Olena Horenko

ADVANCED ENGLISH FOR MATHEMATICIANS

Textbook

Third, extended edition

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Our age is the age of communication. In the atmosphere of constantly developing scientific technologies we have to resort to various kinds of communication to tackle appropriate subjects. For the future specialists in the sphere of mathematics and informatics such a kind of communication includes the following abilities: to comprehend special literature and express oneself on different professional topics. On the one hand, such an approach helps the students to enlarge vocabulary of special terminology within the frames of those grammar constructions (infinitival, gerundial and participial), which are widely used in the language of science. On the other hand, it helps to develop practical skills in oral English for professional purposes, to learn the models for writing annotations to scientific texts.

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INTRODUCTORY WORD

Our age is the age of communication. In the atmosphere of constantly developing scientific technologies we have to resort to various kinds of communication to tackle appropriate subjects. Considering all these challenges that accompany information age, we should be ready to meet them adequately and develop our communicative skills. Those who care about learning and thinking have to be well prepared for communication in the linguistic universe aimed at learners' increase of professional potential and vision.

For the future specialists in the sphere of mathematics and informatics such a kind of communication includes the following abilities: to comprehend special literature and express oneself on different professional topics, to be ready to write a report and participate in discussions at conferences, to speak shop with foreign colleagues. Thus, a student has to get acquainted with a great amount of information, to study it creatively, and, what is more important, to express his/her individual position and personal attitude to this question.

Free communication on professional level presupposes two tasks: one must learn computer terminology, what can be a daunting task; one must know grammar to use this terminology correctly. With this end in view, modern texts on mathematics, informatics and cybernetics are applied for all-round study. Thus, the task to teach students correct grammar constructions is carried out on the basis of these special texts. The core of this manual are exercises which are divided into four types. Grammar exercises and word-formation exercises give the students facility of expression. Translation assignments are suggested with the view of training the students' abilities to express their thoughts in English. Comprehension exercises are aimed at oral practice. They are designed to provoke thought and discussion. The book comprises 9 units based on lexical and grammatical material, two units (Unit 10 and Unit 11) which hold material for students' individual work and Supplement including Mathematical Symbols and Signs (parts A, B).

On the one hand, such an approach helps the students to enlarge vocabulary of special terminology within the frames of those grammar constructions (infinitival, gerundial and participial), which are widely used in the language of science. On the other hand, it helps to develop practical skills in oral English for professional purposes, to learn the models for writing annotations to scientific texts.

UNIT 1

INTRODUCTION
TO THE PROBLEM OF SCIENTIFIC DEVELOPMENT

Grammar:
Types of sentences and clauses:
1. Syntax: Simple sentences. Compound sentences. Complex sentences.
2. Clauses.

GRAMMAR PATTERNS
Sentences.

Simple sentences
- Now the situation is oddly similar.
- But late in the final decade a few curiosities came to light.

Compound Sentences
- Once again the physical world has been explained and no further revolutions lie ahead.
- This is an effort on many fronts to create a new technology and it promises to revolutionize our ideas.

Complex sentences
Most of these developments could not have been predicted in the end of the XIX-th century, because prevailing scientific theory said they were impossible.

Clauses

Subject Clauses
- *What requires additional information* is your last statement.
- *That physicists remained calm* was quite natural.
- *Whether these oddities could be explained by existing theories* was not clear.
- *When some doubts as to the correctness of the existing theories appeared* is not definitely known.
- *That travelling through time into the future is possible* has long been an accepted fact:
- It is not strange *that science developed unevenly – by fits and starts.*
- It is not surprising *that on the threshold of the twenty-first century the situation is oddly similar*

Predicative Clauses
- The problem is *that nobody knows in what direction science will develop*
- The question is *whether the quantum state of one entity could be transported to another entity.*
- Research in quantum technology is *what may be called a new field of interaction-free detection.*

Object Clauses
- A hundred years ago scientists around the world thought *that they had arrived at an accurate picture of the physical world.*
- No one would have predicted *that within five years their complacent view of the world would be shockingly upended.*

Attributive Clauses
And for the few developments *that were not impossible, such as airplanes,* the sheer scale of their eventful use would defy imagination.
Even the most informed scientists had no idea *what was to come.*
Quantum technology flatly contradicts our common sense ideas *of how the world works.*

EXERCISES

Exercise 1. Analyse the following sentences. Say whether a sentence is simple, compound or complex. Segment complex sentences and identify the type of the clause.
1. The National Aeronautics and Space Administration conducted a third and final test flight of the unmanned X-43A aircraft, which uses an experimental jet engine designed to push the craft to nearly 10 times the speed of sound. 2. At a post-flight news conference Tuesday, mission managers said they had only begun to look at the data. 3. In the 1990s, research in quantum technology began to show results. 4. An unimaginably powerful computer can be built from a single molecule. 5. By the end of the nineteenth century it seemed that the basic fundamental principles governing behavior of the physical universe were known. 6. The test flight lasted only a couple of minutes and ended when the aircraft ran out of fuel. 7. The test flight was originally scheduled for Monday, but technical problems forced NASA to postpone it for 24 hours. 8. SMART-1 will also

investigate the theory that the moon was formed following the violent collision of a smaller planet with Earth, some 4.5 billion years ago. 9. One might have imagined an airplane – but ten thousand airplanes in the air at the same time would have been beyond imagination.

Exercise 2. Divide the following compound, complex or compound-complex sentences into simple ones.

1. The temperature of the corona is so high that the Sun's gravity can't hold on to it. 2. Although the solar wind is always directed away from the Sun, it changes speed and carries with it magnetic clouds, interacting regions where high speed wind catches up with slow speed wind and composition variations. 3. The Advanced Composition Explorer (ACE) has a number of instruments that monitor the solar wind and the spacecraft team provides real-time information on solar wind conditions at the spacecraft. 4. Yet on the whole, physicists remained calm, expecting that these oddities would eventually be explained by existing theory. 5. Some observers have even gone so far as to argue that science as a discipline has finished its work. 6. One of the most important is the interest in so-called quantum technology that utilizes the fundamental nature of subatomic reality, and it promises to revolutionize our ideas of what is possible. 7. That travelling through time into the future is possible has long been an accepted fact: not only are we all en route into the future at any given moment, but Einstein's theory of special relativity proves that time goes slower if you are moving at very high speed.

Exercise 3. Transform simple sentences into compound, complex or compound-complex ones.

1. A lot of oddities couldn't be explained by existing theory. Physicists remained calm. 2. Roentgen discovered the rays. The rays passed through flesh. 3. These rays were unexplained. He called them X rays. 4. Some observers have even gone rather far. They argued. Science as discipline has finished its work. 5. Now we stand on the threshold of the twenty – first century. The situation is oddly similar. 6. The moon is a key witness of the early conditions. Life emerged on our planet. 7. SMART-1 is the first European spacecraft. It travels to and orbits around the moon. 8. We have some elemental maps of the moon from Clementine and Lunar Prospector. We are missing information on the critical elements aluminum and magnesium. 9. There is no agreement. We'll have to think over how we go ahead with a maximum number of partners who want to participate.

