7. What element gains electrons?

8. Electrons are transferred between species.

**Ex. 7 Read and translate the text**

Exothermic and Endothermic Reactions

The release of energy in chemical reactions occurs when the reactants have higher chemical energy than the products. The chemical energy in a substance is a type of potential energy which we store within the substance. This stored chemical potential energy is the heat contentor enthalpyof the substance. The collection of substances that is involved in a chemical reaction is referred to as a *system* and anything else around it is called the *surroundings*. If the enthalpy decreases during a chemical reaction, a corresponding amount of energy releases to the surroundings. Conversely, if the enthalpy increases during a reaction, a corresponding amount of energy is absorbed from the surroundings. This is simply the Law of Conservation of Energy. Endothermic reactions increase their enthalpy by absorbing heat.

Exothermic reactions decrease their enthalpy by releasing heat.

**Vocabulary**

release of energy − выделение энергии

a reactant − реагент

to store − хранить

heat content − теплосодержание, энтальпия

chemical energy − химическая энергия

enthalpy − энтальпия

stored − сохраненная

surroundings − внешняя среда

collection − множество

to decrease − уменьшаться

a corresponding amount − соответствующее количество

to release − высвобождаться

during − во время

to increase − увеличиваться

to absorb − поглощать

the Law of Conservation of Energy − закон сохранения энергии

endothermic reactions − эндотермические реакции

exothermic reactions − экзотермические реакции

by absorbing heat − путем поглощения тепла

by releasing heat − путем выделения тепла

anything else around − что-либо еще вокруг

**Unit 11**

**Modal verbs: can, could, may, might**

## Can:

## Positive Form: I can read

**Negative Form:**  I cannot (can’t) read.

**Questions**: Can you read?

When we use this modal verb:

to express ability (to be able to do something):

* I **can** make jewelry.
* He **can’t** speak French.
* **Can** you open this jar?

To ask for permission:

* **Can** I use your bathroom?

To make requests or suggestions:

* **Can** I have more napkins?
* **Can** I have the bill?
* You **can** take this spot if you like.
* You **can** do whatever you want.

## Could:

## Positive Form: I could read

**Negative Form:**  I couldn’t read.

**Questions**: Could you read?

When we use this modal verb:

to describe an ability that someone had in the past:

* I **could** swim when I was young.
* You **could** see the boat sinking.
* They **could** tell he was nervous.

In auxiliary functions to express permission politely:

* **Could** I take this jacket with me?
* You **could** borrow my umbrella.
* **Could** you please let me pass you?
* **Could** I get you more water?

To express possibility:

* All of them **could** ride in the van.
* You **could** always stay at our house.
* Could it be true?
* This plan **could** really work out.

The difference between **can** and **could** is that we use **could** instead of **can** when we are not sure in something. For example: He **could** be right.

## Might /may

## Positive Form: I might (may) come soon.

**Negative Form:**  I **might not (may not)** come soon.

We use **may** to ask for formal permission:

* **May** I come in?
* **May** I say something now?
* **May** I ask one question?

We can use **might** in this type of questions but it will be formal:

**Might** he be persuaded to change his mind?

When we talk about probability we can use both **might** and **may**. For example:

She **may** come tomorrow. Or She **might** come tomorrow.

In past simple the modal verbs **might** and **may** have the following form: **may/might + have + Ved(V3).** For example: I **might /may have seen** him yesterday.

We use **can** in positive sentences when we talk about general possibility of something happening while we use **may/might/could** when we talk about the possibility of something happening in a particular situation. For example:

The temperature in June **can** reach 30 o C.

It **may/might/could** rain later.

We prefer **may** rather than **can** in formal contexts, for example:

Exceeding the stated dose **may** cause drowsiness. (from medical container).

We use **might** when we talk about small probability.

**Vocabulary**

a hydrocarbon − углеводород

hydrogen − водород

carbon − углерод

to consist of − состоять из

to remove − удалять

to be removed − быть удаленным

hydrocarbyl − гидрокарбил, нециклический углеродный остаток

aromatic − ароматический

arene − арен

alkane − алкан

alkene − алкен

cycloalkane − циклоалкан

majority − большинство

[crude oil](https://en.wikipedia.org/wiki/Petroleum#Crude_oil) − сырая нефть

organic chemistry − органическая химия

as follows − следующий

saturated hydrocarbons − насыщенные углеводороды

simple − простой

to be composed of − состоять из

to saturate with − насыщать

saturated − насыщенный

unsaturated − не насыщенный

[acyclic](https://en.wikipedia.org/wiki/Open-chain_compound) saturated hydrocarbons − ациклические насыщенные углеводороды

a general formula − распространенная формула

a ring − кольцо

the number − число

a basis − основа

petroleum fuels − нефтяное топливо

linear − линейный

branched − разветвленный

substitution reaction − реакция замещения

[structural isomers](https://en.wikipedia.org/wiki/Structural_isomer) − структурные изомеры

the same − одинаковый

[chiral](https://en.wikipedia.org/wiki/Chirality_%28chemistry%29) − киральный

to constitute − составлять

side chains − боковые цепи

[chlorophyll](https://en.wikipedia.org/wiki/Chlorophyll) − хлорофилл

[tocopherol](https://en.wikipedia.org/wiki/Tocopherol) − токоферол, витамин Е

[methane](https://en.wikipedia.org/wiki/Methane) − метан

[propane](https://en.wikipedia.org/wiki/Propane) − пропан

liquid − жидкость

[hexane](https://en.wikipedia.org/wiki/Hexane) − гексан

[benzene](https://en.wikipedia.org/wiki/Benzene) − бензол

known as − известный как

wax− воск

low melting [solids](https://en.wikipedia.org/wiki/Solid) − легкоплавкие твердые тела

[paraffin wax](https://en.wikipedia.org/wiki/Paraffin_wax) − парафиновый воск

[naphthalene](https://en.wikipedia.org/wiki/Naphthalene) − нафталин

a polymer − полимер

[polyethylene](https://en.wikipedia.org/wiki/Polyethylene) − полиэтилен

[polypropylene](https://en.wikipedia.org/wiki/Polypropylene) − полипропилен

[polystyrene](https://en.wikipedia.org/wiki/Polystyrene) − полистирол

at least − по крайней мере

3-methylhexane − 3-метилгексан

impurity − примесь

kerosene − керосин

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

**Hydrocarbons**

In [organic chemistry](https://en.wikipedia.org/wiki/Organic_chemistry), a hydrocarbon is an [organic compound](https://en.wikipedia.org/wiki/Organic_compound). It consists of [hydrogen](https://en.wikipedia.org/wiki/Hydrogen) and [carbon](https://en.wikipedia.org/wiki/Carbon). Hydrocarbons from which we removed one hydrogen [atom](https://en.wikipedia.org/wiki/Atom) are [functional groups](https://en.wikipedia.org/wiki/Functional_group), we call them hydrocarbyls. [Aromatic hydrocarbons](https://en.wikipedia.org/wiki/Aromatic_hydrocarbon) (arenes), [alkanes](https://en.wikipedia.org/wiki/Alkane), [alkenes](https://en.wikipedia.org/wiki/Alkene), [cycloalkanes](https://en.wikipedia.org/wiki/Cycloalkane) are different types of hydrocarbons. The majority of hydrocarbons on [Earth](https://en.wikipedia.org/wiki/Earth) occur in [crude oil](https://en.wikipedia.org/wiki/Petroleum#Crude_oil). The classifications for hydrocarbons, defined by  [the nomenclature of organic chemistry](https://en.wikipedia.org/wiki/IUPAC_nomenclature_of_organic_chemistry) are as follows. Saturated hydrocarbons are the simplest of the hydrocarbon species. They are composed of single bonds and we saturate them with hydrogen. The formula for [acyclic](https://en.wikipedia.org/wiki/Open-chain_compound) saturated hydrocarbons (i.e., [alkanes](https://en.wikipedia.org/wiki/Alkanes)) is C*n*H2*n*+2. The most general form of saturated hydrocarbons is C*n*H2*n*+2(1-*r*), where *r* is the number of rings. Those with exactly one ring are the [cycloalkanes](https://en.wikipedia.org/wiki/Cycloalkanes). Saturated hydrocarbons are the basis of petroleum fuels and they can be linear or branched species. Substitution reaction is their characteristics property. Hydrocarbons with the same [molecular formula](https://en.wikipedia.org/wiki/Molecular_formula) but different [structural formulae](https://en.wikipedia.org/wiki/Structural_formula) are [structural isomers](https://en.wikipedia.org/wiki/Structural_isomer). 3-methylhexane and branched hydrocarbons can be [chiral](https://en.wikipedia.org/wiki/Chirality_%28chemistry%29). Chiral saturated hydrocarbons constitute the side chains of biomolecules such as [chlorophyll](https://en.wikipedia.org/wiki/Chlorophyll) and [tocopherol](https://en.wikipedia.org/wiki/Tocopherol). [Unsaturated hydrocarbons](https://en.wikipedia.org/wiki/Unsaturated_hydrocarbon) have one or more double or triple bonds between carbon atoms. Those with double bond are called [alkenes](https://en.wikipedia.org/wiki/Alkene). Those with one double bond have the formula *Cn*H*2n* .. Those which contain triple bonds are called [alkynes](https://en.wikipedia.org/wiki/Alkyne), with general formula *Cn*H*2n-2*. [Aromatic hydrocarbons](https://en.wikipedia.org/wiki/Aromatic_hydrocarbon), also known as [arenes](https://en.wikipedia.org/wiki/Arene), are hydrocarbons that have at least one [aromatic ring](https://en.wikipedia.org/wiki/Aromatic_ring). Hydrocarbons can be [gases](https://en.wikipedia.org/wiki/Gas) (e.g. [methane](https://en.wikipedia.org/wiki/Methane) and [propane](https://en.wikipedia.org/wiki/Propane)), [liquids](https://en.wikipedia.org/wiki/Liquid) (e.g. [hexane](https://en.wikipedia.org/wiki/Hexane) and [benzene](https://en.wikipedia.org/wiki/Benzene)), [waxes](https://en.wikipedia.org/wiki/Wax) or low melting [solids](https://en.wikipedia.org/wiki/Solid) (e.g. [paraffin wax](https://en.wikipedia.org/wiki/Paraffin_wax) and [naphthalene](https://en.wikipedia.org/wiki/Naphthalene)) or [polymers](https://en.wikipedia.org/wiki/Polymer) (e.g. [polyethylene](https://en.wikipedia.org/wiki/Polyethylene), [polypropylene](https://en.wikipedia.org/wiki/Polypropylene) and [polystyrene](https://en.wikipedia.org/wiki/Polystyrene)).

**Ex. 2 Answer the questions.**

1. What is hydrocarbon?

2. The atom of what chemical element do we remove from hydrocarbons?

3. What liquid contains hydrocarbons?

4. What type of bonds do unsaturated hydrocarbons have?

5. What is the formula of unsaturated hydrocarbons with one double bond?

**Ex. 3 Complete these sentences. Use can or *could* + one of these verbs.**

**To obtain, to occur, to show, to remove, to constitute, to store, to have**

1.Yesterday I ….. a new substance.

2. Hydrocarbons ….. in crude oil.

3. Chiral saturated hydrocarbons ……. the side chains of biomoleclues.

4. Last time I ….. all impurities from this solution.

5. We …. his compound in kerosene.

6. These hydrocarbons …….triple bonds.

7. I can ….. you how to carry out this experiment.

**Ex. 4 Complete the sentences using can or may/might/could.**

1. Saturated hydrocarbons …..be linear or branched.

2. She …… finish her experiment tomorrow.

3. The release of energy in chemical reactions ….. occur when the reactants have higher chemical energy.

4. I think Michael …. Be at the university now. I will go and check.

5. I think Ann ….. titrate the solution which she has just obtained tomorrow.

6. The reaction of [hydrochloric acid](https://en.wikipedia.org/wiki/Hydrochloric_acid), HCl, with [sodium hydroxide](https://en.wikipedia.org/wiki/Sodium_hydroxide), NaOH, solutions …. Produce a solution of [sodium chloride](https://en.wikipedia.org/wiki/Sodium_chloride).

7. 3-methylhexane and branched hydrocarbons …. Be [chiral](https://en.wikipedia.org/wiki/Chirality_%28chemistry%29).

**Ex. 5 Correct the mistakes in the sentences.**

1. He mays be right.

2. This substance can has react with sodium chloride at high temperature.

3. Hydrocarbons with the same formula is isomers.

4. Can you do carry out this experiment by yourself?

5. Hydrocarbons can are gases and liquids.

6. Some unsaturated hydrocarbons have can double bonds.

7. Can she measures temperature?

**Ex. 6 Translate the following sentences from English into Russian or Kazakh.**

1. The collection of substances that is involved in a chemical reaction is referred to as a *system* and anything else around it is called the *surroundings*.

2. Organic reactions occur between organic molecules (molecules which contain carbon and hydrogen).

3. This causes the [protonation](https://en.wikipedia.org/wiki/Protonation) of water, or the creation of the [hydronium](https://en.wikipedia.org/wiki/Hydronium) (H3O+) ion.

4. In this traditional representation we formulate an acid-base neutralization reaction as a [double-replacement reaction](https://en.wikipedia.org/wiki/Salt_metathesis_reaction).

5. [Aromatic hydrocarbons](https://en.wikipedia.org/wiki/Aromatic_hydrocarbon), also known as [arenes](https://en.wikipedia.org/wiki/Arene), are hydrocarbons that have at least one [aromatic ring](https://en.wikipedia.org/wiki/Aromatic_ring).

6. Chocolate chip ice cream is not homogeneous—one spoonful taken might have two chips, and then another spoonful might have several chips.

7. Within any particular shell, the energy of the orbitals depends on the angular momentum.

8. The majority of hydrocarbons on [Earth](https://en.wikipedia.org/wiki/Earth) occur in [crude oil](https://en.wikipedia.org/wiki/Petroleum#Crude_oil).

**Ex. 7 Read and translate the text**

**General properties of hydrocarbons**

Because of differences in molecular structure, the empirical formula remains different between hydrocarbons. In linear alkanes, alkynes and alkenes, the amount of bonded hydrogen lessens in alkenes and alkynes due to the “self-bonding” or catenation of carbon which prevents entire saturation of the hydrocarbon by the formation of double or triple bonds.

This ability of hydrocarbons to bond to themselves is [catenation](https://en.wikipedia.org/wiki/Catenation), and allows hydrocarbons to form more complex molecules, such as [cyclohexane](https://en.wikipedia.org/wiki/Cyclohexane), and in rare cases, arenes such as [benzene](https://en.wikipedia.org/wiki/Benzene). This ability comes from the fact that the bond character between carbon atoms is entirely non-polar.

Generally, with catenation there is the loss of the total amount of bonded hydrocarbons and an increase in the amount of energy which is necessary for bond cleavage due to strain exerted upon the molecule.

In simple chemistry the carbon atom follows the rule, which states that the maximum number of atoms available to bond with carbon is equal to the number of electrons that are attracted into the outer shell of carbon. In terms of shells, carbon consists of an incomplete outer shell, which comprises 4 electrons, and thus has 4 electrons available for covalent bonding.

Hydrocarbons are [hydrophobic](https://en.wikipedia.org/wiki/Hydrophobic) like [lipids](https://en.wikipedia.org/wiki/Lipid).

Some hydrocarbons also are abundant in the solar system.

**Vocabulary**

because of − из-за

due to − благодаря

an empirical formula − эмпирическая формула

a difference − различие

to remain − оставаться

alkyne − алкин

bonded hydrogen − связанный водород

bonded hyd rocarbons − связанные углеводороды

to lessen − уменьшаться, ослабевать

an amount − количество

self-bonding − само присоединение

catenation − образование цепи

to prevent − предотвращать

entire − полный

an ability − способность

to bond to − присоединяться

to allow − позволять

to come from the fact − объясняться фактом

complex − сложный

bond character − характер связи

entirely − полностью

in rare cases − в редких случаях

to be necessary for − необходимый для

bond cleavage − расщепление связи

strain − давление, деформация

exerted upon − оказываемый на

to follow − следовать

a rule − правило

to state − гласить

available − доступный

an outer shell − внешняя оболочка

to be equal to − быть равным

to be attract into − быть завлекаемым в

in terms of − относительно

to comprise − включать

thus − таким образом

covalent bonding − ковалентное связывание

[hydrophobic](https://en.wikipedia.org/wiki/Hydrophobic) − гидрофобный

solar system − солнечная система

a lipid − липид

**Unit 12**

**Modal verbs: must, have to, should**

|  |  |  |
| --- | --- | --- |
| **Present** | **Positive** | **Negative** |
| have to /  don’t have to | strong obligation (possibly from outside):  Children have to go to school.(sometimes ‘have got to’) | no obligation: I don’t have to work on Sundays. |
| Must / mustn't | strong obligation (possibly based on the speaker’s opinion): I must study today.  It is used to show that something is very likely:  He must be at home now. | Negative obligation: You mustn’t smoke here. |
| Should / shouldn't | mild obligation or advice : You should save some money. | Mild negative obligation or advice: You shouldn’t smoke so much. |

Be careful about the difference between **mustn’t** and **don’t have to**!  
**Mustn’t** means **it’s not allowed**, or **it’s a bad idea**:

* You mustn’t eat so much chocolate, you’ll be sick

**Don’t have to** means **you don’t need to do something**, but **it’s fine if you want to do it:**

* I don’t have to get up early at the weekend (of course, if I want to get up early, that’s fine, but I can stay in bed if I want).

|  |  |  |
| --- | --- | --- |
| **Past** | **Positive** | **Negative** |
| had to / didn’t have to | obligation in the past:  I had to wear a school uniform when I was a child. | No obligation in the past: We didn’t have to go to school on Saturdays |
| must\* | changes to 'had to' |  |
| should have + Ved(V3) / shouldn’t have + Ved(V3) | a past action which didn’t happen: the advice / regret is too late  You should have gone to bed earlier, now you have missed the train. | A past action which didn’t happen: the advice / regret is too late: You shouldn’t have taken that job., it was |

**Questions:** Should I read this book?

Do I have to read this book?

