# BASE TWO NUMERATION SYSTEM

**Words to be Learned**

**Exercise 1**

*Read these international words. Try to guess their meaning.*

calculate ['kælkjuleıt] *v,* electronic [**ֽ**elek'trɔnık] ([ı**ֽ**lek'trɔnık]) *a,* indicate ['ındıkeıt] *v,* extensive [ıks'tensıv] *a,* speed *n,* position [pə'zı∫(ə)n] *n,* binary ['baınərı] *a.*

**Exercise 2**

*Repeat after the teacher.*

|  |  |
| --- | --- |
| latter ['lætə] *a* 1. последний; последний из перечисленныхbuild [bıld] (built, built) *v* строитьcomplicated ['kɔmplıkeıtıd] *a* сложныйcorrespond [**ֽ**kɔrıs'pɔnd] *v* 1. соответствовать; 2. переписыватьсяcorrespondence *n* соответствиеoff [ɔf] *зд.* выключениеon *зд.* включениеcircuit ['sɜ:kıt] *n* цепь, контурhigh [haı] *a* высокий power ['pauə] *n* 1. энергия, сила; 2. показатель степени *(мат.)*below [bı'ləu] ниже, подrecently ['ri:səntlı] недавно | squared [skweəd] в квадрате *(мат.)*switch [swıt∫] *n* переключатель; *v* переключать, включатьaccount [ə'kaunt] *n* счет, расчет, подсчетaccount for *v* объяснятьnotation [nəu'teı∫(ə)n] *n* обозначениеtherefore ['ðeəfɔ:] поэтомуadvantage [əd'vα:ntıʤ] *n* преимуществоdisadvantage [**ֽ**dısəd'vα:ntıʤ] *n* недостатокappear [ə'pıə] *v* 1. появляться; 2. казатьсяcompare [kəm'peə] *v* сравнивать, сопоставлять |

**Notes**

1. some centuries before – за несколько столетий до
2. in some of the most complicated – в некоторых наиболее сложных
3. as shown below – как показано ниже
4. 23 – two cubed or two to the third power

22 – two squared

1**×**23 – one multiplied by two to the third power

1. is the simplest – самый простой
2. well familiar with – хорошо знакомы с
3. the system has the advantage (disadvantage) of having – сиcтема обладает тем преимуществом (недостатком), что она имеет

**Exercise 3**

*Read the words below. Mind the combinations of letters producing* [л],[ɜ:], [əu], [au] *sounds.*

[л] – month, young, trouble, result, discover, other, some, rough, done, enough, mother, sum, above, just, country, among, sun, love, become, double, subject, jump, grudge, ton, come;

[ɜ:] – work, serve, dirty, early, world, search, burn, vertical, hurt, word, circuit, worse, firm, earn, term, were, firm, burst, journal;

[əu] – know, hold, open, so, process, told, own, note, road, approach, boat, motion, cold, slow, low, bold, grow;

[au] – about, stout, allow, house, count, amount, power, brown, countable, down, without, how.

**Exercise 4**

*Answer the following questions. Mind the irregular verbs.*

1. Where did you find this article? (in your journal) 2. When did you hold the conference? (two days ago) 3. When did he take his exam in physics? (last week) 4. What did you see at their laboratory? (very interesting tests) 5. What did his research adviser tell him? (to present his thesis) 6. What kind of research did he do? (important) 7. To whom did he speak about the advantages of their plan? (some foreign scientist) 8. When did professor read the abstract of your dissertation? (yesterday) 9. Where did they build the new computer? (at our Institute) 10. What did she teach you? (German)

**Exercise 5**

**a)** *Ask questions to which the sentences below could be answers;*

**b)** *Ask a general question about every sentence.*

1. There are two reasons that account for this situation. 2. This system of notation is widely used now. 3. This scientist worked in this laboratory in the latter part of the 19th century. 4. The binary system is another name for the base two system. 5. The minus sign indicates that the work cannot be started. 6. The plus sign indicates that the machine is operating well. 7. His brother failed his exam in the spring and therefore he must take it again in September. 8. They used a mechanical calculator for their work. 9. There is no correspondence between the results obtained by the two groups of researchers.

**Exercise 6**

*Practice reading these words.*

become, burn, out, bus, slow, another, sold, world, early, own, cover, powerless, under, load, research, curve, circle, fuss, country, double, trouble, word, boat, about, journal, young, counter, allow, among, without, grow, now, road, know, how, slowly.

**Exercise 7**

*Name the predicate in every sentence below. Translate the sentences.*

1. He is trying to find the value of «**a**». 2. This unimportant question need not be discussed during their meeting. 3. His first article was soon followed by another article in our journal. 4. All the data are being sent to them. 5. It is impossible to indicate the position of this planet at the moment. 6. Since the machine is not complicated they could easily operate it. 7. In a few months' time they are going to put into operation another computer. 8. The result obtained showed something quite unexpected. 9. He does not want to speak about the disadvantages of his method of research now. 10. The position of every digit is being changed. 11. They will be making some very interesting experiments at the lab. 12. The system introduced appeared new.