Exercise 4. Match subjects (A-F) to the parts of the sentences (1–6)
1. ….. was not quite surprising.
2 ….. is your last experiment.
3. ….. is not definitely known.
4. It is not surprising…
5. It is not strange…
6. … is far from being clear.
A. When some doubts as to the correctness of the existing theories appeared. B. that science developed unevenly – by fits and starts. C.What requires additional work D. that on the threshold of the twenty-first century the situation is oddly similar. E. That physicists remained calm F. Whether these oddities can be explained by existing theories.
Exercise 5. Read the text and be ready to discuss it.

The Solar Wind

A. The solar wind streams off of the Sun in all directions at speeds of about 400 km/s (about 1 million miles per hour). The source of the solar wind is the Sun's hot corona. The temperature of the corona is so high that the Sun's gravity cannot hold on to it. Although we understand why this happens we do not understand the details about how and where the coronal gases are accelerated to these high velocities. This question is related to the question of coronal heating.

B. The solar wind is not uniform. Although it is always directed away from the Sun, it changes speed and carries with it magnetic clouds, interacting regions where high speed wind catches up with slow speed wind and composition variations. The solar wind speed is high (800 km/s) over coronal holes and low (300 km/s) over streamers. These high and low speed streams interact with each other and alternately pass by the Earth as the Sun rotates. These wind speed variations buffet the Earth's magnetic field and can produce storms in the Earth's magnetosphere.

C. The Ulysses spacecraft has now completed one orbit through the solar system during which it passed over the Sun's south and north poles. Its measurements of the solar wind speed, magnetic field strength and direction, and composition have provided us with a new view of the solar wind.

D. The Advanced Composition Explorer (ACE) satellite was launched in August of 1997 and placed into an orbit about the L1 point between the Earth and the Sun. The L1 point is one of several points in space where the gravitational attraction of the Sun and Earth are equal and opposite. This particular point is located about 1.5 million km (1 million miles) from the Earth in the direction of the Sun. ACE has a number of instruments that monitor the solar wind and the spacecraft team provides real-time information on solar wind conditions at the spacecraft.

Exercise 6. Read the article about the solar wind again. For questions (1–7) choose from the extracts (A-D).

The Solar Wind

which extract(s):
refers to speed changes? (1)____________
refers to the origin of this wind? (2)____________
refers to the point of gravitational attraction? (3)____________
are about special devices launched to study solar wind? (4)____________
explains the storms in the Earth's magnetosphere? (5)____________
mentions measurements of the wind speed? (6)____________
refers to coronal gases? (7)____________

WORD-FORMATION

Exercise 1. Form adjectives from the following verbs by adding suffix -"able". Translate them into Ukrainian.

Example: comfort-comfortable

1. rely 2. desire 3. read 4. explain 5. manage 6. use 7. forget 8. predict 9. measure 10. remove 11. renew 12. imagine 13. agree 14. enjoy. 15. depend 16 consider 17. prove 18. computer.

Exercise 2. Form adjectives from the following verbs by adding suffix -"ive". Translate them into Ukrainian.

Example:express – expressive

1. collect 2. impress 3. conduct 4. act 5. oppress 6. effect 7. dominate 8. adapt 9. compress.

Exercise 3. Form nouns from the following adjectives by adding suffix – (i)"ty". Translate them into Ukrainian.

Example: odd – oddity; curious – curiosity.

diverse 2. hostile 3. complex 4. reliable 5. historic 6. active 7. formal 8. probable 9. topical 10. universal 11. certain 12. vital 13. modern 14. safe 15. prior 16. valid 17. severe 18. special 19. novel 20. mature 21. local 22. possible 23. able 24. capable 25. noble 26. obscure 27. modal 28. adaptive 29. conductive 30. passive. 31. computable 32. tractable 33. applicable 34. clear 35. lucid.

Exercise 4. Translate the following words into English:
1. різноманіття 2. вимірюваність 3. новизна 4. ймовірність 5. можливість 6. здатність 7. актуальність 8. складність 9. надійність 10. модальність 11. сучасність 12. передбачуваність 13. активність 14. проводимість 15. пасивність. 16. ясність 17. прозорість.

Exercise 5. Make up sentences with the following word-combinations
1. diversity of colors; diversity of methods; diversity of species. 2. complexity of the problem; complexity of structures; complexity of such an approach. 3. probability theory; probability of a solution. 4. reliability of equipment; reliability of software. 5. topicality of the thesis. 6. safety belt; safety code; safety factor.

Exercise 6. Translate the sentences using the Subject Clauses:
1. Що приваблює більш за все у цій картині, так це різноманіття кольорів. 2. Що ми можемо втратити, так це різноманіття видів. 3. Що потребує найбільшої уваги – це складність такого підходу. 4. Що варто обговорити зараз – це вірогідність вирішення. 5.Що слід перевірити – це надійність обладнання. 6. Що ми можемо відкинути – це фактор ризику. 7. Що ви не визначили у роботі – це її новизну.

Exercise 7. Translate the sentences paying attention to the underlined words:
1. По-перше, ви повинні визначити актуальність вашої роботи. 2. По-друге, вам слід акцентувати її новизну. 3. Автентичність знахідки була підтверджена різними аналізами. 4. Суворість навколишнього середовища повною мірою компенсувалась щирістю та гостинністю місцевих мешканців. 5. Ясність та прозорість висновків свідчать про високий науковий рівень проведеного дослідження.

Text 1

Science at the end of the Century

A hundred years ago, as the nineteenth century drew to a close, scientists around the world were satisfied that they had arrived at an accurate picture of the physical world. As physicist Alastair Rae put it, "By the end of the nineteenth century it seemed that the basic fundamental principles governing the behavior of the physical universe were known" (Alastair I.M. Rae, Quantum Physics: Illusion or reality? Cambridge, Eng.: Cambridge University Press, 1994). Indeed, many scientists said that the study of physics was nearly completed: no big discoveries remained to be made, only details and finishing touches.

But late in the final decade, a few curiosities came to light. Roentgen discovered rays that passed through flesh; because they were unexplained, he called them X rays. Two months later, Henry Becquerel accidentally found that a piece of uranium ore emitted something that fogged photographic plates. And the electron, the carrier of electricity, was discovered in 1897.

Yet on the whole, physicists remained calm, expecting that these oddities would eventually be explained by existing theory. No one would have predicted that within five years their complacent view of the world would be shockingly upended, producing an entirely new conception of the universe and entirely new technologies that would transform daily life in unimaginable ways.

If you were to say to a physicist in 1899 that in 1999, a hundred years later, moving images would be transmitted into homes all over the world from satellites in the sky; that bombs of unimaginable power would threaten the species; that antibiotics would abolish infectious disease but that disease would fight back; that women would have to vote; that millions of people would take to the air every hour in aircraft capable of taking off and landing without human touch; that you could cross the Atlantic at two thousand miles an hour; that humankind would travel to the moon, and then lose interest; that microscopes would be able to see individual atoms; that people would carry telephones weighing a few ounces, and speak anywhere in the world without wires; or that most of these miracles depended on devices the size of a postage stamp, which utilized a new theory called quantum mechanics – if you said all this, the physicists would almost certainly pronounce you mad.

Most of these developments could not have been predicted in 1899, because prevailing scientific theory said they were impossible. And for the few developments that were not impossible, such as airplanes, the sheer scale of their eventual use would have defied comprehension. One might have imagined an airplane – but ten thousand airplanes in the air at the same time would have been beyond imagining. So it is fair to say that even the most informed scientists, standing on the threshold of the twentieth century, had no idea what was to come.