***The modal verb* must *is not used in questions, instead of it we use* have to.**

Notice: in scientific style the frequently used modal verb is **should**. We can’t say: ~~This reaction must occur at high temperature.~~

We must say: This reaction should occur at high temperature.

The modal verbs ***“must”***and **“*have to****”* are mainly used in everyday speech contexts.

**Vocabulary**

acyclic − алифатический (ациклический)

a [homologous series](https://en.wikipedia.org/wiki/Homologous_series) − гомологический ряд

[ethylene](https://en.wikipedia.org/wiki/Ethylene) − этилен

[International Union of Pure and Applied Chemistry](https://en.wikipedia.org/wiki/International_Union_of_Pure_and_Applied_Chemistry) − Международный совет по теоретической и прикладной химии

thane − этен

on the largest scale − в больших масштабах

industrially − на производстве

to draw − изображать

combustible − легковоспламеняющийся

odorless − без запах

propene − пропен

[butene](https://en.wikipedia.org/wiki/Butene) − бутен

room temperature − комнатная температура

a waxy solid − воскообразное твердое тело

[allylic](https://en.wikipedia.org/wiki/Allylic) − аллиловый

to serve as − служить в качестве

a feedstock − исходное сырье

to participate − участвовать

petrochemical industry − нефтехимическая промышленность

polymerization − полимеризация

alkylation − алкилирование

a wide variety of − большое число

reactivity − реакционная способность

higher alkenes − высшие алкены

approximately − примерно

a liquid − жидкость

safety regulations − техника безопасности

to observe − соблюдать

a glove − перчатка

to pass an exam − сдавать экзамен

to explode − взрываться

to break the rule − нарушать правило

to dilute − разбавлять

boomerang effect − обратный эффект

to follow the rule − соблюдать правило

a laboratory assistant − лаборант

physical state − физическое состояние

molecular mass − молекулярная масса

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

**Alkenes**

In [organic chemistry](https://en.wikipedia.org/wiki/Organic_chemistry), an alkene is an [unsaturated hydrocarbon](https://en.wikipedia.org/wiki/Unsaturated_hydrocarbon) that contains at least one [carbon](https://en.wikipedia.org/wiki/Carbon)–carbon [double bond](https://en.wikipedia.org/wiki/Double_bond). Acyclic alkenes, with only one double bond and no other [functional groups](https://en.wikipedia.org/wiki/Functional_group) form a [homologous series](https://en.wikipedia.org/wiki/Homologous_series) of [hydrocarbons](https://en.wikipedia.org/wiki/Hydrocarbon) with the general formula [C](https://en.wikipedia.org/wiki/Carbon)*n*[H](https://en.wikipedia.org/wiki/Hydrogen)2*n*. The simplest alkene, [ethylene](https://en.wikipedia.org/wiki/Ethylene) (C2H4), with the [International Union of Pure and Applied Chemistry](https://en.wikipedia.org/wiki/International_Union_of_Pure_and_Applied_Chemistry) (IUPAC) name *thane*, is the [organic compound](https://en.wikipedia.org/wiki/Organic_compound) which people produce on the largest scale industrially. Chemists often draw [aromatic](https://en.wikipedia.org/wiki/Aromatic) compounds as cyclic alkenes, but their structure and properties are different and they are not considered to be alkenes.

The physical properties of alkenes and [alkanes](https://en.wikipedia.org/wiki/Alkane) are similar. They are colourless, nonpolar, combustible, and almost odorless. The [physical state](https://en.wikipedia.org/wiki/Physical_state) depends on [molecular mass](https://en.wikipedia.org/wiki/Molecular_mass): like the corresponding saturated hydrocarbons, the simplest alkenes, [ethene](https://en.wikipedia.org/wiki/Ethylene), [propene](https://en.wikipedia.org/wiki/Propene), and [butene](https://en.wikipedia.org/wiki/Butene) are gases at room temperature. Linear alkenes of approximately five to sixteen carbons are liquids, and higher alkenes are waxy solids.

Alkenes are relatively stable compounds, but are more reactive than [alkanes](https://en.wikipedia.org/wiki/Alkane), either because of the reactivity of the carbon–carbon pi-bond or the presence of [allylic](https://en.wikipedia.org/wiki/Allylic) CH centers. Alkenes serve as a feedstock for the [petrochemical](https://en.wikipedia.org/wiki/Petrochemical) industry because they can participate in a wide variety of reactions, polymerization and alkylation.

**Ex.2 Answer the questions**

1. What is alkene?

2. What are the physical properties of alkenes?

3. What is the difference between alkanes and alkenes?

4. How do chemists draw aromatic compounds of alkene?

5. How do you understand carbon-carbon double bond?

**Ex. 3 Complete these sentences. Use *must, have to or should***

1. I …. finish my experiment in time.

2. All schoolchildren …….observe safety regulations when they work in the chemical laboratory.

3. You look very ill. You …. see a doctor.

4. I … check my results once again. It seems to me that I have made a mistake in calculations.

5. When schoolchildren carry out experiments with acids they … wear special gloves.

6. You … understand the mechanism of the formation of pi bonds. I will include this theme in the examination materials.

7. If you want to pass your exam well you … read this book.

**Ex. 4 Complete these sentences. Use *mustn’t or don’t have to***

1. You….touch this switch. It is very dangerous.

2. You …..do this work now. You can do it later.

3. You ….add this liquid to the solution because if you do it there will be an explosion in the laboratory.

4. You ….learn this rule because our teacher didn’t include it in the examination materials.

5. I am happy because I ……carry out the experiment to produce liquid ammonia. Someone has already done it.

6. You ….touch these reactants.

7. You …. break this rule when you work with explosives liquids.

**Ex. 5 Circle the best option**

1. … I borrow you textbook, please?

a) must b) can c) have to d) should

2. You … dilute this solution with boric acid because it give a rise to a boomerang effect.

a) have to b) could c) must d) shouldn’t

3. I think that this substance … change its colour.

a) may b) will c) have to d) should

4. … you call me back please. I am busy now.

a) may b)could c)must d) should

5. To obtain the solution of nitric acid you……use this method.

a)may b)might c)can d) must

6. Who …..check his experimental results?

a) can b) have to c) has to d) mustn’t

7. All laboratory assistants ….follow the safety rules.

a) have to b) mustn’t c) may d) might

8. To saturate this hydrocarbon you ……study its properties at first.

a) must b) will c) can d) could

**Ex. 6 Put the questions to the bold-typed words**

1. **Alkenes** are relatively **stable** compounds.

2. [Functional groups](https://en.wikipedia.org/wiki/Functional_group) form a [homologous series](https://en.wikipedia.org/wiki/Homologous_series).

3. **People** produce **this substance industrially.**

4. **Chemists** often draw [aromatic](https://en.wikipedia.org/wiki/Aromatic) **compounds** as cyclic alkenes.

5. **These reactants** interact with one another **at room temperature**.

6. **Electron** shells have orbitals**.**

7. They will produce **this substance** **tomorrow**.

**Ex. 7 Read and translate the text**

**Where do we use hydrocarbons?**

Hydrocarbons are a primary energy source for current civilizations. The predominant use of hydrocarbons is as a combustible [fuel](https://en.wikipedia.org/wiki/Fuel) source. In their solid form, hydrocarbons take the form of asphalt ([bitumen](https://en.wikipedia.org/wiki/Bitumen)). People use the mixtures of volatile hydrocarbons as a [propellant](https://en.wikipedia.org/wiki/Propellant) for [aerosol sprays](https://en.wikipedia.org/wiki/Aerosol_spray). [Methane](https://en.wikipedia.org/wiki/Methane) (CH4) and [ethane](https://en.wikipedia.org/wiki/Ethane) (C2H6) are gaseous at ambient temperatures and pressure cannot readily liquefy them. Chemists easily liquefy [propane](https://en.wikipedia.org/wiki/Propane) (C3H8) and it exists in ‘propane bottles’ mostly as a liquid. Chemists also easily liquefy [butane](https://en.wikipedia.org/wiki/Butane) (C4H10) and use it as a fuel. [Pentane](https://en.wikipedia.org/wiki/Pentane) (C5H12) is a clear liquid at room temperature; people use it in chemistry and industry as an odorless [solvent](https://en.wikipedia.org/wiki/Solvent) of waxes and high molecular weight organic compounds. [Hexane](https://en.wikipedia.org/wiki/Hexane) (C6H14) is also a widely used non-polar, non-aromatic solvent. The C6 through C10 alkanes, alkenes and isomeric cycloalkanes are the components of [gasoline](https://en.wikipedia.org/wiki/Gasoline). With the addition of carbon units, the simple non-ring structured hydrocarbons have higher viscosities, boiling points, solidification temperatures.

**Vocabulary**

a primary energy source − важный источник энергии

a current civilization − современная цивилизация

a predominant use − главная сфера использования

combustible [fuel](https://en.wikipedia.org/wiki/Fuel) − горючее топливо

a solid form − твердая форма

asphalt − асфальт

to take the form − принимать форму

[bitumen](https://en.wikipedia.org/wiki/Bitumen) − битумен

a mixture − смесь

volatile − летучий

[propellant](https://en.wikipedia.org/wiki/Propellant) − топливо

an [aerosol spray](https://en.wikipedia.org/wiki/Aerosol_spray) − аэрозоль

methane − метан

ethane − этан

gaseous − газообразный

to liquefy − разжижать

readily − легко

a propane bottles − пропановый баллон

[butane](https://en.wikipedia.org/wiki/Butane) − бутан

[pentane](https://en.wikipedia.org/wiki/Pentane) − пентан

a clear liquid − прозрачная жидкость

an odorless [solvent](https://en.wikipedia.org/wiki/Solvent) − растворитель без запаха

high molecular weight organic compound − высокомолекулярное соединение

hexane − гексан

gasoline − бензин

with the addition − с добавлением

a carbon unit − углеродная единица

wildey –used − широко используемый

non-ring − не кольцевой

structured − структурированный

viscosity − вязкость

solidification temperature − температура затвердевания

**Unit 13**

**Passive Voice**

We make the passive by putting the verb 'to be' into whatever tense we need and then adding the [past participle](http://www.perfect-english-grammar.com/irregular-verbs.html). For regular verbs, we make the past participle by adding 'ed' to the infinitive. So **play** becomes **played.**

**Positive sentences**

|  |  |  |
| --- | --- | --- |
| Tense | Active Voice | Passive Voice |
| Present Simple | I do this work | This work is done by me |
| Past Simple | I did this work | This work was done by |
| Future Simple | I will do this work | This work will be done by me |
| Present Continuous | I am doing this work | This work is being done by me |
| Past Continuous | I was doing this work | This work was being done by me |
| Present Perfect | I have done this work | This work has been done by me |
| Past Perfect | H had done this work | This work had been done by me |
| Can/could | I can/could do this work | This work can/could be done by me |
| Must /Should | I must/should do this work | This work must/should be done by me |
| May/might | I may/might do this work | This work may/might be done by me |

Negative sentences

|  |  |  |
| --- | --- | --- |
| Tense | Active Voice | Passive Voice |
| Present Simple | I don’t do this work | This work isn’t done by me |
| Past Simple | I didn’t this work | This work wasn’t done by |
| Future Simple | I will not do this work | This work will not be done by me |
| Present Continuous | I am not doing this work | This work is not being done by me |
| Past Continuous | I was not doing this work | This work was not being done by me |
| Present Perfect | I haven’t done this work | This work hasn’t been done by me |
| Past perfect | I hadn’t done this work | This work hadn’t been done by me |
| Can/could | I can’t/couldn’t do this work | This work can/couldn’t be done by me |
| Must /Should | I mustn’t/shouldn’t do this work | This work must/shouldn’t be done by me |
| May/might | I may not /might not do this work | This work may not /might not be done by me |

Questions

|  |  |  |
| --- | --- | --- |
| Tense | Active Voice | Passive Voice |
| Present Simple | Do I do this work? | Is this work done by me |
| Past Simple | Did I do this work? | Was this work done by |
| Future Simple | Will I do this work? | Will this work be done by me ? |
| Present Continuous | Am I doing this work? | Is this work being done by me? |
| Past Continuous | Was I doing this work? | Was this work being done by me |
| Present Perfect | Have I done this work? | Has this work been done by me |
| Past Perfect | Had I done this work | Had this work been done by me? |
| Can/could | Can/Could I do this work? | Can/could this work be done by me? |
| Should | Should I do this work? | Should this work be done by me? |
| May | May I do this work? | May this work be done by me? |

### When should we use the Passive?

1. **When we want to change the focus of the sentence:**
   * The Mona Lisa was painted by Leonardo Da Vinci. (We are more interested in the painting than the artist in this sentence)
2. **When who or what causes the action is unknown or unimportant or obvious or 'people in general':**
   * He was arrested (obvious agent, the police).
   * My bike has been stolen (unknown agent).
   * The road is being repaired (unimportant agent).
   * The form can be obtained from the post office (people in general).
3. **In factual or scientific writing:**
   * The chemical is placed in a test tube and the data entered into the computer.
4. **In formal writing instead of using someone/ people/ they (these can be used in speaking or informal writing):**
   * The brochure will be finished next month.

Vocabulary

electrolysis − электролиз

direct current (DC) − постоянный ток

to force − заставить

to achieve − достигать

an electrode − электрод

to submerse − погружать

a technique − способ, метод

an electrically conductive solution − токопроводящий раствор

electrical voltage− электрическое напряжение

to be applied − прикладываться

electron flow − поток электронов

to flow − двигаться

until − до тех пор пока

to receive the electrons − принимать электроны

a reduction reaction − реакция восстановления

a cathode − катод

to supply − поставлять, снабжать

an anode − анод

an oxidation reaction − реакция окисления

to be called − называться

a molten salt − расплавленная соль

to electrolyze − электролизовать

to be composed of − состоять из

solid state − твердое состояние

to freely move − свободно двигаться

to melt − плавиться

mobility − подвижность

to make − делать

cation − катион

anion − анион

in this case − в этом случае

to reduce − восстанавливать

to oxidize − окислять

possible − возможный

to determine − определять

polyatomic ion − комплексный ион

perchlorate − перхлорат

sulfate − сульфат

nitrate − нитрат

specifically − а именно

water − вода

to fill − заполнять

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

**Electrolysis**

Electrolysis is a technique that uses a [direct](https://en.wikipedia.org/wiki/Direct_current) [electric current](https://en.wikipedia.org/wiki/Electric_current) (DC) to force non-spontaneous chemical reaction to occur. This is achieved when two electrodes are submersed in an electrically conductive solution, and the electrical voltage which is applied to the two electrodes increases until electrons flow. The electrode which receives the electrons, or where the reduction reactions occur, is called the cathode[.](#_bookmark192) The electrode which supplies the electrons, or where the oxidation reactions occur, is called the anode. A molten salt is an example of something that may be electrolyzed because salts are composed of ions. When the salt is in its solid state, the ions cannot freely move. However, when the salt is heated enough until it melts, the ions are free to move. This mobility of the ions in the molten salt makes the salt electrically conductive. In the electrolysis of a molten salt, for example melted *N aCl*, the cation of the salt (in this case *Na*+) will be reduced at the cathode, and the anion of the salt (in this case *Cl−*) will e oxidized at the anode:

Cathode reaction: Na+ + e- → Na

Anode reaction: 2Cl → Cl2 + 2 e-

Aqueous solutions of salts can be also electrolyzed because they are also electrically conductive. In aqueous solutions, there is an additional reaction possible at the cathode and the anode:

Cathode: 2 H2O + 2 e- → H2 + 2 OH- (reduction of water)

Anode: 2 H2O → 4 H+ + O2 + 4 e- (oxidation of water)

With the addition of these two reactions, there are now two possible reactions at each electrode. At the cathode, either the reduction of the cation or the reduction of water will occur. At the anode, either the oxidation of the anion or the oxidation of water will occur. The following rules determine which reaction takes place at each electrode:

* + - Cathode: If the cation is a very active metal, water will be reduced. Very active metals include Li, Na, K, Rb, Cs, Ca, Sr, and Ba. If the cation is an active or inactive metal, the cation will be reduced.
    - Anode: If the anion is a polyatomic ion, water will generally be oxidized. Specifically, sulfate, perchlorate, and nitrate ions are not oxidized.

**Ex. 2 Answer the questions**

1. What is electrolysis?

2. How is this process achieved?

3. Is this method used in biology or in chemistry?

4. What happens with ions when salt is solid state?

5. What metals are active?

**Ex. 3 Rewrite the following sentences in Passive**

1.We can electrolyze an aqueous solutions.

2. I reduced water.

3. I have obtained the interesting results.

4. Yesterday I measured the concentration.

5. I am calculating molecular mass now.

6. We were submersing the electrically conductive solution in electrodes.

7. This salt makes this substance active.

**Ex. 4 Rewrite the following sentences in Active**

1.Water has been added to this solution by me.

2. The substances were analyzed by us three days ago.

3. The salt was being heated by Jane.

4. This reaction must be studied by students.

5. Has this substance been obtained by you?

6. This concentration was measured by him yesterday.

7. Can redox reactions be studied by us next time?

**Ex. 5 Put the questions to the bold-typed words**

1.**It** is determined **by the following rules**.

2.**Water** wasn’t oxidized.

3.**This metal** is reduced **at the cathode.**

4. **A molten salt** may be electrolyzed **in the solution**.

5. **Electrons** are received **by the cathode**.

6. **These shells** were filled **by electrons**.

7. **The salt** is made electrically conductive **by the mobility of ions**.

**Ex. 6 Correct the mistakes in the sentences**

1. Acid has been obtain by me.

2. Who was these methods studied by?

3. Hydrocarbons are mainly uses in petrochemical industry.

4. Electrons is supply by electrodes.

5. The [physical state](https://en.wikipedia.org/wiki/Physical_state) are determined by [molecular mass](https://en.wikipedia.org/wiki/Molecular_mass).