**Exercise 8**

*Disagree with each one of the statements below.*

1. You can leave the speed unchanged. 2. He switched off the circuit in due time. 3. I am familiar with his recent paper. 4. The book was written in the traditional classical manner. 5. He believes you can account for the application of this method of construction. 6. The binary system of notation is used in such cases. 7. The information obtained showed the real situation. 8. You can easily see the difference between these machines. 9. We are trying to find some additional facts. 10. There is something unusual about the article published by them. 11. The information is being checked. 12. They are applying new methods of research.

**Exercise 9**

*Read the text below. Give its short outline in Russian or English.*

**Base Two Numerals**

During the latter part of the seventeenth century a great German philosopher and mathematician Gottfried Wilhelm von Leibnitz (1646-1716), was doing research on the simplest numeration system. He developed a numeration system using only the symbols 1 and 0. This system is called a base two or binary numeration system.

Leibnitz actually built a mechanical calculating machine which until recently was standing useless in a museum in Germany. Actually he made his calculating machine some 3 centuries before they were made by modern machine makers.

The binary numeration system introduced by Leibnitz is used only in some of the most complicated2 electronic computers. The numeral 0 corresponds to *off* and the numeral 1 corresponds to *on* for the electrical circuit of the computer.

Base two numerals indicate groups of ones, twos, fours, eights, and so on. The place value of each digit in 1101two is shown by the above words (*on* or *off*)and also by powers of 2 in base ten notation as shown below3.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Jhbmnh

|  |  |  |  |
| --- | --- | --- | --- |
| …23Eights | Fours | 21Twos | 1Ones |
| 1 | 1 | 0 | 1 |

 | The numeral 1101two means(1**×**23)4 + (1**×**22) + (0**×**2) ++ (1**×**1) = (1**×**8) + (l**×**4) ++ (0**×**2) + (1**×**1) = 8 + 4 ++ 0 + 1 = 13. Therefore 1101two= 13. |

A base ten numeral can be changed to a base two numeral by dividing by powers of two.

From the above you know that the binary system of numeration is used extensively in high-speed electronic computers. The correspondence between the two digits used in the binary system and the two positions (on and off) of a mechanical switch used in an electric circuit accounts for this extensive use.

The binary system is the simplest5 place-value, power-position system of numeration. In every such numeration system there must be symbols for the numbers zero and one. We are using 0 and 1 because we are well familiar with6 them.

The binary numeration system has the advantage of having7 only two digit symbols but it also has a disadvantage of using many more digits to name the same numeral in base two than in base ten. See for example:

476=111011100two.

It is interesting to note that any base two numeral looks like a numeral in any other base. The sum of 10110 and 1001 appears the same in any numeration system, but the meaning is quite different. Compare these numerals:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 10110two |  | 10110ten |  | 10110seven |
| + **1001**two |  | + **1001**ten |  | + **1001**seven |

**Exercise 10**

*Listen and repeat. Guess the meaning of the italicized words.*

part–*partly;* philosopher–*philosophical;* use–usable–*useless*–*useful*–*usefulness*–*uselessness;* symbol–*to symbolize;* actually–*to act;* mechanical–*mechanically;* to make–*maker;* to introduce–*introduction;* to correspond–*correspondent a;* value–*valuable;* digit–*digital;* power–*powerful*–*powerless;* to change–*changeable*–*unchangeable;* used–*misused;* familiar–*familiarity;* base–*baseless;* to appear–*to disappear;* advantage–*advantageous.*

**Exercise 11**

*Give short 'yes' or 'no' answers to the following questions.*

**a)** 1. Were there any outstanding scientists at that congress? (Yes). 2. Are there various service facilities in the main University building? (Yes). 3. Are there students of different nationalities at this college? (Yes). 4. Is there anybody who knows German in your class? (No). 5. Will there be any exhibition at this museum in January? (No).

**b)** 1. Could you recognize these two people? (Yes). 2. Can you see any familiar faces among those who are present here? (No). 3. Must you stay in town over the week-end? (No). 4. May I leave early today? (No). 5. Must the children study these laws? (Yes).

**c)** 1. Did you believe all he said? (No). 2. Do they investigate the problems of heredity at their institute? (Yes). 3. Did he meet his parents at the station? (Yes). 4. Does your brother always have a shower before breakfast? (Yes). 5. Does your sister speak three foreign languages? (No).

**d)** 1. Was the information obtained considered in due time? (Yes). 2. Is her science adviser's recent book much spoken about? (Yes). 3. Were all of you asked to take part in this experiment? (No). 4. Were the advantages of the new method of control discussed by them yesterday? (Yes). 5. Was everybody told about the time of the examination? (Yes).

**e)** 1. Are they reconstructing this ancient building? (No). 2. Is he doing his morning exercises now? (No). 3. Were they having dinner when you came to the dining-room? (Yes). 4. Will the children be taking a walk in the park between eleven and twelve o'clock? (No). 5. Was he working at his article all day long on Sunday? (Yes).