Now in the beginning of the twenty-first century the situation is oddly similar. Once again, physicists believe the physical world has been explained, and that no further revolutions lie ahead. Because of prior history, they no longer express this view publicly, but they think it just the same. Some observers have even gone so far as to argue that science as a discipline has finished its work; that there is nothing important left for science to discover. But just as the late century gave hints of what was to come, so the late twentieth century also provided some clues to the future. One of the most important is the interest in so-called quantum technology that utilizes the fundamental nature of subatomic reality, and it promises to revolutionize our ideas of what is possible.

Quantum technology flatly contradicts our common sense ideas of how the world works. It posits a world where computers operate without being turned on and objects are found without looking for them. An unimaginably powerful computer can be built from a single molecule. Information moves instantly between two points, without wires or networks. Distant objects are examined without any contact. Computers do their calculations in other universes. And teleportation – "Beam me up, Scotty" – is ordinary and used in many different ways.

In 1990s, research in quantum technology began to show results. In 1995, quantum ultrasecure messages were sent over a distance of eight miles, suggesting that a quantum Internet would be built in the coming century. In Los Alamos physicists measured the thickness of a human hair using laser light that was never actually shone on the hair, but only might have been. This bizarre, "counterfactual" result initiated a new field of interaction-free detection: what has been called "finding something without looking". And in 1998, quantum teleportation was demonstrated in three laboratories around the world – in Innsbruck, in Rome and at Cal Tech. Physicist Jeff Kimble, leader of the Cal Tech team, said that quantum teleportation could be applied to solid objects: "The quantum state of one entity could be transported to another entity… We think we know how to do that". (Michael Crychton "Timeline" – Introduction to the novel).

Active vocabulary

Discovery, curiosity, oddity, uranium ore, photographic plates, moving image, satellite, humankind, miracle, scale, comprehension, threshold, quantum technology, teleportation, entity, interaction-free detection, species. To pass through, to emit, to fog, to upend, to transmit, to abolish, to predict, to defy, to give hints, to beam up.

Accidentally, entirely, unimaginably, instantly.

VOCABULARY AND COMPREHENSION EXERCISES

Exercise 1. Translate into Ukrainian the following word combinations:
1. accurate picture of the physical world 2. fundamental principles 3. finishing touch 4. entirely new conception 5. existing theory 6. complacent view of the world 7. prevailing scientific theory 8. eventual use 9. counterfactual result 10. ultrasecure message 11. moving images 12. to defy comprehension.

Exercise 2. Find in the text the English equivalents of:
1. наблизитися до кінця; 2. створити детальну картину; 3. принципи, що керують поведінкою всесвіту; 4. але в цілому; 5. дивні речі; 6. цілковито нова концепція; 7. самозадоволене сприйняття світу; 8. величезна потужність; 9. офіційна наукова теорія; 10. робити виклик здоровому глузду; 11. надзвичайно надійні повідомлення; 12. безконтактне виявлення.

Exercise 3. Find in the text synonyms to the following nouns, verbs and adjectives.
Essence (being), wonder, scope, strange thing, to cloud, to radiate, to terminate, to attack, to cancel, to challenge, to come to an end, to start a trend, to utilize, haphazardly, unpredictable, whimsical, completely safe.

Exercise 4. Translate into English using active vocabulary of the text:
1. Сто років тому назад, наприкінці XIX століття вчені були задоволені своїм рівнем знань, оскільки вважали, що створили точну картину фізичного світу. 2. У цей період не виникало жодного сумніву стосовно того, що фундаментальні принципи, котрі визначають поведінку фізичного Всесвіту, були відомі. 3. Але наприкінці останньої декади кілька дивних речей привернули до себе увагу. 4. По-перше, були відкриті якісь невідомі промені, котрі могли проходити крізь матеріальне тіло; по-друге, був відкритий електрон, носій електричного струму; а по-третє, цілком випадково було відкрите якесь дивне випромінювання платівок з уранової руди. 5. Але в цілому учені залишались спокійними, оскільки очікували, що врешті-решт ці дива будуть пояснені існуючими теоріями. 6. Ніхто у той час не міг навіть передбачити, що через сто років рухливі образи передаватимуться у домівки по всьому світу за допомогою супутників; що людство подорожуватиме до Місяця; що людиноситимуть телефони, котрі важать не більше однієї унції; що потужні комп'ютери допомагатимуть людям вирішувати різні складні завдання. 7. Більшість із цих відкриттів не могла би бути передбаченою у 1899 році, оскільки

вони були неможливі згідно з домінуючою науковою теорією. 8. Проте без перебільшення можна сказати, що за XX століття наука зробила такий величезний крок уперед, якого вона ще досі не робила. 9. На перший погляд ситуація у науковій сфері XXI століття є дуже подібною до аналогічної ситуації наприкінці XIX століття. 10. Втім існують і деякі розбіжності. 11. Якщо наприкінці XIX століття важко було передбачити деякі перспективні напрямки розвитку науки, то наприкінці XX століття певні наукові пріоритети вже були визначені. 12. До таких науково-технічних пріоритетів можна віднести: подальший розвиток нанотехнологій, квантову фізику й механіку, розкодування геному людини, коду ДНК, подальше вивчення вірусології тощо. 13. Слід також відзначити неабиякий інтерес учених до подальшого вивчення численних загадок космосу. 14. Немає жодного сумніву, що у найближчому майбутньому будуть створені нові типи комп'ютерів, заснованих на нових принципах дизайну. 15. Тобто можна підсумувати, що ми живемо у ту добу, коли наукова фантастика стає дійсністю, а дійсність, у свою чергу, стає фантастикою.

Exercise 5. Write an annotation to the text. Make use of the following words and word-combinations:

1. The title of the article is… (the article is entitled…; the article under consideration is headlined …). 2. The main idea of the article is … (the article deals with …; the article is about …; the article is connected with …). 3. First (firstly, on the one hand) the author states (emphasizes, informs) that… 4. Second (secondly, on the other hand) the author pays special attention to … (underlines the fact, that …). 5. Besides (moreover, in addition to the above facts/information) it should be mentioned (noted, taken into consideration) that …6. All in all (in general, on the whole) the article is …. 7. To my mind (in my opinion, as for me) the problem (method/technique) accentuated here is ….

Exercise 6. Discuss the text

1. What is the text about? 2. What is the main idea of the text? 3. What other titles would you give to the text? 4. Is the progress of science predictable? 5. Why shouldn't scientists be complacent as to the process of scientific research? 6. What other discoveries, not mentioned in the text, couldn't even be predicted? 7. What is quantum technology? 8. In what way can quantum technology revolutionize the world? 9. Do you believe in quantum teleportation?

Exercise 7. Read a fragment from M.Crichton's novel "Timeline" and try to give a definition to the terms "quantum physics" and "quantum theory'.