6. Volume and molecular mass was measured by us last week.

7. How has molarity bee calculated?

8. Water can is demineralized at high temperature.

**Ex. 7 Read and translate the text**

**What is salt?**

In [chemistry](https://en.wikipedia.org/wiki/Chemistry), a salt is an [ionic compound](https://en.wikipedia.org/wiki/Ionic_compound) that results from the [neutralization](https://en.wikipedia.org/wiki/Neutralization_%28chemistry%29) reaction of an [acid](https://en.wikipedia.org/wiki/Acid) and a [base](https://en.wikipedia.org/wiki/Base_%28chemistry%29). Salts are composed of [cations](https://en.wikipedia.org/wiki/Cation) (positively [charged](https://en.wikipedia.org/wiki/Electric_charge) ions) and [anions](https://en.wikipedia.org/wiki/Anion) (negative ions) so that the product is electrically [neutral](https://en.wikipedia.org/wiki/Electric_charge) (without a net charge). These ions can be [inorganic](https://en.wikipedia.org/wiki/Inorganic_compound), such as chloride, or [organic](https://en.wikipedia.org/wiki/Organic_chemistry), such as [acetate](https://en.wikipedia.org/wiki/Acetate); and can be [monatomic](https://en.wikipedia.org/wiki/Monatomic_ion), such as fluoride, or [polyatomic](https://en.wikipedia.org/wiki/Polyatomic_ion), such as [sulfate](https://en.wikipedia.org/wiki/Sulfate)

There are several varieties of salts. Salts that [hydrolyze](https://en.wikipedia.org/wiki/Hydrolyze) to produce [hydroxide](https://en.wikipedia.org/wiki/Hydroxide) ions when they are dissolved in [water](https://en.wikipedia.org/wiki/Water) are [basic salts](https://en.wikipedia.org/wiki/Basic_salts), whilst those that hydrolyze to produce [hydronium](https://en.wikipedia.org/wiki/Hydronium) ions in water are acidic salts. Neutral salts are those that are neither acid nor basic salts. [Zwitterions](https://en.wikipedia.org/wiki/Zwitterion) contain an anionic centre and a cationic centre in the same [molecule](https://en.wikipedia.org/wiki/Molecule), but are not salts. Examples of zwitterions include [amino acids](https://en.wikipedia.org/wiki/Amino_acid), many [metabolites](https://en.wikipedia.org/wiki/Metabolite), [peptides](https://en.wikipedia.org/wiki/Peptide), and [proteins](https://en.wikipedia.org/wiki/Protein). Usually, non-dissolved salts at [standard temperature and pressure](https://en.wikipedia.org/wiki/Standard_temperature_and_pressure) are [solid](https://en.wikipedia.org/wiki/State_of_matter).

[Molten salts](https://en.wikipedia.org/wiki/Molten_salt) and solutions which contain dissolved salts (e.g., sodium chloride in water) are called [electrolytes](https://en.wikipedia.org/wiki/Electrolyte), as they can [conduct electricity](https://en.wikipedia.org/wiki/Electrical_conductor). As observed in the [cytoplasm](https://en.wikipedia.org/wiki/Cytoplasm) of [cells](https://en.wikipedia.org/wiki/Cell_%28biology%29), in [blood](https://en.wikipedia.org/wiki/Blood), [urine](https://en.wikipedia.org/wiki/Urine) and [mineral waters](https://en.wikipedia.org/wiki/Mineral_water), mixtures of many different ions in solution usually do not form defined salts after evaporation of the water.

Vocabulary notes

a positively [charged](https://en.wikipedia.org/wiki/Electric_charge) ion − положительно заряженный ион

a negative charge − отрицательный заряд

electrically [neutral](https://en.wikipedia.org/wiki/Electric_charge) − электронейтральный

without − без

inorganic − неорганический

chloride − хлорид

[acetate](https://en.wikipedia.org/wiki/Acetate) −ацетат

[monatomic](https://en.wikipedia.org/wiki/Monatomic_ion) − одноатомный

polyatomic − полиатомный

fluoride − фторид

several − несколько

variety − вид

to hydrolyze − гидролизовать

[hydroxide](https://en.wikipedia.org/wiki/Hydroxide) ions − ионы гидроксида

to produce − образовывать

[basic salts](https://en.wikipedia.org/wiki/Basic_salts) − основные соли

whilst − в то время как

acidic salts − кислые соли

[hydronium](https://en.wikipedia.org/wiki/Hydronium) ion − ион гидрония, гидроний

neutral salts − нейтральные соли

[zwitterion](https://en.wikipedia.org/wiki/Zwitterion) − цвиттер-ион

anionic − анионный

cationic − катионный

a center − центр

[amino acids](https://en.wikipedia.org/wiki/Amino_acid) −амино кислоты

a metabolite − метаболит

a peptide − пептид

a protein − белок

electrolyte − электролит

as − так как

as observed − как наблюдается

[cytoplasm](https://en.wikipedia.org/wiki/Cytoplasm) − цитоплазма

a cell − клетка

[blood](https://en.wikipedia.org/wiki/Blood) − кровь

[urine](https://en.wikipedia.org/wiki/Urine) − моча

defined − определенные

evaporation − испарение

to pour − наливать

**Unit 14**

**Prepositions (Part 1)**

## On

Used to express a surface of something:

* I put an egg on the kitchen table.
* The paper is on my desk.

Used to specify days and dates:

* The garbage truck comes on Wednesdays.
* I was born on the 14th day of June in 1988.

Used to indicate a device or machine, such as a phone or computer:

* He is on the phone right now.
* She has been on the computer since this morning.
* My favorite movie will be on TV tonight.

Used to indicate a part of the body:

* The stick hit me on my shoulder.
* He kissed me on my cheek.
* I wear a ring on my finger.

Used to indicate the state of something:

* Everything in this store is on sale.
* The building is on fire.

We use this preposition when we talk about the completion of some activity, e.g.: По завершении эксперимента мы написали монографию. - On the completion of experiment we wrote the monograph.

We use this preposition in the meaning of about in the titles, e.g.: О разложении металлов. - On the decomposition of metals.

## At

Used to point out specific time:

* I will meet you at 12 p.m.
* The bus will stop here at 5:45 p.m.

Used to indicate a place:

* There is a party at the club house.
* There were hundreds of people at the park.
* We saw a baseball game at the stadium.

Used to indicate an email address:

* Please email me at abc@defg.com.

Used to indicate an activity:

* He laughed at my acting.
* I am good at drawing a portrait.

## Used with the verb “to look”, for instance: Look at the blackboard.

**At:**

We use “at” in the meaning of Russian preposition “при” but in English we use it only after physical magnitude like pressure, temperature and etc. For example: This substance burns at high pressure. - Это вещество горит при высокой температуре.

## In

Used for unspecific times during a day, month, season, year:

* She always reads newspapers in the morning.
* In the summer, we have a rainy season for three weeks.
* The new semester will start in March.

Used to indicate a location or place:

* She looked me directly in the eyes.
* I am currently staying in a hotel.
* My hometown is Los Angeles, which is in California.

Used to indicate a shape, color, or size:

* This painting is mostly in blue.
* The students stood in a circle.
* This jacket comes in four different sizes.

Used to express while doing something:

* In preparing for the final report, we revised the tone three times.
* A catch phrase needs to be impressive in marketing a product.

Used to indicate a belief, opinion, interest, or feeling:

* I believe in the next life.
* We are not interested in gambling

Vocabulary

The Periodic table − периодическая таблица

a tabular display − информация, представленная в виде таблицы

to arrange − располагать

based on − на основании

an atomic number − атомный номер

chemical properties − химические свойства

to present − представлять

by − по мере

the main body − основная часть

a grid − решетка

a valence − валентность

a valence electron − валентный электрон

to keep together − собирать

a halogen − галоген

a noble gas − благородный газ

as a result − в результате

to predict − прогнозировать

to provide − обеспечивать, предоставлять

relations − отношения

a useful framework − полезная информация

chemical behavior − химическое поведение

a science − наука

to develop − разрабатывать

ununoctium − унуноктий

hydrogen − водород

from ….to − от…..до

californium − калифорний

including − включая

to exist naturally − существовать в природе

to synthesize − синтезировать

radionuclides − радионуклиды

naturally occurring elements − элементы, встречающиеся в природе

along with − наряду

numerous − многочисленный

The Periodic Law – периодический закон

cornerstone – краеугольный камень

to state – формулировать

as follows – следующим образом

nuclear charge – ядерный заряд

to arrive at a conclusion – прийти к заключению

arrangement – расположение

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

valence group – валентная группа

to delineate - очерчивать

vacant space – свободное место

existence – существование

confidence - уверенность

to express – выражать

prediction - предсказание

missing - отсутствующий

within – в течение

to modify - видоизменять

to withstand – выдерживать

onslaught – появление

an isotope – изотоп

rare gases – редкие газы

electron configuration – электронная конфигурация

to strengthen – укреплять

scandium − скандий

gallium − галлий

periodicity − периодичность

although − хотя

a charge − заряд

a nuclear charge − заряд ядра

a flask − колба

electron configuration − электронная конфигурация

an isotope − изотоп

naturally occurring elements − элементы, встречающееся в природе

a valence group − валентная группа

to exist naturally − существовать в природе

the rest − остальные

to discover − открывать

**Periodic table and Periodic law**

The periodic table is a tabular display of the chemical elements, which is arranged based on their atomic numbers and chemical properties. Elements are presented by the increase of atomic number. The main body of the table is a 18 × 7 grid, and elements with the same number of valence electrons are kept together in groups, such as the halogens and the noble gases. The Periodic table can help predict the properties of various elements and the relations between properties. As a result, it provides a useful framework for the analyses of chemical behavior, and is widely used in chemistry and other sciences.

The Periodic table was created by Dmitri Mendeleev in 1869.

All elements from atomic numbers 1 (hydrogen) to 118 (ununoctium) have been synthesized. Of these, all up to and including californium exists naturally; the rest have only been artificially synthesized in laboratories, along with numerous synthetic radionuclides of naturally occurring elements.

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

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

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

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

**Ex.2 Answer the following questions.**

1. How are elements arranged in the Periodic table?

2. What can periodic table predict?

3. Does californium exist naturally?

4. What does the Periodic Law state?

5. Who developed the Periodic Table?

**Ex.3 Complete the sentences. Use in, at, on.**

1. Liquid is ……the flask.

2. You can fine the properties of chemical elements ……the periodic table.

3. She will come to the laboratory ……5.30.

4. The book about the properties of metals and nonmetals is…..the table.

5. We have our chemistry lesson at school ….Tuesday.

6. I will calculate the molecular mass of this chemical compound ….two minutes.

7. Look….the blackboard ! I am writing a chemical equation.

**Ex. 4 Correct the mistakes in the following sentences.**

1. Put the bottle with the explosive liquid at the table.

2. I don’t know the name of this chemical compound which is written in the blackboard.

3. There is nothing on this room.

4. You should send me your paper on my-email.

5. You can find the atomic number of this chemical element at the Periodic table.

6. This solution should be placed at the electrolytic cell.

7. This chemical reaction occurs in high temperature.

**Ex. 5 Put the questions to the bold-typed words.**

1. **The Periodic table** was created by **Dmitri Mendeleev** **in 1869.**

2. **The Periodic table** can help predict **the properties.**

3. **Isotopes** have only strengthened **the idea.**

4. **Yesterday** we studied **the Periodic Law.**

5. The **Periodic** table provides **useful** information.

6. **His confidence** was clearly expressed **in the predictions**.

7. **The Periodic Law** states **many interesting facts**.

**Ex. 6 Translate the following sentences into Russian or Kazakh.**

1.One of the cornerstones of modern chemical theory is  
the Periodic Law.

2. [Zwitterions](https://en.wikipedia.org/wiki/Zwitterion) contain an anionic centre and a cationic centre in the same [molecule](https://en.wikipedia.org/wiki/Molecule), but are not salts.

3. Aqueous solutions of salts can be also electrolyzed because they are also electrically conductive.

4. A molten salt is an example of something that may be electrolyzed because salts are composed of ions.

5. All elements from atomic numbers 1 (hydrogen) to 118 (ununoctium) have been synthesized.

6. [Hexane](https://en.wikipedia.org/wiki/Hexane) (C6H14) is also a widely used non-polar, non-aromatic solvent.

7. Salts are composed of [cations](https://en.wikipedia.org/wiki/Cation) (positively [charged](https://en.wikipedia.org/wiki/Electric_charge) ions) and [anions](https://en.wikipedia.org/wiki/Anion) (negative ions) so that the product is electrically [neutral](https://en.wikipedia.org/wiki/Electric_charge) (without a net charge).

8. Neutral salts are those that are neither acid nor basic salts.

**Ex.7 Read and translate the text.**

Blocks of the Periodic Table

The Periodic Table does more than just list the elements. The word periodic means that in each row, or period, there is a pattern of characteristics in the elements. This is because the elements are listed in part by their electron configuration. The Alkali metals and Alkaline earth metals have one and two valence electrons (electrons in the outer shell) respectively. These elements lose electrons to form bonds easily, and are thus very reactive. These elements are the s-block of the periodic table. The p-block, on the right, contains common non-metals such as chlorine and helium. The noble gases, in the column on the right, almost never react, since they have eight valence electrons, which makes it very stable. The halogens, directly to the left of the noble gases, readily gain electrons and react with metals. The s and p blocks make up the main-group elements, also known as representative elements. The d-block, which is the largest, consists of transition metals such as copper, iron, and gold. The f-block, on the bottom, contains rarer metals including uranium. Elements in the same Group or Family have the same configuration of valence electrons, making them behave in chemically similar ways.

Vocabulary notes

blocks of the Periodic Table – блоки периодической системы

just – просто

to list – называть

to mean – значить

each row – каждый ряд

pattern – образец

in part – частично

configuration – конфигурация, строение

alkali metal – щелочной металл

alkaline earth metal – щелочноземельный металл

outer shell – внешняя оболочка

respectively – соответственно

to lose – терять

to form – формировать

bond – связь

easily – легко

very reactive – хорошо вступающий в реакции

on the right – находящийся справа

to contain – содержать

common – обычный

non-metal – не металл

since – так как

to make – делать

stable – устойчивый

directly – прямо

to the left – слева

readily – легко, быстро, с готовностью

to gain – получать

to make up – составлять

main-group – главная группа

transition metal – переходный элемент

on the bottom – внизу, на дне

rare metal – редкий металл

to include – включать

the same – те же самые

to behave – проявлять себя, вести себя

similar – подобный

**Unit 15**

**Prepositions (Part 2)**

**During or for**

We use *during* to say when something happens, if it happens in or over a period of time. We use *for* to talk about the length of time something lasts.

Compare

|  |  |
| --- | --- |
| *They went to Florida* ***during*** *the winter.* | They went at one point in the winter. |
| *They went to Florida* ***for*** *the winter.* | They went from the beginning to the end of the winter. |

*She phoned me* ***during*** *the week to tell me that she was getting married.* (referring to a point in the week)

*We were in the cinema* ***for*** *three and a half hours.*

Not: … ~~during three and a half hours~~.

*Our flight to New York was delayed* ***for*** *seven hours.*

Not: … ~~during seven hours~~.

*We went to Italy* ***for*** *a week.*

Not: … ~~during a week~~.

We can also use *for* to refer to public holidays and seasons:

*He always goes to his mother’s house* ***for*** *New Year.*

Not: … ~~during New Year~~.

We use “during” to talk about an event or activity having little duration that happens within the same period of time, e.g.: During heating this reaction occurred more rapidly. - При нагревании эта реакция протекала быстро.

### Between

Between normally refers to something in the middle of two objects or things (or places).

There are mountains **between** Chile and Argentina.

### Over

We use it to talk about an event or activity that lasted for some period of time or for the whole of it e.g.: Over three years they have tried to obtain this mixture. In this case we can also use “during”.

We can use “over” to talk about the situations when one object is situated above other object. Катализатор располагали над подложкой. - Catalyst was placed over substrate.

**From:**

We use this preposition to talk about the source of originating a certain thing. Этот материал сделан из нержавеющей стали. - This material is made from stainless steel.

We use this preposition to talk about the emerging of some scientific objects. Эта смесь образовалась из аммиака. - This mixture is formed from ammonia.

We use this preposition to talk about time interval of an activity or distance. Синтез длился с двух до трех часов. - Synthesis lasted from 2 p.m. to 3 p.m.

We use “from” in the meaning of “as a result of”. For example: Это вещество образовалось в результате гидролиза. - This substance was formed as a result of (from) hydrolysis.

**Under:**

We use this preposition to talk about conditions the existence of which can cause certain scientific processes or phenomena. In scientific texts it can be used only with the word “conditions”. This process takes place under the conditions of high pressure. – Этот процесс протекает в высокотемпературных условиях.

### We use “under” when we talk about the low position of some object; when object is below other object. For example: We can find the book under the table. – Мы сможем найти книгу под столом.

**Through**

We use “through when we talk about the movement in three dimensional space.

For example: He pushed me through the crowd. – Он протолкнул меня через всю толпу.

We use it when we about the movement from one side of something to the other. For example: We passed this solution through a tube. – Мы пропустили этот раствор через трубку.

**By:**

We use by in passive constructions when we want to indicate the object or person with the help of which this action is done, e.g.: This substance was obtained by gas chromatography. - Это вещество получили при помощи газовой хроматографии.

We use “by” in the meaning of “according to”, e.g.: By this theory this substance should turn red. – Согласно этой теории это вещество должно стать красным.

We use by in the meaning of Russian preposition по. For example: По массе эти частицы превосходят фуллерены. - By mass these particles surpass fullerenes.