**Exercise 12**

*Write down your answers with the help of a + or a* – *sign.*

1. Was Leibnitz doing his research in the twentieth century? 2. Did he develop a base-five system? 3. Did he use the binary system in his machine? 4. How many symbols did he use? 5. Does the numeral 1 correspond to the word «off»? 6. Does the numeral 0 correspond to the word «off»? 7. Are many high-speed electronic computers being used everywhere now? 8. Does the expression 0×1 = 0 hold for all numeration systems? 9. Must every numeration system have symbols that represent zero and one? 10. Has the binary numeration system advantages as well at (*так же как*) disadvantages?

**Exercise 13**

*Arrange the words according to the parts of speech they belong to.*

builder, calculate, calculation, indicator, indication, equality, useless, symbolic, notation, advantageous, powerful, classical, sameness, actually, correspondence, familiarity, activate, inversely, production, container, wholeness, baseless, physical, specially, successful, presence, appointment.

**Exercise 14**

*Disagree with the following statements and give the correct variant.*

Leibnitz developed a numeration system using three symbols.

No, he did not. He developed a numeration system using two symbols.

1. Leibnitz was doing his research on the simplest numeration system during the latter part of the 19th century. 2. The machine constructed by Leibnitz was used extensively in the 18th century. 3. The mechanical calculating machine was first built in England. 4. The binary numeration system was introduced in France. 5. The binary numeration system is used in some of the most primitive computers. 6. The numeral 0 corresponds to «on». 7. The place value of each digit in 1101two is unimportant. 8. A base ten numeral cannot be changed to a base two numeral. 9. High-speed electronic computers use base five numeration system. 10. In any numeration system there must be symbols for 1, 0, and 3. 11. The binary numeration system has no advantages over the base ten system. 12. The base ten system has no disadvantages.

**Exercise 15**

**a)** *Read the text;*

**b)** *Write a plan of the text in the form of questions;*

**c)** *Speak about Albert Einstein (work in pairs).*

**Albert Einstein**

Albert Einstein (['aınstaın]) was born ([bɔ:n]) in Germany 1879. His un'usual 'talent for mathematics and physics began to show when he was a student at a technical school in Zurich (['zjuərık]). At the age of 21, after four years of study at the university, he began to work as a clerk [klα:k] at an office. And in 1905 he made some revolutionary discoveries in science. He published three papers. In his first paper he explained ([ıks'pleın]) *объяснять*) the photoelectric effect with the help of M. Plank's quantum theory. His second paper was a mathematical development of the theory of Brownian motion (['məu∫(ə)n]). His third paper was about the «Special Theory of Relativity» ([**ֽ**relə'tıvıtı]). It must be mentioned (['men∫ən] *упоминать*) that a great contribution to the theory of relativity had been made earlier by the great mathematicians Lorentz and Poincaré. Einstein's work was published in a physical journal. It stated that energy equals mass multiplied by the square of the speed of light (*свет*). This theory is expressed by the equation: *E = mc2* [si:'skweəd].

Scientists all over the world met this Einstein's work with interest and surprise [sə'praız]. But only very few physicists realized (['rıəlaız] *осознавать*) the importance of his theory at that time.

Another of Einstein's great discoveries was his unified ['ju:nıfaıd] field theory. It was the result of 35 years of intensive research work. He expressed it in four equations where he combined the physical laws that control forces (силы) of light and energy with the mysterious [mıs'tıərıəs] force of gravitation [**ֽ**grævı'teı∫(ə)n].

Albert Einstein gave all his life to science. He was an extremely talented man and a great thinker. He was always looking at the world around him with his eyes ([aız] *глаза*) wide open and he was always asking: «Why? Why is that so?»

His ideas made a revolution in natural ['næt∫(ə)r(ə)l] sciences of the 20th century.

**Exercise 16**

*Read these words and guess the meaning of the italicized words.*

'talent–*'talented;* mass–*'massive;* speed–*to speed*–*'speedily*– *'speediness*–*spee'dometer;* to con'trol–*con'trollable*–*uncontrollable;* 'magnetism–*mag'netic;* to re'peat–*repe'tition;* to 'indicate–*indication;* gravi'tation–*gravitational;* to 'illustrate–*illus'tration;* to sur'prise–*a sur'prise*–*surprising;* mys'terious–*a 'mystery;* to con-'sult–*consul'tation;* 'final–*fi'nality;* to ob'tain–*ob'tainable.*

**Exercise 17**

*Give an adequate translation of each sentence below.*

1. Когда Лейбниц изучал простейшую систему счисления? 2. Сколькими символами он пользовался для своей системы счисления? 3. Эта система называется двоичной, так как она использует только две цифры. 4. По существу он создал вычислительную машину три века назад. 5. Какого рода вычислительные машины строят современные ученые? 6. Чему соответствует число 0 в этой системе? 7. Число 1 означает включение. 8. Современные электронные счетные машины очень сложны. 9. Число 1101 в двоичной системе соответствует числу 13 в десятеричной системе. 10. В любой системе счисления должны быть цифры 1 и 0. 11. Двоичная система имеет некоторое преимущество. 12. Каковы недостатки этой системы?