A hundred years ago physicists understood that energy – like light or magnetism or electricity – took the form of continuously flowing waves. We still refer to "radio waves" and "light waves". In fact, the recognition that all forms of energy shared this wavelike nature was one of the great achievements of nineteenth-century physics. But there was a small problem. It turned out that if you shined light on a metal plate, you got an electric current. The physicist Max Planck studied the relationship between the amount of light shining on the plate and the amount of electricity produced, and he concluded that energy wasn't a continuous wave. Instead, energy seemed to be composed of individual units, which he called quanta. The discovery that energy came in quanta was the start of quantum physics. A few years later, Einstein showed that you could explain the photoelectric effect by assuming that light was composed of particles, which he called photons. These photons of light struck the metal plate and knocked off electrons, producing electricity. Mathematically, the equations worked. They fit the view that light consisted of particles. And pretty soon physicist began to realize that not only light, but all energy was composed of particles. In fact, all matter in the universe took the form of particles. Atoms were composed of heavy particles in the nucleus, light electrons buzzing around on the outside. So, according to the new thinking, everyting is particles, which are discrete units or quanta. And the theory that describes how these particles behave is quantum theory. It is a major discovery of twentieth century physics.

These particles are very strange entities. You can't be sure where they are, you can't measure them exactly, and you can't predict what they will do. Sometimes they behave like particles, sometimes like waves. Sometimes two particles will interact with each other even though they are a million miles apart, with no connection between them. And so on. The theory is starting to seem extremely weird. On the one hand it gets confirmed, over and over. It's the most proven theory in the history of science. Supermarket scanners, lasers and computer chips all rely on quantum mechanics. So there is absolutely no doubt that quantum theory is the correct mathematical description of the universe. But, on the other hand, the problem is that it's only a mathematical description. It's just a set of equations. And physicists couldn't visualize the world that was implied by those equations – it was too weird, too contradictory. (Michael Crychton “Timeline” – pp. 124-125).

Exercise 8. Read the text again and express your agreement or disagreement with the following statements:

1. The recognition that all forms of energy shared wavelike nature was one of the great achievements of nineteenth-century physics. 2. Energy is a continuous wave. 3. Everything is particles, which are discrete units or quanta. 4.You can easily measure quantum particles. 5.Quantum theory is the correct mathematical description of the universe. 6.Scientists comprehend all the aspects of quantum theory.

Exercise 9. Translate the following passage into English, paying special attention to types of sentences.

Кажуть, що квантова теорія не задовольняє, тому що вона є лише дуалістичним описом природи за допомогою взаємодоповнюючих понять „хвиля" і „частка". Але тому, хто дійсно зрозумів квантову теорію, ніколи вже не спаде на думку говорити про дуалізм. Він буде сприймати цю теорію як цілісний опис атомних явищ. Квантова теорія виявляється вражаючим прикладом того, як можна зрозуміти певні обставини з цілковитою чіткістю і тим не менш все ж знати, що про них можна говорити лише в образах і символах. Образами і символами слугують, по суті, класичні поняття. Вони не відповідають в точності реальному світові. Однак, оскільки при описі явищ необхідно залишатись у просторі природної мови, до істинного стану речей можна наблизитись, лише спираючись на ці образи.
(Вернер Гейзенберг. Фізика і філософія)

Exercise 10. Answer the following questions:

1. Do you believe that it is possible to travel in time? 2. What books about time travel have you read? 3. What do you know about the history of time travel?

Exercise 11. Read the text and be ready to discuss it.

Time machine

The physicist Amos Ori from Technion, the Israel Institute of Technology in Haifa, claims to have found the first realistic model of a time machine which can transport us into the past.

That travelling through time into the future is possible has long been an accepted fact: not only are we all en route into the future at any given moment, but Einstein's theory of special relativity proves that time goes slower if you are moving at very high speed. If you take a journey on fast space ship, then when you come back to earth, time there will have passed faster than it did for you, and you effectively jump into the future (this phenomenon is known as time dilation).

Time travel into the past, however, is an entirely different matter. Einstein's general theory of relativity postulates that space can be curved by the gravitational force exerted by objects of very large mass. It also says that time and space are inextricably linked to each other, so that time, as well, could be curved. As the eminent mathematician Kurt Gödel discovered in the 1940s, there is nothing in Einstein's theory to prevent a line in time from curving back on itself and reconnecting to a point that is in the past.

However, time travel into the past throws up an enormous paradox: what if you travel back in time and murder your grandfather before he had a chance to meet your grandmother? Then would you exist or not? Some people believe that this seemingly insurmountable obstacle proves that time travel is impossible. Moreover, none of us humans has ever reported meeting a visitor from the future. This, according to the sceptics, means that either travel into the past is impossible - and that there are as yet unknown laws of nature that prevent it - or that it will be possible at some point in the future, but that the people in that future will not be able to travel back as far as now. A potential solution to the paradox comes from quantum theory, according to which all possible realities could exist simultaneously in parallel universes. If you travel into the past and murder your granddad, then this past will be in a universe in which you do not exist.

Paradox or not, adventurous theorists have never been able to resist building models of time machines. However, the ones that have been proposed so far all require the universe to have some very unlikely characteristics. Gödel's model, for example, supposes that the universe does not expand. Others, like the wormhole model, require large amounts of negative matter. Matter of this type has negative mass, so that gravity, rather than attracting it, pushes it away – negative matter falls upward. Although some physicists believe that this matter does exist in the universe in small quantities, no-one has ever found any of it.

Quantum-mechanical phenomenon such as quantum teleportation might appear to create a mechanism that allows for faster-than-light (FTL) communication or time travel, and in fact some interpretations of quantum mechanics such as the Bohm interpretation presume that some information is being exchanged between particles instantaneously in order to maintain correlations between particles. This effect was referred to as «spooky action at a distance» by Einstein.

Exercise 12. Be ready to speak on:
1. The future development of science, its perspectives and expectations.
2. The development of science in the XX-th century.
3. The paradoxes of scientific development.
4. Time machine as a reality and fantasy.

MIXED BAG

Exercise 1. Give opposite of the following words:
Ex.: good –bad.
1. quick; 2. soft; 3. absolute; 4. artificial; 5. modern; 6. simple; 7. skinny; 8.industrious; 9. generous; 10. constant; 11. high; 12. deep; 13. hot; 14. knowledgeable; 15. to accept; 16. to borrow; 17. to buy; 18. to go; 19. to finish; 20. to move; 21. to stop.
Exercise 2. Find in section B synonyms to the adjectives in the section A:
Section A. 1. shy; 2. greedy; 3. deep; 4. inattentive; 5. productive
Section B. 1. avid; 2. modest; 3. profound; 4. timid; 5. fruitful; 6. meek; 7. avaricious; 8. absent-minded; 9. gentle; 10. prolific; 11. humble; 12. creative; 13. close-fisted; 14. bottomless; 15. careless; 16. efficient; 17. creative.
Exercise 3. Give the names of persons specializing in the spheres of:
Physics, mathematics, geology, astronomy, philology, programming, history, chemistry, biology, geography, law, medicine, mecanics, architecture, economy, cybernetics, psychology, sociology.
Exercise 4. Read the list of interesting facts and be ready to continue it:
Do you know that ...
- the difference between a hot substance and a cold one is in the movement of the atoms?
- the largest eggs are laid by sharks and ostriches?
- some snakes have legs?

Exercise 5. Try to guess the following riddles:
What, by losing an eye, has nothing left but a nose?
What is it that you have at every meal but never eat?
What is full of holes, but holds water?
Exercise 6. Put the following sentences in active voice:
The server is notified by the website manager that retrieval of the data must be performed by the account holder.
Various options are generally made in user choice.
Provision of textbook materials should be offered by the instructor.