Vocabulary

dissociation − диссоциация

to dissociate − диссоциировать

to split into − расщепляться

a particle − частица

to separate − делиться

for instance − например

[heterolytic fission](https://en.wikipedia.org/wiki/Heterolytic_fission) − гетероциклический распад

the degree of dissociation (dissociation degree) − степень диссоциации

to give − давать

electronegative − электроотрицательный

a fraction − фракция

original − исходный

a solute − растворенное вещество

more accurately − более точнее

per mole − на моль

to be close to − приближаться

less powerful − менее сильный

lesser − меньший

[solvation](https://en.wikipedia.org/wiki/Solvation) − сольватация

like − как

to mean − означать

separation − разделение

to recover − восстанавливать

medium (pl.media) − среда

electrically conductive medium − электропроводная среда

en electrolyte − электролит

whereas − тогда как

a weak electrolyte −слабый электролит

a strong electrolyte − сильный электролит

a free ion − свободный ион

acetic acid − ацетоновая кислота

[ammonium](https://en.wikipedia.org/wiki/Ammonium) − аммоний

very soluble − хорошо растворимый

the strength of an electrolyte − сила электролита

to last − длиться

to place − располагать, помещать

a substrate − подложка

alkali − щелочь

**Ex. Read and translate the text**

**Dissociation**

Dissociation in [chemistry](https://en.wikipedia.org/wiki/Chemistry) is a process in which molecules (or ionic compounds such as [salts](https://en.wikipedia.org/wiki/Salt_%28chemistry%29), or [complexes](https://en.wikipedia.org/wiki/Complex_%28chemistry%29)) separate or split into smaller particles such as atoms, ions or [radicals](https://en.wikipedia.org/wiki/Radical_%28chemistry%29). For instance, when an [acid](https://en.wikipedia.org/wiki/Acid) dissolves in water, a [covalent](https://en.wikipedia.org/wiki/Covalent) bond between an [electronegative](https://en.wikipedia.org/wiki/Electronegative) atom and a hydrogen atom is broken by [heterolytic fission](https://en.wikipedia.org/wiki/Heterolytic_fission), which gives a proton (H+) and a negative [ion](https://en.wikipedia.org/wiki/Ion). The dissociation degree is the fraction of original solute molecules that have dissociated. It is usually indicated by the Greek symbol α. More accurately, degree of dissociation is the amount of solute which dissociated into ions or radicals per mole. In case of very strong acids and bases, degree of dissociation will be close to 1. Less powerful acids and bases will have lesser the degree of dissociation. The dissociation of salts by [solvation](https://en.wikipedia.org/wiki/Solvation) in a [solution](https://en.wikipedia.org/wiki/Solution) like [water](https://en.wikipedia.org/wiki/Water_%28molecule%29) means the separation of the [anions](https://en.wikipedia.org/wiki/Anion) and [cations](https://en.wikipedia.org/wiki/Cation). The salt can be recovered by the [evaporation](https://en.wikipedia.org/wiki/Evaporation) of the solvent. An electrolyte is a substance that contains free ions and can be used as an electrically conductive medium. Most of the solute does not dissociate in a weak electrolyte whereas in a strong electrolyte a higher ratio of solute dissociates to form free ions.

A weak electrolyte is a substance whose solute exists in solution mostly in the form of molecule. [Acetic acid](https://en.wikipedia.org/wiki/Acetic_acid) (CH3COOH) and [ammonium](https://en.wikipedia.org/wiki/Ammonium) (NH4+) are good examples. Acetic acid is very soluble in water. A strong electrolyte is a solute that exists in solution completely or nearly completely as ions. Again, the strength of an electrolyte is defined as the percentage of solute.

**Ex.2 Answer the questions.**

1.What is dissociation?

2.What is degree of dissociation?

3.How do we indicate degree of dissociation?

4. Is Acetic acid soluble in water?

5.Does solute dissociate in a weak electrolyte ?

**Ex. 3 Complete the sentence. Use the prepositions: during, for, under, over, at.**

1.This experiment lasted …. three days.

2. This substance was formed ….. dissociation.

3. The substance was placed …..substrate.

4. This process takes place …..the conditions of high temperature.

5. …. the experiment we could obtain new substances.

6. I have obtained this mixture ….high pressure.

7. We studied these substance ….three days.

**Ex.4 Complete the sentences. Use the prepositions: from, by, through, between**

1. These bonds are formed ….. these molecules.

2. I was doing this experiment …..2 p.m. to 3 p.m.

3. I will try to pass this solute …..acidic medium.

4. We have obtained this substance ….dissociation.

5. This experiment was done….by me.

6. …..this this theory we should obtain the high concentration of this substance.

7. What is the difference ….. a positive charge and a negative charge?

**Ex. 5 Put the questions to the bold-typed words.**

1.The strength of **an electrolyte** is defined as **the percentage of solute.**

2. **A** [negative sign](https://en.wikipedia.org/wiki/Plus_and_minus_signs) indicates **the reactant concentration.**

3. **Salts** don’t dissociate **in water.**

4. **Acetic acid** doesn’t react with **alkali.**

5. **The salt** can be recovered **by** [evaporation](https://en.wikipedia.org/wiki/Evaporation).

6. **This solution** contains **dissolved** salts.

7. **We** have used **methane** **in this process**.

**Ex. 6 Translate the following sentences into Russian or Kazakh.**

1. Most of the solute does not dissociate in a weak electrolyte.

2. Less powerful acids and bases will have lesser the degree of dissociation.

3. Acetic acid is very soluble in water.

4. A strong electrolyte is a solute that exists in solution completely or nearly completely as ions.

5. The dissociation degree is the fraction of original solute molecules.

6. [Chemical kinetics](https://en.wikipedia.org/wiki/Chemical_kinetics) is the part of [physical chemistry](https://en.wikipedia.org/wiki/Physical_chemistry) that studies reaction rates.

7. We could obtain this compound with the help of neutralization reaction.

8. An electrolyte is a substance that contains free ions.

**Ex. 7 Read and translate the text.**

**Oxygen**

Oxygen is a [chemical element](http://en.wikipedia.org/wiki/Chemical_element) with symbol O and [atomic number](http://en.wikipedia.org/wiki/Atomic_number) 8. It is a member of the [chalcogen](http://en.wikipedia.org/wiki/Chalcogen) [group](http://en.wikipedia.org/wiki/Group_%28periodic_table%29) on the [Periodic table](http://en.wikipedia.org/wiki/Periodic_table) and is a highly [reactive](http://en.wikipedia.org/wiki/Chemical_reaction) [nonmetallic](http://en.wikipedia.org/wiki/Nonmetal) element and [oxidizing agent](http://en.wikipedia.org/wiki/Oxidizing_agent) that readily forms [compounds](http://en.wikipedia.org/wiki/Chemical_compound) (notably [oxides](http://en.wikipedia.org/wiki/Oxide)) with most elements. Oxygen is the [third-most abundant](http://en.wikipedia.org/wiki/Abundance_of_the_chemical_elements) element in the universe, after [hydrogen](http://en.wikipedia.org/wiki/Hydrogen) and [helium](http://en.wikipedia.org/wiki/Helium)[.](http://en.wikipedia.org/wiki/Oxygen#cite_note-NBB297-2) Oxygen is colorless, odorless, and tasteless; with the formula O2.

Many classes of organic molecules in living organisms, such as [proteins](http://en.wikipedia.org/wiki/Protein), [nucleic acids](http://en.wikipedia.org/wiki/Nucleic_acid), [carbohydrates](http://en.wikipedia.org/wiki/Carbohydrate), and [fats](http://en.wikipedia.org/wiki/Fat) contain oxygen. Oxygen is toxic to  [anaerobic organisms](http://en.wikipedia.org/wiki/Obligate_anaerobe). Oxygen is the [most abundant](http://en.wikipedia.org/wiki/Abundances_of_the_elements_%28data_page%29) element by mass in the [Earth's crust](http://en.wikipedia.org/wiki/Crust_%28geology%29#Earth.27s_crust).

Ozone is produced in the [upper atmosphere](http://en.wikipedia.org/wiki/Upper_atmosphere) when O2 combines with atomic oxygen. Atomic oxygen is made when [ultraviolet](http://en.wikipedia.org/wiki/Ultraviolet) (UV) radiation splits O2. [Oxygen is produced industrially](http://en.wikipedia.org/wiki/Oxygen#Industrial_production) by the [fractional distillation](http://en.wikipedia.org/wiki/Fractional_distillation) of liquefied air, the [electrolysis of water](http://en.wikipedia.org/wiki/Electrolysis_of_water). Oxygen is more [soluble](http://en.wikipedia.org/wiki/Solubility) in water than nitrogen. Water in equilibrium with air contains approximately 1 molecule of dissolved O2 for every 2 molecules of N2, compared to an atmospheric ratio of approximately 1:4. The solubility of oxygen in water depends on temperature. Oxygen condenses at 90.20 [K](http://en.wikipedia.org/wiki/Kelvin) (−182.95 °C, −297.31 °F), and freezes at 54.36 K (−218.79 °C, −361.82 °F).

Oxygen was discovered independently by [Carl Wilhelm Scheele](http://en.wikipedia.org/wiki/Carl_Wilhelm_Scheele), in [Uppsala](http://en.wikipedia.org/wiki/Uppsala), in 1773. The name oxygen was coined in 1777 by [Antoine Lavoisier](http://en.wikipedia.org/wiki/Antoine_Lavoisier).

Vocabulary notes

oxygen − кислород

a member − член

[chalcogen](http://en.wikipedia.org/wiki/Chalcogen) [group](http://en.wikipedia.org/wiki/Group_%28periodic_table%29) − халькогенная группа

reactive − реакционноспособный

highly − весьма

an oxidizing agent −окислитель

abundant − распространенный

hydrogen − водород

helium − гелий

tasteless − без вкуса

the universe − вселенная

a protein − белок

a fat − жир

a carbohydrate −углевод

a nucleic acid − нуклеиновая кислота

anaerobic organisms − анаэробные организмы

the [Earth's crust](http://en.wikipedia.org/wiki/Crust_%28geology%29#Earth.27s_crust) − земная кора

ozone − озон

to combine − соединяться

atomic oxygen − атомарный кислород

the [upper atmosphere](http://en.wikipedia.org/wiki/Upper_atmosphere) − верхний слой атомосферы

[ultraviolet](http://en.wikipedia.org/wiki/Ultraviolet) (UV) radiation − ультрафиолетовое излучение

to produce industrially − получать на производстве

[fractional distillation](http://en.wikipedia.org/wiki/Fractional_distillation) − фракционная перегонка

liquefied air − сжиженный воздух

nitrogen − азот

equilibrium − равновесие

approximately − примерно

compared to − по сравнению с

solubility − растворимость

to depend on − зависеть от

to condense − конденсироваться

to freeze − замерзать

to coin − заимствовать

**Texts for additional reading**

**Organic compounds of carbon**

Alcohols are organic compounds. They contain -OH group. Examples of alcohols are methanol, CH3OH, ethanol C2H2OH.

Primary alcohols have two hydrogen atoms on the carbon atom. Secondary alcohols have one hydrogen on this carbon atom. Tertiary alcohols have no hydrogen on this carbon atom. The different types of alcohols differ in the way they react chemically. For example the following reactions occur with potassium dichromate (VI):

primary alcohol → aldehyde → carboxylic acid

secondary alcohols → ketone

tertiary alcohol - no reaction.

Other characteristics of alcohols are reactions with acids. These reactions give esters. The reaction of dehydration gives alkenes or ethers. Alcohols which have two -OH groups are diols. Alcohols which three –OH groups are triols. Aldehydes are organic compounds. They contain the group -CHO. Examples of aldehydes are methanol , HCOH, and ethanal, CH3CHO. The oxidation of primary alcohols forms aldehydes . The further oxidation causes the formation of carboxylic acids. They are reducing agents. With sodium hydrogensulphate (IV) they form addition compounds of the type [RCOH(SO3)H]-. They also form addition compounds with hydrogen cyanide and give cyanohydrins and undergo condensation reactions.

Methane is acolourless odourless gas, CH4; m.p. is -182.5°C; b.p. is -164°C. Methane is the simplest hydrocarbon. It is 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. Chemists can convert it into methanol by catalytic oxidation.

Vocabulary notes

carbon − углерод

an organic compound − органическое соединение

alcohol − спирт

primary − первичный

tertiary − третичный

secondary − вторичный

potassium dichromate − дихромат калия

ester − сложный эфир

methanol − метанол

ethanol − этанол

to differ in the way one reacts chemically − отличаться по способу реагирования

dehydration − дегидратация

alkenes − алкены

ether − эфир

aldehyde − альдегид

carboxylic acid − карбоновая кислота

oxidation − окисление

to cause − вызывать

reducing agent − восстановитель

sodium hydrogensulphate − гидросульфат натрия

formation − образование

addition compounds − добавочные соединения

hydrogen cyanide − цианистый водород

cyanohydrins − цианогидриды

methane − метан

m.p. (melting point) − точка плавления

b.p. (boiling point) − точка кипения

hydrocarbon − углеводород

alkane series − ряд алкенов

main constituent − основная компонент

natural gas − природный газ

raw material − сырье

to convert into − превратить

conversion − превращение

catalytic oxidation − каталитическое окисление

**Laboratory**

The laboratory is a place where the students and research assistants of the chemical faculty carry out different experiments. Modern laboratories of organic chemistry, inorganic chemistry, analytical chemistry, physical chemistry, colloidal chemistry, and electrochemistry have running water and gas. Every chemical laboratory has a ventilating hood for the escape of harmful odours and vapors. Every laboratory has lightening and different types of equipment.

All chemical laboratories have benches. These benches have a lot of drawers. Chemists keep their materials and devices in these drawers. Chemical laboratories also have many shelves and cases. Chemists keep their containers with chemicals in these cases. Flasks, weighing bottles, test-tubes, beakers, funnels, evaporating dishes are on the benches.

Chemists keep their glassware in good order. Some chemical laboratories, for example of the laboratories of physical chemistry have a microscope. Chemists use this device when they need to describe the properties of a substance or define what substances they obtained after experiment.

There are many burners in the chemical laboratory, for example Bunsen burner. Chemists use burners when they need to produce flame. Chemists use crucibles. They use crucibles when they need to heat a solution, ignite materials. People make crucibles of quartz, porcelain and iron. Also I know platinum crucibles. Chemists use platinum crucibles very seldom.

Vocabulary notes

a laboratory − лаборатория

a research assistant − научный сотрудник

to carry out − проводить

a ventilating hood − тяга

the escape of harmful odours and vapors − выход вредных запахов и паров

lightening − освещение

running water − водопровод

equipment − оборудование

a bench − лабораторный стол

a drawer − ящик

to keep − хранить

a device − прибор

a container − сосуд, емкость

a chemical − химическое вещество (химикат)

a case − шкаф

a flask − колба

weighing bottles − стаканчики для взвешивания

a test-tube − пробирка

a beaker − мензурка

a funnel − воронка

glassware − стеклянная посуда

to keep smth in a good order − хранить что-то в идеальном порядке

to describe − описывать

to define − определять

a property − свойство

a burner − горелка

Bunsen burner − горелка Бунзена

to heat a solution − разогревать раствор

quartz − кварц

iron − железо

**Chlorine**

Chlorine is a chemical element that is a greenish-yellow gas at ordinary temperature and pressure. The gas is poisonous and has a strong odour. It is about two and one-half times as heavy as air.

Chlorine is not found free in nature. It is commonly found in combination with sodium. It forms sodium chloride (common salt). Chlorine is the most abundant member of the halogen family of chemical elements.

Most chlorine is produced commercially by the passing of an electric current through a solution of water and sodium chloride. This process, which is called electrolysis, is carried out in a container which is called an electrolytic cell. The electric current decomposes the solution and produce chlorine and sodium hydroxide (caustic soda).

Chlorine is used in many industrial processes and in the manufacture of many different products. It is widely used in the purification of drinking water and in the treatment of sewage. It is also used in the bleaching of paper and other products and in the separation of such metals as copper, lead, zinc, nickel, and gold from their ores. Important chlorine compounds include hydrochloric acid, sodium hypochlorite, and zinc chloride.

Chlorine was first isolated by the Swedish chemist Karl Scheele in 1774. Sir Humphry Davy identified it as a distinct chemical element in 1810.

The symbol of chlorine is Cl. Its atomic number is 17. Its atomic weight is 35.453. The melting point of chlorine is -149.8 F. (-101.0 C.). Its boiling point is -30.5 F. (-34.7 C.). Chlorine has specific gravity of : gas, 2.49 (air = 1); liquid, 1.56 (water = 1). Chlorine belongs to Group VIIA of the Periodic Table and can have a valence of -1, +1, 3, 5, or 7. There are two stable isotopes: Cl-35 and Cl-37.

Vocabulary notes

chlorine − хлор

poisonous − ядовитый

a strong odour − сильный запах

heavy − тяжелый

sodium chloride − хлорид натрия

common salt − поваренная соль

to be produced commercially − получать на производстве

passing − пропускание

an electric current − электрический ток

through − через

electrolysis −электролиз

an electrolytic cell − электролитическая ячейка

to decompose − разлагать

manufacture − производство

purification − очистка

treatment − обработка

sewage − сточные воды

bleaching − отбеливание

to use − использовать

copper − медь

lead − свинец

zinc − цинк

nickel − никель

gold − золото

ore − руда

hydrochloric acid − соляная кислота

sodium hypochlorite − гипохлорит натрия

zinc chloride − хлорид цинка

a liquid − жидкость

to isolate − получать в чистом виде

to identify − выделить

to belong to − принадлежать

atomic number − атомный номер

specific gravity − удельный вес

atomic weight − атомный вес

boiling point (b.p.) − температура кипения

melting point (m.p.) − температура плавления

to belong to − принадлежать

**Lithium**

Lithium is a silver-white metallic chemical element. Lithium is the lightest metal and the third lightest of all the elements. Lithium is softer than lead and it is ductile. It is a good conductor of electricity, and can combine with many other metals to form alloys. When we expose it to air lithium tarnishes rapidly. It is therefore stored under gasoline and kerosene, or in airtight containers. At high temperatures lithium is capable of absorbing gases. We use lithium to remove oxygen and other gases in the manufacture of stainless steel, copper and copper alloys. The addition of the small percentage of lithium increases the strength of aluminum alloys, lead and tin. Lithium-magnesium alloys have numerous industrial and structural uses.