UNIT 2

HISTORY OF MATHEMATICS

Grammar:
1. The Subject
2. The Predicate
3. Emphatic construction “It is…that” and its modifications

GRAMMAR PATTERNS

The Subject

The subject can be expressed by: a) a noun or a pronoun	**Mathematics** is the study of quantity, structure, space, change, and related topics of pattern and form. **This** is also the original meaning in English.
b) *it, one, they, we, you* as an impersonal formal subject	If **one** considers science to be strictly about the physical world, then mathematics, or at least pure mathematics, is not a science. **You** never believe in such things.
c) a subject clause	**That the word mathematics comes from the Greek** is a widely known fact. It is not surprising, **that mathematicians seek out patterns whether found in numbers, space, natural science, computers or imaginary abstractions.**
d) an infinitive, gerund or special constructions with non-finite forms of the verb	This material will be analysed in units 5, 7, 9

Exercise 1.Translate the sentences into Ukrainian identifying the subject:

1. From the beginning of recorded history, the major disciplines within mathematics arose out of the need to do calculations relating to taxation and commerce. 2. These needs can be roughly related to the broad subdivision of mathematics into the studies of quantity, structure, space, and change. 3. We may be sure that knowledge and use of basic mathematics have always been an inherent and integral part of individual and group life. 4. One should remember the main symbols of mathematics. 5. It is not strange that mathematics is used throughout the world as an essential tool in many fields, including natural science, engineering, medicine, and the social sciences. 6. That mathematical discoveries have been made throughout history and continue to be made today is a fact that can't be denied. 7. That even the „purest" mathematics often turns out to have practical applications is what Eugene Wigner has called „the unreasonable effectiveness of mathematics".

The Predicate.

The simple predicate	Mathematicians **formulate** new conjectures and establish their truth by rigorous deduction. The mathematician Benjamin Pierce **called** mathematics "the science that draws necessary conclusions". At first these problems **were found** in commerce and land measurement.
The compound predicate	Refinements of the basic ideas **are visible** in mathematical texts originating in different regions. Mathematicians often **strive to find** proofs of theorems that are particularly elegant. Mathematical language **can** also **be hard** for beginners.

Exercise 2. Identify the type of the predicate in the given sentences.

1. Mathematics has since been greatly extended, and there has been a fruitful interaction between mathematics and science, to the benefit of both. 2. Modern notation makes mathematics much easier for the

professional. 3. Rigor is fundamentally a matter of mathematical proof. 4. Mathematicians want their theorems to follow from axioms by means of systematic reasoning. 5. Fields Medal is often considered the equivalent of science's Nobel Prizes. 6. Experimental mathematics continues to grow in importance within mathematics. 7. These four needs can be roughly related to the broad subdivision of mathematics into the study of quantity, structure, space, and change.

Emphatic constructions

is smb. who It was + smth. + that has been somewhere where	1. **It is he who** found the solution. 2. **It was this experiment that** brought the success. 3. **It was in Los Alamos** where the A-bomb was created.	1. **Саме він** знайшов вирішення. 2. **Саме цей експеримент** приніс результат. 3. **Саме у Лос Аламосі** була створена атомна бомба.

Exercise 3. Translate the following sentences into Ukrainian

1. It was mathematics that first arose from the practical need to measure time and to count. 2. It was Thales who used geometry to solve problems such as calculating the height of pyramids. 3. It was in the ancient Egypt where people were able to solve many different kinds of practical mathematical problems, including the intricate calculations necessary to build the pyramids. 4. It was the Pythagoreans who proved the existence of irrational numbers. 5. It was Indian decimal place-valued number system, including zero, that was especially suited for easy calculation. 6. It was the Arabs who learned of the considerable scientific achievements of the Indians, including the invention of a system of numerals (now called,"Arabic" numerals).

Exercise 4. Make the following sentences emphatic

1. Archimedes of Syracuse used the method of exhaustion to calculate the area under the arc of a parabola. 2. Al-Khwarizmi introduced the name (al-jabr) that became known as algebra. 3. In the 17th century Napier, Briggs and others greatly extended the power of mathematics as a calculatory science with the discovery of logarithms. 4. Euler is

considered to be the most important mathematician of the 18th century. 5. Toward the end of the 18th century, Lagrange began a rigorous theory of functions and of mechanics. 6. In a 1900 speech to the International Congress of Mathematicians, David Hilbert set out a list of 23 unsolved problems in mathematics.

Exercise 5. Translate the following sentences into English

1.Саме такий підхід дозволяє вирішити цю проблему. 2. Саме Архімед використовував цей метод. 3. Саме у XVII сторіччі математика потужно розвивалась як наука обчислення. 4. Саме у цій промові Гілберт висунув список невирішених математичних проблем. 5. Саме з розвитком цивілізації зростала і роль математики у вирішенні різних суспільних завдань. 6. Саме у добу середньовіччя великий внесок у розвиток математики зробили араби.

WORD-FORMATION

Exercise 1. Form nouns from the following verbs by adding suffix "ment". Translate them into Ukrainian.

Example: attach – attachment

1. measure 2. establish 3. equip 4. achieve 5. announce 6. advertise 7. abolish 8. require 9. embarrass 10. punish 11. enchant 12. denounce 13. agree 14. arm 15. disarm 16. accomplish 17. fulfil 18. attach.

Exercise 2. Translate the following words into English:

1. озброєння 2. відданість 3. обладнання 4. спростування 5. досягнення 6. скасування 7. вимірювання 10. виконання 11. анонсування 12. вимога 13. покарання 14. домовленість 15. завершення.

Exercise 3. Make up sentences with the following words and word-combinations

1. abolishment of corporal punishment 2. considerable achievement 3. precise measurement 4. out-of date equipment 5. international agreement 6. modern scientific achievements.

Exercise 4. Translate the following sentences into English paying special attention to the underlined words:

1. Немає сумніву, що XXI століття принесе нові досягнення у сфері науки. 2. Виконання всіх вимог безпеки є передумовою надійного функціонування цього пристрою. 3. В Україні скасовано смертну кару. 4. У ході переговорів були досягнуті домовленості по найбільш важливим питанням. 5. Проблема роззброєння зберігає свою актуальність з урахуванням небезпеки загострення регіональних конфліктів.

History of Mathematics

Exercise 1. Answer the following questions:

1.What do you know about the origin of mathematics? 2. How would you define the evolution of mathematics? 3. In what way would you support the idea that mathematics is the queen of science?

Exercise 2. Read and translate the active vocabulary of the text using a dictionary:

1. to measure 2. to count 3. evidence 4. to be scored 4. to be revealed 5. cave 6. pottery 7. sophisticated 8. intricate 9. thumb 10. sexagesimal 11. decimal 12. height 13. precursor 14. approximation 15. summation 16. surface 17. to be skilled in 18. probability 19. conjecture 20. differential 21. insight 22. to herald 23. to span 24. consequence.

Exercise 3. Give Ukrainian equivalents of the English ones:

method of exhaustion; quadratic equation; quadratic reciprocity; rigorous approach; integer congruencies; major effect; continuum hypothesis; to be loosely formulated; wide range.

Exercise 4. Read and translate the text:

A brief history of mathematics

Mathematics first arose from the practical need to measure time and to count. The earliest evidence of primitive forms of counting occurs in scored pieces of wood and stone. Early uses of geometry are revealed in patterns found on ancient cave walls and pottery. As civilizations arose in Asia and the Near East, sophisticated number systems and basic knowledge of arithmetic, geometry, and algebra began to develop.

Early Civilizations

The ancient Egyptians were able to solve many different kinds of practical mathematical problems, including the intricate calculations necessary to build the pyramids. Egyptian arithmetic, based on counting in groups of ten, was relatively simple. This Base-10 system probably arose from biological reasons, as we have 8 fingers and 2 thumbs. Numbers are sometimes called digits from the Latin word for finger.

The most remarkable feature of Babylonian arithmetic was its use of a sexagesimal (base 60) place-valued system in addition to a decimal system. Babylonian mathematics is still used to tell time – an hour consists of 60 minutes, and each minute is divided into 60 seconds – and circles are measured in divisions of 360 degrees.

Greek and Hellenistic mathematics

Greek mathematics was more sophisticated than the mathematics that had been developed by earlier cultures. Thales used geometry to solve problems such as calculating the height of pyramids and the distance of ships from the shore. Pythagoras is credited with the first proof of the Pythagorean Theorem. The Pythagoreans proved the existence of irrational numbers. Eudoxus developed the method of exhaustion, a precursor of modern integration. Euclid is the earliest example of the format still used in mathematics today: definition, axiom, theorem and proof. He also studied cones. Archimedes of Syracuse used the method of exhaustion to calculate the area under the arc of a parabola with the summation of an infinite series, and gave remarkably accurate approximations of Pi. He also studied the spiral bearing his name, formulas for the volumes of surfaces of revolution, and an ingenious system for expressing very large numbers.

The Middle Ages

Indian mathematicians were especially skilled in arithmetic, methods of calculation, algebra, and trigonometry. It was their decimal place-valued number system, including zero, which was especially suited for easy calculation.

When the Greek civilization declined, Greek mathematics (and the rest of Greek science) was kept alive by the Arabs. The Arabs also learned of the considerable scientific achievements of the Indians, including the invention of a system of numerals (now called '»Arabic» numerals) which could be used to write down calculations instead of having to resort to an abacus. One of the greatest scientific minds of Islam was al-Khwarizmi, who introduced the name (al-jabr) that became known as algebra.

From about the 11th century first Abelard of Bath and then Fibonacci brought Islamic mathematics and its knowledge of Greek mathematics back into Europe.

The Renaissance

Major progress in mathematics in Europe turned out to have started at the beginning of the 16th century with the algebraic solution of cubic and quadratic equations. Copernicus and Galileo revolutionized the applications of mathematics to the study of the Universe. The Progress in algebra had a major psychological effect and enthusiasm for mathematical research, in particular research in algebra spread from Italy to Belgium and France.

The Seventeenth and Eighteenth Centuries

In the 17th century Napier, Briggs and others greatly extended the power of mathematics as a calculatory science with the discovery of logarithms. Cavalieri made progress towards the calculus with his infinitesimal methods and Descartes added the power of algebraic methods to geometry. Progress towards the calculus continued with Fermat, who, together with Pascal, began the mathematical study of probability. However the calculus is considered to be the topic of most significance in the 17th century.

Newton, building on the work of many earlier mathematicians such as his teacher Barrow, developed the calculus into a tool to push forward the study of nature. His work contained a wealth of new astronomy. Newton's theory of gravitation and his theory of light take us into the 18th century. However we must also mention Leibniz, whose much more rigorous approach to the calculus (although still unsatisfactory) was to set the scene for the mathematical work of the 18th century when the calculus grew in power and variety of application.

It is Euler who is considered to be the most important mathematician of the 18th century. In addition to work in a wide range of mathematical areas, he invented two new branches, namely calculus of variations and differential geometry. Euler was also important in pushing forward research in number theory started so effectively by Fermat. Toward the end of the 18th century, Lagrange began a rigorous theory of functions and of mechanics. The period around the turn of the century saw Laplace's great work of celestial mechanics.

The Nineteenth Century

Rapid progress was made in the 19th century. Non-Euclidian geometry developed by Lobachevsky and Bolyai led to characterization of geometry by Riemann. Gauss, who is thought by some to be the greatest mathematician of all time, studied quadratic reciprocity and integer congruencies. His work in differential geometry was to revolutionize the topic. He also contributed in a major way to astronomy and magnetism. The 19th century saw the work of Galois on equations and his insight into the path that mathematics would follow in studying fundamental operations. Cauchy, basing on the work of Lagrange on functions, began rigorous analysis of the theory of functions of a complex variable. This work was continued by Weierstrass and Riemann. At the end of the 19th century Cantor invented set theory almost single-handedly. Analysis was driven by the requirements of mathematical physics and astronomy. Maxwell is known to have revolutionized the application of analysis to mathematical physics, and Galois' introduction of the group concept heralded a new direction for mathematical research which has continued through the 20th century.

The Twentieth Century

In a 1900 speech to the International Congress of Mathematicians, David Hilbert set out a list of 23 unsolved problems in mathematics. These problems, spanning many areas of mathematics, formed a central focus for much of 20th century mathematics. Today 10 have been solved, 7 are partially solved, and 2 are still open. The remaining 4 are too loosely formulated to be stated as solved or not. Famous historical conjectures were finally proved. In 1976, Wolfgang Haken and Kenneth Appel used a computer to prove the four color theorem. Andrew Wiles, building on the work of others, proved Fermat's Last Theorem in 1995. Paul Cohen and Kurt Godel proved that the continuum hypothesis is independent of (could neither be proved nor disproved from) the standard axioms of set theory.Entirely new areas of mathematics such as mathematical logic, topology, complexity theory, and game theory changed the kinds of questions that could be answered by mathematical methods.

At the same time, deep insights were made about the limitations to mathematics. A consequence of Godel's two incompleteness theorems is that in any mathematical system that includes Peano arithmetic (including all of analysis and geometry), truth necessarily outruns proof; there are true statements that cannot be proved within the system. Hence mathematics cannot be reduced to mathematical logic and David Hilbert's dream of making all of mathematics complete and consistent failed.

Exercise 5. Find in the text equivalents of the following words and word-combinations:

1. керамічні вироби; 2. виникати із практичних потреб; 3. квадратична обратимість; 4. довести спроможність; 5. довільно формулювати; 6. теорія множин; 7. майже самостійно 8. у широкому діапазоні; 9. чіткий підхід; 10. занепад цивілізації 11. значні наукові досягнення; 12. підштовхнути подальше вивчення природи; 13. метод виснаження; 14. Застосування математики; 15. шестдесятирічна система; 16.наближення; 17. припущення; 18. підсумовування.

Exercise 6. Mark the statements as true or false:

1. Egyptian arithmetic, based on counting in groups of ten, was extremely complicated. 2. The Pythagoreans failed to prove the existence of irrational numbers. 3. So called Arabic numerals were invented by Arabs. 4. The epoch of Renaissance is marked by major progress of European mathematics. 5. In the 17th century the power of algebraic methods was added to geometry by Descartes. 6. Gauss revolutionized differential geometry.