Lithium is irradiated with neutrons to produce tritium, a radioactive isotope of hydrogen which is widely used in medicine. Lithium bromide and lithium chloride readily absorb moisture and are used in air conditioners and dry cell batteries.

The element was discovered in 1817 by the Swedish chemist Johan A. Arfvedson. It is widely distributed in the earth’s crust. Lithium compounds are obtained from the ores by various chemical processes. The metal is usually obtained by electrolysis of lithium chloride.

Lithium carbonate is used in the treatment of maniac-depressive illnesses. The chief ores of lithium are spodumene and petalite, two minerals which are composed of lithium, aluminum, silicon and oxygen, and amblygonite, a mineral which is composed of lithium, aluminum, fluorine, phosphorus and oxygen.

The symbol of lithium is Li. The atomic number of lithium is 3. Its atomic weight is 6.941. Lithium has melting point of 356 F. (180 C.). Lithium has boiling point of 2,457 F. (1,347 C.). The specific gravity of the element is 0.53. Lithium has two stable isotopes: Li-6 and Li-7. It belongs to Group I-A of the Periodic Table and has a valence of +1.

Vocabulary notes

lithium − литий

silver-white − серебристо-белый

light − легкий

ductile − пластичный

to combine with − соединяться

an alloy − сплав

to expose − подвергать воздействию

to tarnish − тускнеть

rapidly − быстро

to store − хранить

gasoline − бензин

airtight containers − герметичные контейнеры

to capable of − способен

to absorb −поглощать

under − под

to remove − удалять

oxygen − кислород

stainless steel − нержавеющая сталь

copper alloys − медные сплавы

addition − добавление

to increase − увеличивать

strength − прочность

tin − олово

aluminum alloys − алюминиевые сплавы

lithium-magnesium alloys − литиево-магниевые сплавы

to have numerous industrial and structural uses − использоваться во многих промышленных сферах и строительстве

to irradiate with − облучать

neutron − нейтрон

tritium − тритий

a radioactive isotope − радиоактивный изотоп

lithium bromide − бромид лития

lithium chloride − хлорид лития

readily − легко

moisture − влага

dry cell batteries − сухие электрические батареи

to discover − обнаруживать

to be widely distributed − быть широко распространенным

the earth’s crust − земная кора

lithium carbonate − карбонат лития

treatment − лечение

spodumene − сподумен

petalite − петалит

to be composed of − состоять из

silicon − кремний

fluorine − фтор

phosphorus − фосфор

amblygonite − амблигонит

The Tyndall Effect

The Tyndall effect distinguishes colloids from solutions. In a solution, the particles are so fine that they will not scatter light. This is not true for a colloid. If you shine light through a solution, we will not see the beam of light. We will see it in a colloid. For instance, if you have ever played with a laser pointer, you have seen the Tyndall effect. You cannot see the laser beam in air (a solution), but if you shine it into a mist (a colloid, or suspension, actually), the beam is visible. Clouds look white (or gray), as opposed to blue, because of the Tyndall effect - the light is scattered by the small droplets of suspended water.

Vocabulary notes

the Tyndall еffect – эффект Тиндаля

to distinguish – различить

fine – мелкий, ясный

to scatter – разбрасывать

light – свет

true – правильно, действительно

to shine – светить

through – через

a beam – луч

visible – видимый

a laser pointer – лазерная указка

a laser beam – лазерный луч

air – воздух

mist – туман

actually – действительно

a cloud – облако

opposed – противоположный

to scatter – разбрасывать, рассеивать

a droplet – капелька

suspended water – суспензированная (взвешенная) вода

**Hydrogen**

Hydrogen is a [chemical element](http://en.wikipedia.org/wiki/Chemical_element). Its [chemical symbol](http://en.wikipedia.org/wiki/Chemical_symbol) is H. Its [atomic number](http://en.wikipedia.org/wiki/Atomic_number)  is 1. Its [atomic weight](http://en.wikipedia.org/wiki/Atomic_weight) is 1.00794 [u](http://en.wikipedia.org/wiki/Atomic_mass_unit). Hydrogen is a light element in the [periodic table](http://en.wikipedia.org/wiki/Periodic_table). Hydrogen is a very [abundant](http://en.wikipedia.org/wiki/Abundance_of_the_chemical_elements) chemical element in the universe. Hydrogen has one isotope. Its boiling point is 20 271 K. Its melting point is 13.99 K.

At [standard temperature and pressure](http://en.wikipedia.org/wiki/Standard_temperature_and_pressure), hydrogen is a [colorless](http://en.wikipedia.org/wiki/Transparency_%28optics%29), [odorless](http://en.wikipedia.org/wiki/Odorless), [tasteless](http://en.wikipedia.org/wiki/Taste), non-toxic, [nonmetallic](http://en.wikipedia.org/wiki/Nonmetal) [diatomic](http://en.wikipedia.org/wiki/Diatomic_molecule) [gas](http://en.wikipedia.org/wiki/Gas). Its [molecular formula](http://en.wikipedia.org/wiki/Molecular_formula) is H2. Hydrogen readily forms [covalent](http://en.wikipedia.org/wiki/Covalent_bond) compounds with many [non-metallic](http://en.wikipedia.org/wiki/Nonmetal) elements. Hydrogen exists in the Earth in the form of water or [organic compounds](http://en.wikipedia.org/wiki/Organic_compound). Hydrogen plays an important role in [the reactions](http://en.wikipedia.org/wiki/Acid%E2%80%93base_reaction) between acids and bases. In [ionic compounds](http://en.wikipedia.org/wiki/Ionic_compound), hydrogen has a form of a negative charge. Chemists call it a [hydride](http://en.wikipedia.org/wiki/Hydride). Hydrogen cations in [ionic compounds](http://en.wikipedia.org/wiki/Ionic_compound) have always very complex forms. Hydrogen forms compounds with many elements.

Henry Cavendish obtained hydrogen gas in the 16th century. He mixed metals with acids. He also discovered that hydrogen produces water when it burns. In industry people produce hydrogen with the help of the reforming of natural gas. People use hydrogen when they want to obtain ammonia. Also hydrogen gas forms an explosive liquid in the air. People also use electrolysis of water in the production of hydrogen.

Vocabulary notes

hydrogen − водород

the universe − вселенная

[odorless](http://en.wikipedia.org/wiki/Odorless) − без запаха

[tasteless](http://en.wikipedia.org/wiki/Taste) − без вкуса

[diatomic](http://en.wikipedia.org/wiki/Diatomic_molecule) [gas](http://en.wikipedia.org/wiki/Gas) − двухатомный газ

a base − основание

a negative charge − отрицательный заряд

a [hydride](http://en.wikipedia.org/wiki/Hydride) − гидрид

complex forms сложные формы

to mix − смешивать

to burn − гореть

to produce − образовывать

reforming − реформинг

natural gas − природный газ

an explosive liquid − взрывчатая жидкость

ammonia −аммиак

production − получение

**Silicon dioxide**

Silicon dioxide is a [chemical compound](http://en.wikipedia.org/wiki/Chemical_compound). It is an [oxide](http://en.wikipedia.org/wiki/Oxide) of [silicon](http://en.wikipedia.org/wiki/Silicon). Its [chemical formula](http://en.wikipedia.org/wiki/Chemical_formula) is [Si](http://en.wikipedia.org/wiki/Silicon)[O](http://en.wikipedia.org/wiki/Oxygen)2. People knew about silicon dioxide in ancient times. People usually find silicon dioxide in nature. They find it in nature in the form of [quartz](http://en.wikipedia.org/wiki/Quartz). Silicon dioxide is present in different living organisms. Silicon dioxide is a very complex and abundant material. People produce silicon dioxide synthetically. People also produce silicon dioxide with the help of the processing of quartz. The examples of silicon dioxide include [crystal](http://en.wikipedia.org/wiki/Crystal)s and [aerogels](http://en.wikipedia.org/wiki/Aerogel). People use silicon dioxide in microelectronics and food industry. People also obtain silicon dioxide with the help of mining. Then they purify the mineral which they mined. The Earth’s crust contains 10 % of quartz.

Pyrogenic silica is a [colloidal](http://en.wikipedia.org/wiki/Colloid) form of silicon dioxide. Chemists prepare it with the help of the burning of [SiCl4](http://en.wikipedia.org/wiki/Silicon_tetrachloride) in the hydrocarbon flame. At the end of this reaction chemists obtain a "smoke" of SiO2.

People use silicon dioxide in the production of glass. People use silicon dioxide when they produce windows, bottles. Silicon dioxide has many crystalline and amorphous forms. Films of silicon dioxide grow very fast. Chemists grow these films with the help of thermal oxidation. When they use thermal oxidation they obtain a very thin layer. Engineers use this layer in microelectronics. In microelectronics this layer plays the role of an insulator. Silicon dioxide is also present in the sand. In medicine people use silicon dioxide in the preparation of tablets.

Vocabulary notes

silicon dioxide − диоксид кремния

ancient times − древние времена

to be present − присутствовать

to produce − получать синтетическим путем

[crystal](http://en.wikipedia.org/wiki/Crystal)s − кристаллы

[aerogels](http://en.wikipedia.org/wiki/Aerogel) − аэрогели

food industry − пищевая промышленность

mining − добыча месторождений полезных ископаемых

to purify − очищать

to mine −добывать

the Earth’s crust − земная кора

pyrogenic silica − коллоидальная двуокись кремния, пирогенный кремнезем

a [colloidal](http://en.wikipedia.org/wiki/Colloid) form − коллоидная форма

to prepare − приготовить

burning − горение, сжигание

a hydrocarbon flame − углеводородное пламя

glass − стекло

crystalline − кристаллический

amorphous − аморфный

a film − пленка

to grow − расти

fast − быстро

thermal oxidation − термическое окисление

a thin layer − тонкий слой

an insulator − изоляционный материал

sand − песок

## Bismuth

Bismuth is a metallic chemical element. It is brittle, has a high luster, and is greyish-white with a red or pink tinge. Bismuth is relatively inactive chemically at normal temperatures, but when bismuth is heated in air it burns. It is soluble in strong acids such as aqua regia and nitric acid. Bismuth combines directly with fluorine and the other halogen elements, as well as with sulfur and selenium.

Bismuth has some unusual physical properties. It is one of only two elements that expands upon solidifying. Except for mercury, bismuth is the poorest heat conductor of all the metals. Bismuth’s electrical resistance increases in a magnetic field. This property is greater in bismuth than in other metals.

Bismuth occurs in nature as a free metal, but is more common in ores that contain other elements. The principal ores are bismite (Bi2O3) and bismuthinite (Bi2S3). Most bismuth is recovered as a by-product from the mining of lead, copper, tin and zinc. The leading producers of bismuth are Mexico, China, Peru, Australia and Japan.

Bismuth in impure form was known to the alchemists of the Middle Ages. It was first identified as a separate element in 1753 by Claude Franois Geoffroy, a French chemist.

Bismuth is used chiefly to make low-melting point alloys. These alloys are used in electrical fuses and water- heater safety valves, and also in fire detectors and automatic sprinkler systems. Bismuth is sometimes added to alloys of iron, steel and aluminum to improve the machining qualities of these alloys. Other uses of bismuth are in drugs, cosmetics, glass and ceramics.

The symbol of bismuth is Bi. Its atomic number is 83. Its atomic weight is 208.9804. Bismuth has melting point of 520.34 F. (271.3 C.). Bismuth has boiling point of 2,840 F. (1,560 C.). The specific gravity of bismuth is 9.8. It belongs to Group VA of the Periodic Table and may have a valence of +3 or +5. Several radioactive isotopes of bismuth are known. Only one isotope, Bi-209, is stable.

Vocabulary notes

bismuth − висмут

a luster − блеск

a high luster − сильный блеск

aqua regia − царская водка

fluorine − фтор

sulfur −сера

selenium − селен

as well as − также

to expand − расширяться, увеличиваться

upon solidifying − при затвердевании

except for − за исключением

mercury − ртуть

a heat conductor − теплопроводник

electrical resistance − электрическое сопротивление

to increase − увеличиваться

a magnetic field − магнитное поле

bismite − висмутовая охра

bismuthinite − бисмутинит

to recover − получать, восстанавливать

a by-product − побочный продукт

impure form − не чистая форма

the Middle Ages − средневековье

a separate element − отдельный элемент

low-melting point alloys − легкоплавкие сплавы

electrical fuses − электрические предохранители

water- heater safety valves − предохранительные клапаны водонагревателей

fire detectors − пожарные извещатели

automatic sprinkler systems − автоматические противопожарные системы

steel − сталь

to improve − улучшать

machining qualities − качество обработки на станке

* + 1. Heterogeneous Mixtures

A **heterogeneous mixture** is not uniform. Different samples may have different compositions, like the example of chocolate chip ice cream. Concrete, soil, blood, and salad are all examples of heterogeneous mixtures.

Suspensions

When sand gets kicked up in a pond, it clouds the water. Soon the sand settles down, and is no longer mixed into the water. This is an example of a **suspension**. Suspensions are heterogeneous mixtures that will eventually settle. They are usually, but not necessarily, composed of phases in different states of matter. Italian salad dressing has three phases: the water, the oil, and the small pieces of seasoning. The seasonings are solids that will sink to the bottom, and the oil and water are liquids that will separate.

Vocabulary notes

Sand - песок

to kick up – поднять (пыль)

cloud - облако

to settle down – оседать (на дно)

is no longer - больше не

to mix - смешать

heterogeneous mixture – неоднородная смесь

eventually – в конечном счете

to settle - установить

necessarily - обязательно

to compose - составлять

different - разный

dressing – заправка, приправа

state of matter – состояние вещества

oil -масло

piece of seasoning – немного приправы

solid -твердый

to sink - тонуть

bottom - дно

liquid - жидкий

to separate – отделять

a mixture − смесь

heterogeneous − гомогенный

a suspension − взвесь, суспензия

## Cobalt

Cobalt is a metallic element of the iron group. It resembles iron in appearance, but has a slight reddish tinge. Cobalt is harder than iron, but melts at a lower temperature and this element is somewhat heavier. Acids dissolve cobalt.

Cobalt is very resistant to corrosion and wear, even at high temperatures. Cobalt is alloyed with chromium and tungsten, and it is used in the making of high-speed cutting tools. Cobalt has magnetic properties that make it suitable for alloys which are used to make strong permanent magnets. An important example is alnico, an alloy which contains aluminum, nickel, iron and cobalt.

Cobalt is required in tiny amounts for proper nutrition. This element forms an essential part of Vitamin B 12. Cobalt 60, a radioactive isotope, is used as a commercial source of high - energy radiation.

Cobalt was discovered by Georg Brandt, a Swedish chemist, in about 1735. Cobalt is not found in a pure state in nature, but it often occurs with nickel, copper or iron. Most cobalt is obtained as a by-product in the smelting of nickel or copper ores.

Russia, Australia, Zambia, and Canada are the leading producers of cobalt. A variety of metallurgical processes are used to recover the cobalt, depending on the type of ore.

Various compounds of cobalt are used as pigments in pottery, glass, enamels and paints.

One of the best known is cobalt blue, a bluish-green compound of aluminum and cobalt oxide that has been long used in pottery. Some cobalt compounds are used as driers, substances that promote drying in paints, varnishes and printing inks.

The symbol of cobalt is Co. The atomic number of cobalt is 27. Its atomic weight is 58.9332. Its melting point is 2,723 F. (1,495 C.). Cobalt has boiling point of 5,198 F. (2,870 C.). Its specific gravity is of 8.9. It belongs to Group VIII of the Periodic Table and has a valence of +2 or +3.

Vocabulary notes

cobalt − кобальт

to resemble − быть похожим

a slight reddish tinge − легкий рыжеватый оттенок

to be resistant to corrosion and wear − устойчивый к коррозии и износу

to be alloyed with − легировать

chromium − хром

tungsten − вольфрам

making − изготовление

high-speed cutting tools − высоко скоростные режущие инструменты

to be suitable for − быть пригодным для

permanent magnets − постоянные магниты

strong − сильный, мощный, прочный

alnico − альнико

nickel − никель

to be required for − требоваться для

a proper nutrition − правильное питание

essential − важный

commercial source − промышленный источник

high - energy radiation − излучение высокой энергии

a pure state − в чистой форме

copper − медь

to occur − встречаться, происходить

a by-product − побочный продукт

smelting − плавка

a variety of − разнообразный

depending on − в зависимости

a pigment − пигмент

various − разнообразный

pottery − фаянсовая посуда

enamels − эмаль

paints − краски

cobalt blue − кобальтовая синева

a drier − сушильный агент

to promote − способствовать

drying − высыхание

a varnish − лак

printing ink − типографические чернила

**Fluorine**

Fluorine is a [chemical element](http://en.wikipedia.org/wiki/Chemical_element) with symbol F**.** Its [atomic number](http://en.wikipedia.org/wiki/Atomic_number) is 9. It is a light [halogen](http://en.wikipedia.org/wiki/Halogen). Fluorine exists as a toxic pale yellow [diatomic](http://en.wikipedia.org/wiki/Diatomic_molecule) gas at [standard conditions](http://en.wikipedia.org/wiki/Standard_conditions_for_temperature_and_pressure). It is a very [electronegative](http://en.wikipedia.org/wiki/Electronegativity) element. It is very reactive. Fluorine forms compounds with many elements and some noble gases. Fluorine is a very abundant element.

[Fluorite](http://en.wikipedia.org/wiki/Fluorite) is the primary mineral source of fluorine. French chemist [Henri Moissan](http://en.wikipedia.org/wiki/Henri_Moissan) isolated elemental fluorine with the help of a low-temperature [electrolysis](http://en.wikipedia.org/wiki/Electrolysis). Chemists use this process in the modern production. Also chemists use industrial synthesis of fluorine gas for the enrichment of uranium.