Exercise 7. Match the following words with their definitions:

Consistent, consequence, evidence, conjecture, sophisticated, intricate, insight, precursor, surface, pottery	Result, complicated, subtle, affirmation, top layer, forerunner, assumption, vision, agreeing, ceramics

Exercise 8. Fill in the gaps with the words in the box:

Precursor, differential, pottery, heralded, exhaustion, spanning, conjectures

1. Patterns found on walls of ancient caves and …reveal early uses of geometry. 2. The method of …which may be regarded as a ….of modern integration was developed by Exodus. 3. In the 18th century two new branches were invented by Euler. They were … geometry and calculus of variations. 4. A new direction for mathematical research was … by Galois' introduction of the group concept. 5. Unsolved mathematical problems, … many problems in mathematics, formed a central focus for much of the 20th century mathematics. 6. In the second half of the 20th century famous historical …were proved at last.

Exercise 9. Translate the following sentences from English into Ukrainian:

1. Practical need to measure time and to count stimulated the origin of mathematics. 2. Sophisticated number systems and basic knowledge of arithmetic, geometry and algebra developed together with civilization. 3. Though Egyptian arithmetic was relatively simple, it helped to solve different mathematical problems. 4. Much more sophisticated was Greek mathematics mainly due to contribution of Pythagoras, Euclid and Archimedes. 5. After the decline of the Greek civilization, their mathematical tradition was kept alive by Arabs. 6. Only in the period of Renaissance major progress in mathematics began in Europe.

Exercise 10. Translate the following sentences from Ukrainian into English.

1. Математика виникла ще у найдавніші часи людської цивілізації із нагальної потреби вимірювати час та вести розрахунки. 2. По мірі того, як зростали потреби цивілізації, поступово вдосконалювалися знання у сфері арифметики, геометрії та алгебри. 3. Навіть відносно прості принципи та методи єгипетської арифметики дозволяли вирішувати доволі складні математичні завдання. 4. Багато складних

практичних і теоретичних питань було вирішено у рамках грецької школи математики, в основному завдяки доробку таких відомих вчених як Евклід, Піфагор та Архімед. 5. Занепад грецької цивілізації не призвів до занепаду її математичних традицій, які були розвинуті арабськими математиками. 6. Новий прогрес математики у Європі розпочався у добу Відродження.

Exercise 11. Discuss the following questions:

1. The development of mathematics in early civilizations.
2. The contribution of Greek mathematicians.
3. Major progress in mathematics during the epoch of Renaissance.
4. The development of mathematics in the 17th and 18th centuries.
5. Unsolved problems in mathematics.
6. Modern trends in mathematics.

Exercise 12. Read the text again and use notes below to speak about:

1. The major periods in the history of mathematics. 2. The gradual development of mathematics since Renaissance up to the 19th century. 3. The origin of new trends in mathematics in the 19th century. 4. Progress of mathematics in modern times.

1. (to arise from practical need; to solve different mathematical problems; intricate calculations; to prove the existence of irrational numbers; to develop the method of exhaustion; to keep alive; to invent a system of numerals);

2. (algebraic solution of cubic and quadratic equations; to revolutionize the applications of mathematics; discovery of logarithms; the topic of most significance; rigorous approach to the calculus; number theory; celestial mechanics);

3. (rapid progress in non-Euclidian geometry; quadratic reciprocity; integer congruencies; fundamental operations; to invent set theory almost single-handedly; to herald a new direction);

4. (to set a list of unsolved problems; to span many areas in mathematics; to prove famous conjectures; continuum hypothesis; to make deep insight about the limitations to mathematics; to make all of mathematics complete and consistent).

Exercise 13. Translate the text into Ukrainian.

In early civilizations mathematics arose from the practical need to measure time and to count. Gradually sophisticated number systems and basic knowledge of arithmetic, geometry, and algebra began to develop. In ancient Egypt mathematicians knew how to solve many different kinds of practical mathematical problems, including the intricate calculations necessary to build the pyramids. Due to Pythagoras, Euclid and Archimedes of Syracuse Greek mathematics was more sophisticated than the mathematics that had been developed by earlier cultures. Major progress in mathematics in Europe began in the 16th century with the algebraic solution of cubic and quadratic equations. Descartes, Fermat, Pascal, Newton, Leibniz and Euler developed different trends in mathematics in the 17th–18th centuries. The 19th century saw rapid progress in all areas of mathematics. Lobachevsky, Bolyai, Riemann, Gauss, Galois, Cauchy, Lagrange and Cantor were among those, who contributed greatly to further progress in the sphere of mathematics. A list of 23 unsolved problems in mathematics presented at the International Congress of Mathematicians by David Hilbert formed a central focus for much of 20th century mathematics. Nowadays entirely new areas of mathematics such as mathematical logic, topology, complexity theory and game theory have changed those questions that could be answered only by mathematical methods.

Exercise 14. Translate the text into English.

Математика, як і будь-яка інша наука, має свою історію. Вона виникла у давні часи із практичної потреби вимірювати час та відстань, здійснювати підрахунки. З розвитком цивілізації зростала і роль математики у вирішенні різних суспільних завдань. Математика різнобічно розвивалась у Єгипті та Вавилоні, але найбільш вражаючі відкриття були зроблені у Давній Греції. У добу середньовіччя великий внесок у розвиток математики зробили араби, які не лише продовжили традицію грецької школи математиків, але й запозичили певні здобутки індійської математики. Потужний прогрес у сфері математики починається в Європі з доби Відродження. У цей час Копернік та Галілей почали застосовувати математику до вивчення Всесвіту. У XVII столітті можливості математики у сфері обчислення суттєво розширюються завдяки винаходу логарифмів. Декарт збагатив геометрію застосуванням алгебраїчних методів. Подальший прогрес математики пов'язаний з іменами Ферма і Паскаля, які започаткували математичне вивчення теорії ймовірності. Значний внесок у сферу математики був зроблений Ньютоном, Лейбніцем, Ейлером, Лаграном та Лапласом. У XIX столітті математика потужно розвивається у різних напрямках. Зусилля таких видатних вчених як Лобачевський, Ріман, Гаусс, Галуа, Кантор, Максвелл вивели математику на інший теоретичний рівень, поєднали її з багатьма іншими науками, зокрема фізикою та астрономією. Проте далеко не всі математичні проблеми були вирішені у цей час. Саме тому Давід Гілберт сформував список із двадцяти трьох невирішених математичних проблем, який він і оголосив на Міжнародному Конгресі Математиків у 1900 році. Нині більшість з цих проблем вже вирішена, але це не означає, що математика вже не буде розвиватися. Вона має величезні перспективи подальшого розвитку, і це є аксіомою, оскільки процес пізнання нескінченний.

Exercise 15. Write an annotation to the text "A brief history of mathematics". Pay attention to Ex. 5 (Vocabulary and Comprehension exercises) of Unit I.

MIXED BAG

Exercise 1. Give opposite of the following words:
Ex.: good –bad.
1. winner; 2. sacred; 3. stupid; 4. interesting; 5. transparent; 6. glad; 7. to find; 8. to catch; 9. to increase; 10. to grow; 11. to tell the truth; 12. positive; 13. quiet, peaceful; 14. to imprison; 15. to land; 16. to abolish; 17. vital; 18. beautiful; 19. happy; 20. dangerous; 21. expensive.

Exercise 2. Find in section B synonyms to the adjectives in section A:
Section A: 1. interesting; 2. boring; 3. difficult; 4. dangerous; 5. arrogant
Section B: 1. conceited; 2. insecure; 3. curious; 4. dull; 5. tiresome; 6. complicated; 7. attractive; 8. perillous; 9. absorbing; 10. hard; 11. hazardous; 12. haughty; 13. entertaining; 14. intricate; 15. uninteresting; 16. risky; 17. supercillious.