The refining of pure fluorine is a very expensive process. So many chemists in industry use its compounds. Chemists use fluorine in the production of steel. They use only the half of fluorine in these processes.

Chemists convert the rest part of fluorine into [hydrogen fluoride](http://en.wikipedia.org/wiki/Hydrogen_fluoride), various organic fluorides, or into [cryolite](http://en.wikipedia.org/wiki/Cryolite). Cryolite plays a key role in [aluminum refining](http://en.wikipedia.org/wiki/Hall%E2%80%93H%C3%A9roult_process). Organic fluorides have very high chemical and thermal stabilities. Chemists use them in the production of refrigerators and insulation materials, in the production of toothpaste. The medicines such as [atorvastatin](http://en.wikipedia.org/wiki/Atorvastatin) and [fluoxetine](http://en.wikipedia.org/wiki/Fluoxetine) also contain fluorine.

[Fluorocarbon](http://en.wikipedia.org/wiki/Fluorocarbon) gases are [greenhouse gases](http://en.wikipedia.org/wiki/Greenhouse_gas). [Organic fluorine compounds](http://en.wikipedia.org/wiki/Organofluorine_compound) influence the health of people. Fluorine does metabolic function in mammals. Fluorine atoms have nine electrons. The first ionization energy of fluorine is very high. Fluorine has two solid forms: α- and β-fluorine. Only one isotope of fluorine occurs in nature: 19F.

Vocabulary notes

fluorine − фтор

pale yellow − бледно желтый

fluorite − флюорит

low-temperature [electrolysis](http://en.wikipedia.org/wiki/Electrolysis) − низкотемпературный электролиз

industrial synthesis − промышленный синтез

fluorine gas − фтористый газ

enrichment − обогащение

uranium − уран

refining − очистка

[hydrogen fluoride](http://en.wikipedia.org/wiki/Hydrogen_fluoride) − фтороводород

fluoride − фторид

[cryolite](http://en.wikipedia.org/wiki/Cryolite) − криолит

chemical stability − химическая устойчивость

thermal stability − термостойкость

a refrigerator − холодильник

greenhouse gas − тепличный газ

to influence − влиять

solid forms − твердые формы

[atorvastatin](http://en.wikipedia.org/wiki/Atorvastatin) − атровастатин

[fluoxetine](http://en.wikipedia.org/wiki/Fluoxetine) − флюоксетин

**Colloids**

What exactly is toothpaste? We can't exactly classify it by its state of matter. It has a definite shape and volume, like a solid. But then you squeeze the tube, and it flows almost like a liquid. And then there's jelly, shaving cream, smoke, dough.

These are examples of **colloids**. A colloid is a heterogeneous mixture of two substances of different phases. Shaving cream and other foams are gases dispersed in a liquid. Jelly, toothpaste, and other gels are liquid dispersed in a solid. Dough is a solid dispersed in a liquid. Smoke is a solid dispersed in a gas.

Colloids consist of two phases: a dispersed phase inside of a continuous medium.

Vocabulary notes

colloid – коллоид

part solid – частично твердый

part liquid –частично жидкий

exactly – точно

to classify – классифицировать

state of matter – состояние вещества

definite – определенный

shape – форма

volume – объем

to squeeze – выжимать

tube – тюбик, труба

to flow – течь (глагол)

almost – почти

jelly – желе

shaving cream – крем для бритья

smoke – дым

dough – тесто

heterogeneous – неоднородный, гетерогенный

different – разный

foam – дым

gas – газ

to disperse – растворять , рассеивать

liquid – жидкий

jelly – желе

gel – гель

solid – твердый

to consist of – состоять из

dispersed phase – дисперсная фаза

inside – внутри

continuous medium – постоянная среда

###### **Beryllium**

Beryllium is a greyish-white metallic chemical element. Beryllium is hard, brittle, lightweight, nonmagnetic element. It is an excellent conductor of heat. It is easily attacked by alkalis or mineral acids with the exception of nitric acid. When we expose it to air at ordinary temperatures, the metal forms an oxide coating that protects it from rust. Beryllium is widely used in alloys because it imparts hardness and strength to copper. Beryllium-copper alloys are used to make electrical contacts, springs, antimagnetic tools and many other devices.

Beryllium and many beryllium compounds are toxic. Beryllium metal, which is about two-thirds as heavy as aluminium, is used in the parts of jet engines, missiles, high-speed aircraft, and spacecraft. It is used as an additive in solid rocket fuels and as a reflector to regulate the flow of neutrons in nuclear reactors. Because it is highly transparent to X-rays, the metal is used in X-ray tubes to form a "window" through which the rays are emitted.

The most important beryllium compound is beryllium oxide. It is extremely hard, it is strong, and it has high electrical resistance. Beryllium oxide is used as a heat-conducting material in electronic devices. It is used to make high-temperature crucibles.

The most important beryllium ore is beryl. Beryl is mined in many parts of the world. Most beryllium is produced by the conversion of the beryllium compounds in the ores to beryllium fluoride, and then the fluoride is reduced with magnesium.

Beryllium was discovered in 1798 by the French chemist Louis Vauquelin. The metal was first prepared in pure form in 1828 by the German chemist Friedrich Whler and, independently, the French chemist Antoine Bussy.

The symbol of beryllium is Be. Its atomic number is 4. The atomic weight of beryllium is 9.01218. Its melting point is 2,332 F. (1,278 C.). The boiling point of beryllium is 5,378 F. (2,970 C.). Beryllium has specific gravity of 1.85. Beryllium has one stable isotope, Be-9. It belongs to Group II-A of the Periodic Table and has a valence of +2.

Vocabulary notes

beryllium − бериллий

greyish-white − серовато-белый

lightweight − легкий

to be easily attacked − легко подвергаться воздействию

alkalis − щелочи

mineral acids − минеральные кислоты

an oxide coating − оксидное покрытие

to protect − защищать

rust − ржавчина

hardness − твердость

to impart − придавать

beryllium-copper alloys − берилиево-медные сплавы

electrical contacts − электрические контакты

springs − пружины

antimagnetic tools − антимагнитные инструменты

a part − деталь

jet engines − двигатели реактивных самолетов

а missile − ракета

high-speed aircraft − высоко скоростной самолет

spacecraft − космический корабль

an additive − добавка

solid rocket fuels − твердоракетное топливо

a reflector − отражатель

the flow of neutrons − поток нейтронов

а nuclear reactor − ядерный реактор

transparent − прозрачный

X-rays − рентгеновские лучи

а X-ray tube − рентгеновская трубка

to emit − излучаться

a heat-conducting material − теплопроводный материал

high-temperature crucibles − высокотемпературные тигели

beryl − берилл

to mine − добывать

conversion − переработка

beryllium fluoride − фторид бериллия

magnesium − магний

* + 1. Centrifugation and Sedimentation

These processes rely on differences in density. In a medical lab, blood often goes into a centrifuge. A centrifuge is a machine that spins a sample at fairly high rates of speed. Red blood cells are much denser than the watery substance (called plasma, but it's not the plasma state of matter) that makes up blood. As a result of the spinning, the denser phases move outward and the less dense phases move inward, towards the axis of rotation. Then, the red blood cells can be separated from the plasma.

Sedimentation is similar, but it happens when particles of different densities have settled within a liquid. If we leave a jar of muddy water to settle, the heaviest particles sink to the bottom first. The lightest particles sink last and form a layer on top of the heavier particles. You may have seen this effect in a bottle of salad dressing. The seasonings sink to the bottom, the water forms a lower layer, and the oil forms an upper layer. We can skim out the separate phases. To return it to a mixture, simply shake it up to disturb the layers.

Vocabulary notes

process – процесс

to rely on – полагаться , надеяться на кого(что)-либо

difference – различие

density – плотность

lab – лаборатория

blood – кровь

centrifuge – центрифуга

machine – машина, механизм

to spin – вращаться

sample – образец

fairly high rate of speed – довольно высокая скорость

red blood cells – красные кровяные тельца

dense – плотный

watery substance – вещество , состоящее из воды

state of matter – состояние вещества

to make up - составлять

as a result – в результате

outward – наружу, внешний

inward – внутрь, внутренний

towards – в направлении к

axis – ось

rotation – вращение

sedimentation – осаждение

density – плотность

to settle –располагать

jar of muddy water – банка с грязной водой

to leave – оставлять

to sink – тонуть

light – свет, светлый, светить

particle – частица

layer – слой

top – вершина

effect – эффект

bottle – бутылка

salad dressing – приправа к салату

seasoning – приправа

oil – масло

to separate – отделять

to skim out – снять , отделить

to return – возвращаться

mixture – смесь

simply – просто

to shake up – встряхнуть

to disturb – нарушить, потревожить

* + 1. Unique Properties

We can exploit the differences in substances' properties to allow separation. Consider these examples:

* We can separate a mixture of sand and iron fillings by magnet.
* We can separate salt and sand by solution (sand will not dissolve in water, salt will)
* We can separate helium from a mixture with hydrogen by combustion (this is a very dangerous operation, since hydrogen in the presence of oxygen is highly explosive). Hydrogen is flammable, but helium is not.

There are countless other ways to separate mixtures. For instance, we use gel electrophoresis to separate different sized pieces of DNA. We place them into gel, and apply an electric current. The smaller pieces move faster and separate from the larger pieces.

Chromatography separates phases dissolved in liquid. If you want to see an example, take a strip of paper and draw a dot on it with a colored marker. Dip the strip into water, and wait for a while. You should see the ink separate into different colors as they spread out from the dot.

Vocabulary notes

difference – различие

substance – вещество

property – свойство

to exploit – использовать, эксплуатировать

to allow – допускать, представлять, позволять

separation – отделение

to consider – считать

mixture – смесь

sand – песок

iron – железо

filling – наполнение

to separate – отделять

magnet – магнит

salt – соль

solution – раствор

to dissolve – растворять

water – вода

helium – гелий

hydrogen – водород

combustion – горение

dangerous – опасный

operation – действие

presence – присутствие

oxygen – кислород

highly – сильно, высоко

explosive –взрывчатый

flammable – огнеопасный

countless – бессчетное множество

way – путь

gel electrophoresis **–** электрофорез с гелем

different – разный

size – размер

pieces of DNA – частицы ДНК

to place – помещать

electric current – электрический ток

to apply – применять

to move – двигать

fast – быстро

chromatography – хроматография

to dissolve – растворять

liquid – жидкость

strip – полоска

paper - бумага

to draw – чертить

dot – точка

colored marker – цветной маркер

to dip – опускать, погружать

wait for a while – подождать немного

ink – чернила

different colors – разные цвета

to spread out – распространяться

**The rate of reaction**

The reaction rate (rate of reaction) or speed of reaction for a [reactant](https://en.wikipedia.org/wiki/Reactant) or [product](https://en.wikipedia.org/wiki/Product_%28chemistry%29) in a particular [reaction](https://en.wikipedia.org/wiki/Chemical_reaction) is defined as how fast or slow a reaction takes place. For example, the [rusting](https://en.wikipedia.org/wiki/Rusting#Chemical_reactions) of [iron](https://en.wikipedia.org/wiki/Iron) under the [Earth's atmosphere](https://en.wikipedia.org/wiki/Earth%27s_atmosphere) is a slow reaction that can take many years, but the combustion of [cellulose](https://en.wikipedia.org/wiki/Cellulose) is a reaction that takes place in fractions of a second. [Chemical kinetics](https://en.wikipedia.org/wiki/Chemical_kinetics) is the part of [physical chemistry](https://en.wikipedia.org/wiki/Physical_chemistry) that studies reaction rates. Consider a typical [chemical reaction](https://en.wikipedia.org/wiki/Chemical_reaction):

a A + b B → p P + q Q

The lowercase letters (a, b, p, and q) are [stoichiometric coefficients](https://en.wikipedia.org/wiki/Stoichiometric_coefficients), while the capital letters are the [reactants](https://en.wikipedia.org/wiki/Reactant) (A and B) and the [products](https://en.wikipedia.org/wiki/Product_%28chemistry%29) (P and Q).

A [negative sign](https://en.wikipedia.org/wiki/Plus_and_minus_signs) indicates the reactant concentration is decreasing. The IUPAC recommends that the unit of time should always be the second. In such a case the rate of reaction differs from the rate of increase of concentration of a product P by a constant factor (the reciprocal of its [stoichiometric number](https://en.wikipedia.org/wiki/Stoichiometric_number)) and for a reactant A by minus the reciprocal of the stoichiometric number. Reaction rate usually has the units of mol L−1 s−1.

Vocabulary notes

the rate of reaction − скорость реакции

a reactant − реагент

a speed − скорость

[rusting](https://en.wikipedia.org/wiki/Rusting#Chemical_reactions) − коррозия

iron − железо

to take many years − занять много лет

under [Earth's atmosphere](https://en.wikipedia.org/wiki/Earth%27s_atmosphere) − в условиях атмосферы земли

combustion − горение

[cellulose](https://en.wikipedia.org/wiki/Cellulose) − целлюлоза

in fractions of a second − в считанные секунды

to take place − протекать ,происходить

[chemical kinetics](https://en.wikipedia.org/wiki/Chemical_kinetics) − химическая кинетика

a lowercase letter − маленькая буква

a [stoichiometric coefficient](https://en.wikipedia.org/wiki/Stoichiometric_coefficients) − стехиометрический коэффициент

a capital letter − заглавная буква

to consider − рассматривать

a [negative sign](https://en.wikipedia.org/wiki/Plus_and_minus_signs) − знак минуса

to decrease − уменьшаться

to recommend − рекомендовать

the unit of time − единица времени

in such a case − в таком случае

to differ from − отличаться от

a constant factor − произвольная постоянная

the reciprocal of stoichiometric number − обратная величина стехиометрического числа

**Charge**

Particles may be electrically charged. Charge is a property which defines the force that a particle will exert on other charged particles. There is a well known saying that applies perfectly: "Opposites attract." (Likewise, like charges repel.) Positive charges and negative charges will attract each other and come together. Two positive or two negative charges will push each other away. The amount of charge a particle has is measured in coulombs, but it is more conveniently expressed in terms of an integer. For instance, a helium ion that has 2 less electrons than usual has a charge of +2, and a bromide ion with one more electron than usual has a charge of -1. (This may seem backwards, but remember that an electron has a negative charge.) Notice that charge not only applies to subatomic particles, but also ions and other things as well. Always remember to specify if a charge is positive or negative. We always write the plus sign for positive charges to avoid confusion with a negative charge.

Vocabulary notes

subatomic – субатомный

particle – частица

property – свойство

to learn – узнать, выучить

basic – основной, главный

charge – заряд

electrically – с помощью электричества

to define – определить

force – сила

to exert – оказывать влияние, осуществлять

to apply – применить

opposites attract – противоположности притягиваются

charges repel – отталкивание зарядов

рositive charge – положительный заряд

negative charge – отрицательный заряд

to push away – отталкивать

amount – количество

measure – количество

coulomb –кулон

conveniently – удобно

to express –выражать

in terms of an integer – с точки зрения целых чисел

less – меньше (little – less – the least)

usual – обычный

backwards – назад, в обратном направлении

to remember – помнить

to apply- применять

to specify – определить, указать

unlike – не похоже

ordinary numbers – простые цифры

plus sign *–* знак плюса

to avoid – избежать

confusion – путаница

Appendix 1

Irregular Verbs Table

Список неправильных глаголов

|  |  |  |  |
| --- | --- | --- | --- |
| Base form | Past simple | Past participle | Перевод |
| A | | | |
| arise | Arose | Arisen | возникать, появляться, подниматься |
| awake | awakened / awoke | awakened / awoken | будить, проснуться |
| B | | | |
| be | was, were | Been | быть |
| bear | bore | born / borne | родить |
| beat | beat | beaten / beat | бить |
| become | became | Become | становиться, делаться |
| begin | began | Begun | начинать |
| bend | bent | Bent | сгибать, гнуть |
| bet | bet / betted | bet / betted | держать пари |
| bind | bound | Bound | связать |
| bite | bit | Bitten | кусать |
| bleed | bled | Bled | кровоточить |
| blow | blew | Blown | дуть |
| break | broke | Broken | ломать |
| breed | bred | Bred | выращивать, воспитывать |
| bring | brought | Brought | приносить |
| broadcast | broadcast / broadcasted | broadcast / broadcasted | распространять, разбрасывать |
| burn | burned / burnt | burned / burnt | гореть, жечь |
| burst | burst | Burst | взрываться, прорываться |
| bust | busted / bust | busted / bust | разжаловать |
| buy | bought | Bought | покупать |
| C | | | |
| can | could |  | мочь, уметь |
| cast | cast | Cast | бросить, кинуть, вышвырнуть |
| catch | caught | Caught | ловить, хватать, успеть |
| choose | chose | Chosen | выбирать |
| cling | clung | Clung | цепляться, льнуть |
| clothe | clothed / clad | clothed / clad | одевать (кого-либо) |
| come | came | Come | приходить |
| cost | cost | Cost | стоить, обходиться (в какую-либо сумму) |
| creep | crept | Crept | ползать |
| cut | cut | Cut | резать, разрезать |
| D | | | |
| deal | dealt | Dealt | иметь дело |
| dig | dug | Dug | копать |
| dive | dove / dived | Dived | нырять, погружаться |
| do | did | Done | делать, выполнять |
| draw | drew | Drawn | рисовать, чертить |
| dream | dreamed / dreamt | dreamed / dreamt | грезить, мечтать |
| drink | drank | Drunk | пить |
| drive | drove | Driven | управлять (авто) |
| dwell | dwelt / dwelled | dwelt / dwelled | обитать, находиться |
| E | | | |
| eat | ate | Eaten | есть, кушать |
| F | | | |
| fall | fell | Fallen | падать |
| feed | fed | Fed | кормить |
| feel | felt | Felt | чувствовать |
| fight | fought | Fought | драться, сражаться, бороться |
| find | found | Found | находить |
| fit | fit | Fit | подходить по размеру |
| fly | flew | Flown | летать |
| forbid | forbade | Forbidden | запрещать |
| forecast | forecast | Forecast | предсказывать, предвосхищать |
| foresee | foresaw | Foreseen | предвидеть |
| foretell | foretold | Foretold | предсказывать, прогнозировать |
| forget | forgot | Forgotten | забывать |
| forgive | forgave | Forgiven | прощать |
| freeze | froze | Frozen | замерзать |
| G | | | |
| get | got | gotten / got | получать, достигать |
| give | gave | Given | давать |
| go | went | Gone | идти, ехать |
| grow | grew | Grown | расти |
| H | | | |
| hang | hung / hanged | hung / hanged | вешать, развешивать |
| have, has | had | Had | иметь |
| hear | heard | Heard | слышать |
| hide | hid | Hidden | прятаться, скрываться |
| hit | hit | Hit | ударять, поражать |
| hold | held | Held | держать, удерживать, фиксировать |
| hurt | hurt | Hurt | ранить, причинить боль |
| I | | | |
| inlay | inlaid | Inlaid | вкладывать, вставлять, выстилать |
| input | input / inputted | input / inputted | входить |
| interweave | interwove | Interwoven | воткать |
| K | | | |
| keep | kept | Kept | держать, хранить |
| kneel | knelt / kneeled | knelt / kneeled | становиться на колени |
| knit | knitted / knit | knitted / knit | вязать |
| know | knew | Known | знать, иметь представление (о чем-либо) |
| L | | | |
| lay | laid | Laid | класть, положить |
| lead | led | Led | вести, руководить, управлять |
| lean | leaned / leant | leaned / leant | опираться, прислоняться |
| leap | leaped / leapt | leaped / leapt | прыгать, скакать |
| learn | learnt / learned | learnt / learned | учить |
| leave | left | Left | покидать, оставлять |
| lend | lent | Lent | одалживать, давать взаймы |
| let | let | Let | позволять, предполагать |
| lie | lay | Lain | лежать |
| light | lit / lighted | lit / lighted | освещать, зажигаться, загораться |
| lose | lost | Lost | терять |
| M | | | |
| make | made | Made | делать, производить, создавать |
| may | might | Might | мочь, иметь возможность |
| mean | meant | Meant | значить, иметь ввиду |
| meet | met | Met | встречать |
| miscast | miscast | Miscast | неправильно распределять роли |
| misdeal | misdealt | Misdealt | поступать неправильно |
| misdo | misdid | Misdone | делать что-либо неправильно или небрежно |
| misgive | misgave | Misgiven | внушать недоверия, опасения |
| mishear | misheard | Misheard | ослышаться |
| mishit | mishit | Mishit | промахнуться |
| mislay | mislaid | Mislaid | класть не на место |
| mislead | misled | Misled | ввести в заблуждение |
| misread | misread | Misread | неправильно истолковывать |
| misspell | misspelled / misspelt | misspelled / misspelt | писать с ошибками |
| misspend | misspent | Misspent | неразумно, зря тратить |
| mistake | mistook | Mistaken | ошибаться |
| misunderstand | misunderstood | misunderstood | неправильно понимать |
| O | | | |
| offset | offset | Offset | возмещать, вознаграждать, компенсировать |
| outbid | outbid | Outbid | перебивать цену |
| outdo | outdid | Outdone | превосходить |
| outfight | outfought | Outfought | побеждать в бою |
| outgrow | outgrew | Outgrown | вырастать из |
| output | output / outputted | output / outputted | выходить |
| outrun | outran | Outrun | перегонять, опережать |
| outsell | outsold | Outsold | продавать лучше или дороже |
| outshine | outshone | Outshone | затмевать |
| overcome | overcame | Overcome | Компенсировать |
| overdo | overdid | Overdone | пережари(ва)ть |
| overdraw | overdrew | Overdrawn | Превышать |
| overeat | overate | Overeaten | объедаться |
| overfly | overflew | Overflown | перелетать |
| overhang | overhung | Overhung | нависать |
| overhear | overheard | Overheard | подслуш(ив)ать |
| overlay | overlaid | Overlaid | покры(ва)ть |
| overpay | overpaid | Overpaid | переплачивать |
| override | overrode | Overridden | отменять, аннулировать |
| overrun | overran | Overrun | переливаться через край |
| oversee | oversaw | Overseen | надзирать за |
| overshoot | overshot | Overshot | расстрелять |
| oversleep | overslept | Overslept | проспать, заспаться |
| overtake | overtook | Overtaken | догонять |
| overthrow | overthrew | Overthrown | свергать |
| P | | | |
| partake | partook | Partaken | принимать участие |
| pay | paid | Paid | платить |
| plead | pleaded / pled | pleaded / pled | обращаться к суду |
| prepay | prepaid | Prepaid | платить вперед |
| prove | proved | proven / proved | доказывать |
| put | put | Put | класть, ставить, размещать |
| Q | | | |
| quit | quit / quitted | quit / quitted | выходить, покидать, оставлять |
| R | | | |
| read | read | Read | читать |
| rebind | rebound | Rebound | Перевязывать |
| rebuild | rebuilt | Rebuilt | Перестроить |
| recast | recast | Recast | изменять, перестраивать |
| redo | redid | Redone | делать вновь, переделывать |
| rehear | reheard | Reheard | слушать вторично |
| remake | remade | Remade | Переделывать |
|  |  |  |  |
| repay | repaid | repaid | отдавать долг |
| rerun | reran | rerun | выполнять повторно |
| resell | resold | resold | Перепродавать |
| reset | reset | reset | Возвращать |
| resit | resat | resat | Пересиживать |
| retake | retook | retaken | Забирать |
| retell | retold | retold | Пересказывать |
| rewrite | rewrote | rewritten | Перезаписать |
| rid | rid | rid | Избавлять |
| ride | rode | ridden | ездить верхом |
| ring | rang | rung | Звонить |
| rise | rose | risen | Подняться |
| run | ran | run | Бегать |
| S | | | |
| saw | sawed | sawed / sawn | Пилить |
| say | said | said | сказать, заявить |
| see | saw | seen | Видеть |
| seek | sought | sought | Искать |
| sell | sold | sold | Продавать |
| send | sent | sent | Посылать |
| set | set | set | сажать, ставить, устанавливать, садиться (о солнце) |
| sew | sewed | sewn / sewed | Шить |
| shake | shook | shaken | Трясти |
| shave | shaved | shaved / shaven | Бриться |
|  |  |  |  |
|  |  |  |  |
| shine | shined / shone | shined / shone | светить, сиять, озарять |
| shoot | shot | shot | стрелять, давать побеги |
| show | showed | shown / showed | Показывать |
| shrink | shrank / shrunk | shrunk | сокращаться, сжиматься |
| shut | shut | shut | закрывать, запирать, затворять |
| sing | sang | sung | Петь |
| sink | sank / sunk | sunk | тонуть, погружаться (под воду) |
| sit | sat | sat | Сидеть |
| sleep | slept | slept | Спать |
| slide | slid | slid | Скользить |
| smell | smelled / smelt | smelled / smelt | пахнуть, нюхать |
| sow | sowed | sown / sowed | Сеять |
| speak | spoke | spoken | Говорить |
| speed | sped / speeded | sped / speeded | ускорять, спешить |
| spell | spelled / spelt | spelled / spelt | писать или читать по буквам |
| spend | spent | spent | тратить, расходовать |
| spill | spilled / spilt | spilled / spilt | проливать, разливать |
| spin | spun | spun | Прясть |
| spit | spit / spat | spit / spat | Плевать |
| split | split | split | Расщеплять |
| spoil | spoiled / spoilt | spoiled / spoilt | Портить |
| spread | spread | spread | распространять(ся), простирать(ся) |
| spring | sprang / sprung | sprung | отскочить, прыгать, скакать, возникать |
| stand | stood | stood | Стоять |
| steal | stole | stolen | воровать, красть |
| stick | stuck | stuck | уколоть, приклеить |
| sting | stung | stung | Жалить |
| stink | stunk / stank | stunk | Вонять |
| strew | strewed | strewn / strewed | усеять, устлать |
| stride | strode | stridden | шагать, наносить удар |
| strike | struck | struck | ударить, бить, бастовать |
| string | strung | strung | нанизать, натянуть |
|  |  |  |  |
|  |  |  |  |
| swear | swore | sworn | клясться, присягать |
| sweep | swept | swept | мести, подметать, сметать |
| swell | swelled | swollen / swelled | разбухать |
| swim | swam | swum | плавать, плыть |
| swing | swung | swung | качать, раскачивать, вертеть |
| T | | | |
| take | took | taken | брать, взять |
| teach | taught | taught | учить, обучать |
| tear | tore | torn | рвать |
| tell | told | told | рассказать |
| think | thought | thought | думать |
| throw | threw | thrown | кидать, бросать |
| U | | | |
| undergo | underwent | undergone | испытывать, переносить |
| underlie | underlay | underlain | лежать в основе |
| underpay | underpaid | underpaid | оплачивать слишком низко |
| undersell | undersold | undersold | продавать дешевле |
| understand | understood | understood | понимать, постигать |
| undertake | undertook | undertaken | предпринять |
| underwrite | underwrote | underwritten | подписываться |
| undo | undid | undone | уничтожать сделанное |
| unfreeze | unfroze | unfrozen | размораживать |
| unsay | unsaid | unsaid | брать назад свои слова |
| unwind | unwound | unwound | развертывать |
| uphold | upheld | upheld | поддерживать |
| upset | upset | upset | опрокинуться |
| W | | | |
| wake | woke / waked | woken / waked | просыпаться |
| waylay | waylaid | waylaid | подстерегать |
| wear | wore | worn | носить (одежду), снашиваться |
| weave | wove / weaved | woven / weaved | ткать |
| wed | wed / wedded | wed / wedded | жениться, выдавать замуж |
| weep | wept | wept | плакать, рыдать |
| wet | wet / wetted | wet / wetted | мочить, увлажнять |
| win | won | won | победить, выиграть |
| wind | wound | wound | заводить (механизм) |
| withdraw | withdrew | withdrawn | взять назад, отозвать |
| withhold | withheld | withheld | воздерживаться, отказывать |
| withstand | withstood | withstood | противостоять |
| write | wrote | written | писать |

Appendix 2

**Chemcial elements (Химические элементы)**

**Ac** Actinium [ækʹtɪnɪəm] Актиний

**Ag** Argentum [α:ʹʤentəm]=silver [ʹsɪlvə] Серебро

**A1** Aluminium [æljuʹmɪnjəm] Алюминий

**Am** Americium [əmeʹrɪsɪəm] Америций

**Ar,A** Argon [ʹα:gən] Аргон

**As** Arsenic [ʹa:snik] Мышьяк

**At** Astatium [əsʹteɪtɪəm] Астат(ин)

**Au** Aurum [ʹᴐ:rəm] = Gold [gould] Золото

**В** Boron [ʹbᴐ:rᴐn] Бор

**Ba** Barium [ʹbəriəm] Барий

**Be** Beryllium [bəʹrɪlɪəm] Бериллий

**Bi** Bismuth [ʹbɪzməθ] Висмут

**Bk** Berkelium [bəʹ:keɪljəm] Берк(е)лий

**Br** Bromine [ʹbroumi:n] Бром

**С** Carbon [ʹkα:bən] Углерод

**Са** Calcium [ʹkælsɪəm] Кальций

**Cd** Cadmium [ʹkædmɪəm] Кадмий

**Ce** Cerium [ʹsɪərɪəm] Церий

**Cf** Californium [ˏkælɪʹfᴐnjəm] Калифорний

**Cl** Chlorine [ʹklᴐ:ri:n] Хлор

**Cm** Curium [ʹkju:rɪəm] Кюрий

**Co** Cobalt [koʹbᴐ:lt] Кобальт

**Cr** Chromium [ʹkroumɪəm] = Chrome [ʹkroum] Хром

**Cs** C(a)esium [ʹsi:zɪəm] Цезий

**Cu** Cuprum [ʹkju:prəm] = Copper [ʹкᴐрə] Медь

**Dy** Dysprosium [dɪsʹprouzɪəm] Диспрозий

**Em** Emanation [ˏeməʹneɪjən] Эманация

**Er** Erbium [ˏə:bɪəm] Эрбий

**Es** Einsteinium [aɪnʹstaɪnɪəm] Эйнштейний

**Eu** Europium [juəʹroupɪəm] Европий

**F** Fluorine [ʹfluəri:n] Фтор

**Fe** Ferrum [ʹferəm] = Iron [ʹaɪən] Железо

**Fm** Fermium [ʹfə:mjəm] Фермий

**Fr** Francium [ʹfrænsɪəm] Франций

**Ga** Gallium [ʹgælɪəm] Галлий

**Gd** Gadolinium [ˏgædəʹɪnɪəm] Гадолиний

**Ge** Germanium [ʤə:ʹmeɪnɪəm] Германий

**H** Hydrogen [ʹhaɪdrɪʤən] Водород

**He** Helium [ʹhi:ljəm] Гелий

**Hf** Hafnium [ʹhα:fnɪəm] Гафний

**Hg** Hydrargyrum [ʹhaɪʹdra:ʤɪrəm] = Mercury [ʹmə:kjurɪ] Ртуть

**Ho** Holmium [ʹhoulmɪəm] Гольмий

**In** Indium [ʹɪndɪəm] Индий

**Ir** Iridium [aɪʹri:dɪəm] Иридий

**I** Iodine [ʹaɪədi:n] Йод

**К** Potassium [poʹtesjəm] Калий

**Kr** Krypton [ʹkrɪptᴐn] Криптон

**La** Lanthanum [ʹlænθənəm] Лантан

**Lw** Lawrentium [ˏlᴐ:ʹrentɪəm] Лорендий

**Li** Lithium [ʹliθɪəm] Литий

**Lu** Lutecium [luʹti:ʃɪəm] Лютеций

**Md** Mendelevium [ˏmendəʹli:vɪəm] Менделевий

**Mg** Magnesium [mægʹni: zɪəm] Магний

**Mn** Manganese [mæƞgəʹni:z] Марганец

**Mo** Molybdenum [məʹlɪbdɪnəm] Молибден

**N** Nitrogen [ʹnaɪtrɪʤən] Азот

**Na** Sodium [ʹsoudjəm] Натрий

**Nb** Niobium [naɪʹoubɪəm] Ниобий

**Nd** Neodymium [ˏnɪəʹdɪmɪəm] Неодим(ий)

**Ne** Neon [ʹni:ᴐn] Неон

**Ni** Nickel [ʹnɪkl] Никель

**No** Nobelium [ˏnouʹbi:lɪəm] Нобелий (предполагаемое название для элемента 102)

**Np** Neptunium [nepʹtju:nɪəm] Нептуний

**О** Oxygen [ʹᴐksɪʤən] Кислород

**Os** Osmium [ʹᴐzmɪəm] Осмий

**P** Phosphorus [ʹfᴐsfərəs] Фосфор

**Pa** Prot(o)actinium [ʹproutəækʹtɪnɪəm] Протактиний

**Pb** Plumbum [ʹplᴧmbəm] — Lead [led] Свинец

**Pd** Palladium [pəʹleɪdɪəm] Палладий

**Pm** Promethium [prəʹmi:θɪəm] Прометий

**Pr** Praseodymium [ˏprezɪəʹdɪmɪəm] Празеодим

**Pt** Platinum [ʹplætɪnəm] Платина

**Pu** Plutonium [pIu:ʹtounjəm] Плутоний

**Ra** Radium [ʹreɪdɪəm] Радий

**Re** Rhenium [ʹri:nɪəm] Рений

**Rh** Rhodium [ʹroudɪəm] Родий

**Rz** Ruthenium [ru:ʹθmɪəm] Рутений

**S** Sulphur [ʹsᴧlfə] Сера

**Sb** Stibium [ʹstɪbjəm] = Antimony [ʹæntəmənɪ] Сурьма

**Sc** Scandium [ʹskændjəm] Скандий

**Se** Selenium [sɪʹlɪnjəm] Селен

**Si** Silicon [ʹsɪlɪkən] Кремний

**Sm** Samarium [seʹma:rɪəm] Самарий

**Sn** Stannum [ʹstænəm] = Tin [tɪn] Олово

**Sr** Strontium [ʹstrᴐnʃɪəm] Стронций

**Та** Tantalum [ʹtæntələm] Тантал

**Tb** Terbium [ʹtə:bɪəm] Тербий

**Тc** Technetium [tekʹnɪʃɪəm] Технеций

**Те** Tellurium [teʹlju:rɪəm] Теллур

**Th** Thorium [ʹθᴐ:rɪəm] Торий

**Ti** Titanium [taɪʹteɪnɪəm] Титан

**Tl** Thallium [ʹθælɪəm] Таллий

**Tm** Thullium [ʹθju:lɪəm] Тулий

**U** Uranium [juʹreɪnɪəm] Уран

**V** Vanadium [vəʹneɪdɪəm] Ванадий

**W** Wolfram(ium) [ʹwulfrəm]=Tungsten[ʹtᴧƞsten] Вольфрам

**Xe** Xenon [ʹzenᴐn] Ксенон

**Y** Yttrium [ʹɪtrɪəm] Иттрий

**Yb** Ytterbium [ɪʹtə:bɪəm] Иттербий

**Zn** Zink [zɪƞk] Цинк

**Zr** Zirconium [zəʹkounɪəm] Цирконий

Appendix 3

**Greek symbols (Греческие символы)**

**A** alpha [ʹælfə] альфа

**B** beta [ʹbeitə, ʹbi:tə] бета

**Г** gamma [ʹgæmə] гамма

delta [ʹdeltə] дельта

**Е** epsilon [ʹepsɪʹlᴐn] эпеилон

**Z** (d)zeta [ʹzeɪtə, ʹzi:tə] дзета

**H** eta [ʹeitə, ʹi:tə] эта

theta [ʹθeɪtə, ʹθi:tə] тэта

**I** ʃota [aɪʹoutə] йота

**K** kappa [ʹkæpə] каппа

**λ** lambda [ʹlæmbdə] ламбда

**M** mu [mju:] ми (мю)

**N** nu [nju:] ни (ню)

**O** omikron [ouʹmaɪkrən] омикрон

**П** pi [pi] пи

**P** rho [rou] po

**∑** sigma [ʹsɪgmə] сигма

**Т** tau [tau] тау

**Y** upsilon [ʹju:psɪʹlᴐn] ипсилон

**Ф** phi [ʹfi:] фи

**Xx** chi [ʹhi:] хи

omega [ouʹmegə, ouʹm:gə] омега

Appendix 4

|  |  |
| --- | --- |
| **Symbol** | **Meaning** |
| + | used to separate one reactant or product from another |
| http://www.harpercollege.edu/tm-ps/chm/100/dgodambe/thedisk/chemrxn/arrow.jpg | used to separate the reactants from the products - it is pronounced "yields" or "produces" when the equation is read |
| http://www.harpercollege.edu/tm-ps/chm/100/dgodambe/thedisk/chemrxn/eqarrow.jpg | used when the reaction can proceed in both directions - this is called an equilibrium arrow |
| (g) | indicates that the substance is in a gaseous state |
| http://www.harpercollege.edu/tm-ps/chm/100/dgodambe/thedisk/chemrxn/garrow.jpg | an alternative way of representing a substance in a gaseous state |
| (s) | indicates that the substance is in a solid state |
| http://www.harpercollege.edu/tm-ps/chm/100/dgodambe/thedisk/chemrxn/sarrow.jpg | an alternative way of representing a substance in a solid state |
| (aq) | indicates that the substance is dissolved in water - the aq comes from aqueous |
| http://www.harpercollege.edu/tm-ps/chm/100/dgodambe/thedisk/chemrxn/heat.jpg | indicates that heat is applied to make the reaction proceed |
| cry | Crystal |

Appendix 5

**WRITING IONIC EQUATIONS FOR REDOX REACTIONS (Examples )**

**Example 1: The reaction between chlorine and iron(II) ions**

Chlorine gas oxidises iron(II) ions to iron(III) ions. In the process, the chlorine is reduced to chloride ions.

You would have to know this, or be told it by an examiner. In building equations, there is quite a lot that you can work out as you go along, but you have to have somewhere to start from!

You start by writing down what you know for each of the half-reactions. In the chlorine case, you know that chlorine (as molecules) turns into chloride ions:

http://www.chemguide.co.uk/inorganic/redox/padding.GIFhttp://www.chemguide.co.uk/inorganic/redox/clhalfeqtn1.gif

The first thing to do is to balance the atoms that you have got as far as you possibly can:

http://www.chemguide.co.uk/inorganic/redox/padding.GIFhttp://www.chemguide.co.uk/inorganic/redox/clhalfeqtn2.gif

ALWAYS check that you have the existing atoms balanced before you do anything else. If you forget to do this, everything else that you do afterwards is a complete waste of time!

Now you have to add things to the half-equation in order to make it balance completely.

All you are allowed to add are:

* electrons
* water
* hydrogen ions (unless the reaction is being done under alkaline conditions - in which case, you can add hydroxide ions instead)

In the chlorine case, all that is wrong with the existing equation that we've produced so far is that the charges don't balance. The left-hand side of the equation has no charge, but the right-hand side carries 2 negative charges.

That's easily put right by adding two electrons to the left-hand side. The final version of the half-reaction is:

http://www.chemguide.co.uk/inorganic/redox/padding.GIFhttp://www.chemguide.co.uk/inorganic/redox/clhalfeqtn3.gif

Now you repeat this for the iron(II) ions. You know (or are told) that they are oxidised to iron(III) ions. Write this down:

http://www.chemguide.co.uk/inorganic/redox/padding.GIFhttp://www.chemguide.co.uk/inorganic/redox/feiihalfeqtn1.gif

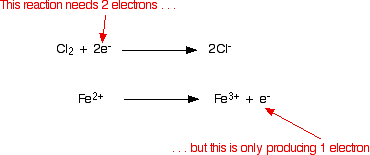
The atoms balance, but the charges don't. There are 3 positive charges on the right-hand side, but only 2 on the left.

You need to reduce the number of positive charges on the right-hand side. That's easily done by adding an electron to that side:

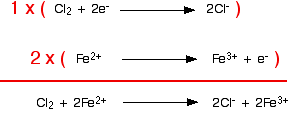
http://www.chemguide.co.uk/inorganic/redox/padding.GIFhttp://www.chemguide.co.uk/inorganic/redox/feiihalfeqtn2.gif

*Combining the half-reactions to make the ionic equation for the reaction*

What we've got at the moment is this:



It is obvious that the iron reaction will have to happen twice for every chlorine molecule that reacts. Allow for that, and then add the two half-equations together.

http://www.chemguide.co.uk/inorganic/redox/padding.GIF

But don't stop there!! Check that everything balances - atoms and charges. It is very easy to make small mistakes, especially if you are trying to multiply and add up more complicated equations.

You will notice that I haven't bothered to include the electrons in the added-up version. If you think about it, there are bound to be the same number on each side of the final equation, and so they will cancel out. If you aren't happy with this, write them down and then cross them out afterwards!

**Example 2: The reaction between hydrogen peroxide and manganate(VII) ions**

The first example was a simple bit of chemistry which you may well have come across. The technique works just as well for more complicated (and perhaps unfamiliar) chemistry.

Manganate(VII) ions, MnO4-, oxidise hydrogen peroxide, H2O2, to oxygen gas. The reaction is done with potassium manganate(VII) solution and hydrogen peroxide solution acidified with dilute sulphuric acid.

During the reaction, the manganate(VII) ions are reduced to manganese(II) ions.

Let's start with the hydrogen peroxide half-equation. What we know is:

http://www.chemguide.co.uk/inorganic/redox/padding.GIFhttp://www.chemguide.co.uk/inorganic/redox/h2o2half1.gif

The oxygen is already balanced. What about the hydrogen?

All you are allowed to add to this equation are water, hydrogen ions and electrons. If you add water to supply the extra hydrogen atoms needed on the right-hand side, you will mess up the oxygens again - that's obviously wrong!

Add two hydrogen ions to the right-hand side.

http://www.chemguide.co.uk/inorganic/redox/padding.GIFhttp://www.chemguide.co.uk/inorganic/redox/h2o2half2.gif

Now all you need to do is balance the charges. You would have to add 2 electrons to the right-hand side to make the overall charge on both sides zero.

http://www.chemguide.co.uk/inorganic/redox/padding.GIFhttp://www.chemguide.co.uk/inorganic/redox/h2o2half3.gif

Now for the manganate(VII) half-equation:

You know (or are told) that the manganate(VII) ions turn into manganese(II) ions. Write that down.

http://www.chemguide.co.uk/inorganic/redox/padding.GIFhttp://www.chemguide.co.uk/inorganic/redox/mno4half1.gif

The manganese balances, but you need four oxygens on the right-hand side. These can only come from water - that's the only oxygen-containing thing you are allowed to write into one of these equations in acid conditions.

http://www.chemguide.co.uk/inorganic/redox/padding.GIFhttp://www.chemguide.co.uk/inorganic/redox/mno4half2.gif

By doing this, we've introduced some hydrogens. To balance these, you will need 8 hydrogen ions on the left-hand side.

http://www.chemguide.co.uk/inorganic/redox/padding.GIFhttp://www.chemguide.co.uk/inorganic/redox/mno4half3.gif

Now that all the atoms are balanced, all you need to do is balance the charges. At the moment there are a net 7+ charges on the left-hand side (1- and 8+), but only 2+ on the right. Add 5 electrons to the left-hand side to reduce the 7+ to 2+.

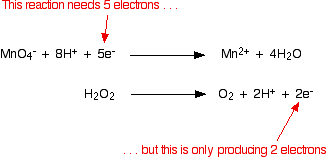
http://www.chemguide.co.uk/inorganic/redox/padding.GIFhttp://www.chemguide.co.uk/inorganic/redox/mno4half4.gif

This is the typical sort of half-equation which you will have to be able to work out. The sequence is usually:

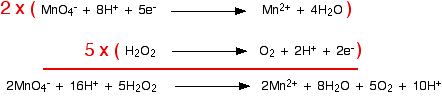
* Balance the atoms apart from oxygen and hydrogen.
* Balance the oxygens by adding water molecules.
* Balance the hydrogens by adding hydrogen ions.
* Balance the charges by adding electrons.

*Combining the half-reactions to make the ionic equation for the reaction*

The two half-equations we've produced are:

http://www.chemguide.co.uk/inorganic/redox/padding.GIF

You have to multiply the equations so that the same number of electrons are involved in both. In this case, everything would work out well if you transferred 10 electrons.



But this time, you haven't quite finished. During the checking of the balancing, you should notice that there are hydrogen ions on both sides of the equation:

http://www.chemguide.co.uk/inorganic/redox/ex2ionic1.gif

You can simplify this down by subtracting 10 hydrogen ions from both sides to leave the final version of the ionic equation - but don't forget to check the balancing of the atoms and charges!

http://www.chemguide.co.uk/inorganic/redox/padding.GIFhttp://www.chemguide.co.uk/inorganic/redox/ex2ionic2.gif

You will often find that hydrogen ions or water molecules appear on both sides of the ionic equation in complicated cases built up in this way. Always check, and then simplify where possible.

***Example 3: The oxidation of ethanol by acidified potassium dichromate(VI)***

This technique can be used just as well in examples involving organic chemicals. Potassium dichromate(VI) solution acidified with dilute sulphuric acid is used to oxidise ethanol, CH3CH2OH, to ethanoic acid, CH3COOH.

The oxidising agent is the dichromate(VI) ion, Cr2O72-. This is reduced to chromium(III) ions, Cr3+.

We'll do the ethanol to ethanoic acid half-equation first. Using the same stages as before, start by writing down what you know:

http://www.chemguide.co.uk/inorganic/redox/padding.GIFhttp://www.chemguide.co.uk/inorganic/redox/organic1.gif

Balance the oxygens by adding a water molecule to the left-hand side:

http://www.chemguide.co.uk/inorganic/redox/padding.GIFhttp://www.chemguide.co.uk/inorganic/redox/organic2.gif

Add hydrogen ions to the right-hand side to balance the hydrogens:

http://www.chemguide.co.uk/inorganic/redox/padding.GIFhttp://www.chemguide.co.uk/inorganic/redox/organic3.gif

And finally balance the charges by adding 4 electrons to the right-hand side to give an overall zero charge on each side:

http://www.chemguide.co.uk/inorganic/redox/padding.GIFhttp://www.chemguide.co.uk/inorganic/redox/organic4.gif

The dichromate(VI) half-equation contains a trap which lots of people fall into!

Start by writing down what you know:

http://www.chemguide.co.uk/inorganic/redox/padding.GIFhttp://www.chemguide.co.uk/inorganic/redox/chrome1.gif

What people often forget to do at this stage is to balance the chromiums. If you don't do that, you are doomed to getting the wrong answer at the end of the process! When you come to balance the charges you will have to write in the wrong number of electrons - which means that your multiplying factors will be wrong when you come to add the half-equations . . . A complete waste of time!

http://www.chemguide.co.uk/inorganic/redox/padding.GIFhttp://www.chemguide.co.uk/inorganic/redox/chrome2.gif

Now balance the oxygens by adding water molecules . . .

http://www.chemguide.co.uk/inorganic/redox/padding.GIFhttp://www.chemguide.co.uk/inorganic/redox/chrome3.gif

. . . and the hydrogens by adding hydrogen ions:

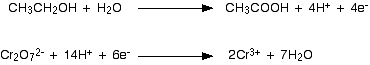
http://www.chemguide.co.uk/inorganic/redox/padding.GIFhttp://www.chemguide.co.uk/inorganic/redox/chrome4.gif

Now all that needs balancing is the charges. Add 6 electrons to the left-hand side to give a net 6+ on each side.

http://www.chemguide.co.uk/inorganic/redox/padding.GIFhttp://www.chemguide.co.uk/inorganic/redox/chrome5.gif

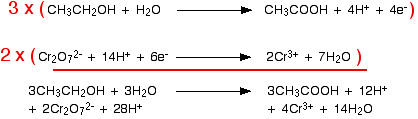
*Combining the half-reactions to make the ionic equation for the reaction*

What we have so far is:

http://www.chemguide.co.uk/inorganic/redox/padding.GIF

What are the multiplying factors for the equations this time? The simplest way of working this out is to find the smallest number of electrons which both 4 and 6 will divide into - in this case, 12. That means that you can multiply one equation by 3 and the other by 2.

The multiplication and addition looks like this:

http://www.chemguide.co.uk/inorganic/redox/padding.GIF

Now you will find that there are water molecules and hydrogen ions occurring on both sides of the ionic equation. You can simplify this to give the final equation:

* http://www.chemguide.co.uk/inorganic/redox/ex3ionic.gif

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**Lesson 9.**

**Keys to the exercises.**

**Ex. 3 Put the adjectives in brackets in Comparative.**

1. more important

2 . more soluble

3. weaker

4. better

5. more

6. worse

7. more useful

**Ex. 4 Put the adjectives in brackets in Superlative .**

1. the most interesting

2. the best

3. the worst

4. the best-equipped

5. the best-known

6. the purest

7. the most acidic

**Ex. 5 Put the adjectives in brackets in Superlative or Comparative**

1. better

2. more

3. the cheapest

4. more

5. the quickest

6. the best

7. more easily –prepared

**Ex. 6 Put the questions to the bold-typed words**

1.

a.When did we discuss the [Bronsted](https://en.wikipedia.org/wiki/Johannes_Nicolaus_Br%C3%B8nsted)and [Lowry](https://en.wikipedia.org/wiki/Thomas_Martin_Lowry) theory at the lesson?

b. What did wediscuss at the lessonyesterday?

c.Where did we discuss the [Bronsted](https://en.wikipedia.org/wiki/Johannes_Nicolaus_Br%C3%B8nsted) and [Lowry](https://en.wikipedia.org/wiki/Thomas_Martin_Lowry) theory?

2.

a. Who has done this experiment?

b. What have you done ?

3.

a. What is more soluble than a base?

b. What is acid more soluble ?

4.

a. What is the most soluble chemical?

5.

a. Who has proposed this method first?

b. What have you proposed first?

6.

a. What forms a covalent bond?

b. What bond does boron form?

7.

a. What happens faster in an acid than in a base?

b. How fast does the sharing of electrons happen in an acid (in a base)?

**Lesson 10.**

**Ex. 3 Remake the following sentences using comparative constructions as..as and not as..as**

For example: Magnesium is brittle. Copper is brittle too. Magnesium is as brittle as chromium.

Magnesium is brittle but copper is not brittle. Magnesium is not as brittle as chromium.

1. Reduction process is as difficult as oxidation process.

2. Redox reactions are not as electron-gaining as organic reactions.

3. Nucleophillic regions are as electron – excessive as electrophillic regions .

4. Bronsted acids are not as hard soluble as Lewis acids.

5. Manganese is not as slightly-soluble as magnesium.

6. Hydrochloric acid is not as strong as boric acid.

7. Sulfuric acid is as weak as boric acid.

**Ex. 4 Put in *as* or *than***

1. than

2. as

3. than

4. as

5. than

6. than

7. as

**Ex. 5 Put the questions to the bold-typed words**

1. **We** often write **redox reactions** **in this way**.

a. Who often writesredox reactions in this way.

b. What do you often write in this way?

c. How do you often write redox reactions?

2. **Organic** reactions occur **at high temperature**.

a. What reactions occur at high temperature?

b.At what temperature do organic reactions occur?

3. **Yesterday** **we** reduced **these species**.

a. When did you reduce these species?

b. Who reduced these species yesterday?

c. What did you reduce yesterday?

4. **Nucleophillic** regions have an **excess of electrons.**

**a.** What regions have an excess of electrons?

**b.** What do nucleophillic regions have?

5**.** Another key concept in organic reactions is **Lewis basicity.**

**a.** What is another key concept in organic reactions?

6. **Magnesium** loses **electrons**.

a. What loses electrons?

b. What does magnesium lose?

7.**This element** changes **its colour** when it burns.

a.What changes its colour when it burns?

b. What does this element change when it burns?

**Lesson 11**

**Ex. 3 Complete these sentences. Use *can* or *could* + one of these verbs.**

**To obtain, to occur, to show, to remove, to constitute, to store, to have**

1. **could obtain**

2. **can occur**

3. **can constitute**

4. **could remove**

5. **can store**

6. **can** **have**

7. **can show**

*Ex. 4 Complete the sentences using can or may/might/could.*

*1.Saturated hydrocarbons …..be linear or branched.*

*2.She ……finish her experiment tomorrow.*

*3. The release of energy in chemical reactions ….. occur when the reactants have higher chemical energy.*

*4. I think Michael …. Be at the university now. I will go and check.*

*5. I think Ann …..titrate the solution which she has just obtained tomorrow.*

*6. The reaction of* [*hydrochloric acid*](https://en.wikipedia.org/wiki/Hydrochloric_acid)*, HCl, with* [*sodium hydroxide*](https://en.wikipedia.org/wiki/Sodium_hydroxide)*, NaOH, solutions …. Produce a solution of* [*sodium chloride*](https://en.wikipedia.org/wiki/Sodium_chloride)*.*

*7. 3-methylhexane and branched hydrocarbons …. Be* [*chiral*](https://en.wikipedia.org/wiki/Chirality_%28chemistry%29)*.*

**Ex. 5 Correct the mistakes in the sentences.**

1. may be

2. can react

3. are

4. Can …carry out

5. can be

6. can have

7. Can …measure