Exercise 3. Explain the difference in the meanings of the words:
1. to find – to find out; 2. to produce – to engender; 3. curiosity – inquisition; 4. equality – equation; 5. fraction – faction; 6. ingenuous – ingenious.

Exercise 4. Read the list of interesting facts and be ready to continue it:
Do you know that ...
- the human heart stops for one-sixth of a second between beats? So your heart stands still for one-sixth of your lifetime.
- it is impossible to sneeze with your eyes open?
- there are no two snow-flakes which are exactly alike?

Exercise 5. Try to guess the following riddles:
What is the end of life?

What are the most wonderful things which were ever built? ....
What has a hand, but can't scratch itself?

Exercise 6. Put the following sentences in active voice:

1. Consumer preferences are markedly affected by advertising. 2. The manager can be assisted by the proposed model so that the order size can be precisely determined. 3. The temperature is increased by uncontrollable factors, as indicated in the experimental results.

UNIT 3

MATHEMATICS

Grammar:
1. The Object
2. The Attribute
3. Construction "There is" and its modifications

1. The Object

The direct object in the sentence can be expressed by: a) a noun; a pronoun; a numeral:	Most mathematicians focus their **research** solely on one of these areas. Number theory explains **it.** Which problem is the simplest? It is **the second**.
b) an object clause:	Many mathematicians feel **that to call their area a science is to downplay the importance of its aesthetic side.**
c) an infinitive, gerund or complex object construction	This material will be analysed in units 5, 6, 9
The indirect object can be expressed by: a) a noun	This article gives **the readers** the idea of Complexity theory.
b) a pronoun	He demonstrated **us** this method

Exercise 1.Translate the given sentences into Ukrainian identifying the object.

The overwhelming majority of works in this ocean contains new mathematical theorems and their proofs. 2. Richard Feynman invented the path integral formulation of quantum mechanics. 3. Modern notation makes mathematics much easier for the professional, but beginners often find it daunting. 4. Many philosophers believe that mathematics is not experimentally falsifiable. 5. J. M. Ziman proposed that science is public knowledge and thus includes mathematics. 6. Many mathematicians feel that to call their area a science is to downplay the importance of its aesthetic side.

2. The Attribute

The attribute may precede or follow the noun and can be expressed by:
an adjective: **Mathematica**l discoveries have been made throughout history.
a noun: Solution **of the problems** carries a $1 million reward.
participles (I and II): An abacus is a simple **calculating** tool. **Joined** efforts of mathematicians helped to solve this problem.
an attributive clause: G. H. Hardy in *A Mathematician's Apology* expressed the belief **that these aesthetic considerations are, in themselves, sufficient to justify the study of pure mathematics.**

Infinitive or gerund in the function of the attribute are studied in the Units 4, 5, 8

Exercise 2. Analyse the following sentences and identify the attribute.
1. Another area of study is size, which leads to the cardinal numbers. 2. Applied mathematics, the branch of mathematics concerned with application of mathematical knowledge to other fields, inspires and makes use of new mathematical discoveries and sometimes leads to the development of entirely new disciplines. 3. Consideration of the natural numbers also leads to the transfinite numbers, which formalize the concept of counting to infinity.

Exercise 3. Translate the following sentences into Ukrainian
1. At that time there appeared applied mathematics, concerned with application of mathematical knowledge to other fields. 2. There existed a great number of problems which required immediate solution. 3. Every year there arise new theories contributing to the solution of this global problem. 4. Nevertheless, there remain some facts which can't be explained by existing theories. 5. There seems to be a considerable number of questions which are still to be answered in this sphere.

Exercise 4. Translate the following sentences into Ukrainian. Pay special attention to the modifications of the construction "There is"
1. At that time there appeared quite a new theory. 2. There exist different explanations of this phenomenon. 3. There remained quite a lot of facts which

had to be explained. 4. There arises an urgent need to check these data once again. 5. There exist a lot of problems which must be solved immediately.

Exercise 5. Translate the following sentences into English using modifications of the construction "There is" (there appear, there exist, there seem, there arise, there remain etc.):

1. Наприкінці XIX століття з'явились нові напрямки у алгебрі та геометрії, які мали значний вплив на подальший розвиток математичної логіки. 2. Існують певні відмінності між ситуацією у науковій сфері наприкінці XIX століття та на порозі XXI. 3. У той час з'явились нові ідеї стосовно походження нашої сонячної системи. 4. Зараз існує велика кількість гіпотез з приводу цього явища. 5. У зв'язку з цим виникає багато питань, які потребують негайного вирішення. 6. З одного боку, існує тенденція враховувати ці фактори. 7. З другого боку, з'являється нова методика, яка дозволяє глибше проаналізувати ці аспекти. 8. Втім залишається ще багато питань, які потребують більш детального вивчення.

WORD-FORMATION

Exercise 1. Form nouns from the following verbs by adding suffix -"ion" (t "ion" or –s "ion"). Translate them into Ukrainian.

Example: transport – transportation; transmit – transmission.

1. constitute 2. add 3. subtract 4. translate 5. reduce 6. repeat 7. compete 8. pollute 9. exhibit 10. divide 11. collide 12. intrude 13. compare 14. assume 15. decide 16. prolong 17. deduce 18. induce 19. implement.

Exercise 2. Form nouns from the following verbs:

Example: multiply – multiplication

1. classify 2. imply 3. amplify 4. codify 5. purify 6. mistify 7. glorify 8. justify 9. qualify 10. personify 11. verify 12. rectify 13. specify 14. certify 15. simplify.

Exercise 3. Translate the following words into English:

1. містифікація 2. виправдання 3. очищення 4. розширення 5. втілення 6. підтвердження 7. зіткнення 8. припущення 9. повторення 10. забруднення 11. рішення 12. продовження 13. спрощення 14. виправлення 15. вторгнення.

Exercise 4. Make up sentences of your own with the following word-combinations:

1. practical application 2. to do calculations 3. verification of results 4. competition in the sphere of science 5. signs of addition and subtraction

6. broad subdivision. 7. implementation of the ideas. 8. comparison game 9. justification of a statement.

Exercise 5. Translate the sentences paying attention to the underlined words:

1. Зараз не існує чіткого розмежування між цими двома галузями. 2. Цю воду можна вживати лише після подвійного очищення. 3. Ми не можемо сподіватися на швидке підтвердження цих розрахунків. 4. Зіткнення наукових думок, теорій та гіпотез лише сприяє подальшому розвитку науки. 5. Застосування цього методу дозволяє суттєво наблизитися до вирішення цієї проблеми.

Text 1.

Mathematics

The word «mathematics» comes from the Greek (máthēma), which means learning, study, science, and additionally came to have the narrower and more technical meaning «mathematical study», even in Classical times. Its adjective is (mathēmatikós), related to learning, or studious, which likewise further came to mean mathematical. From the beginning of recorded history, there arose the major disciplines within mathematics. They arose out of the need to do calculations relating to taxation and commerce, to understand the relationships among numbers, to measure land, and to predict astronomical events. These needs can be roughly related to the broad subdivision of mathematics into the studies of quantity, structure, space and change. Mathematics is the study of quantity, structure, space, change and related topics of pattern and form. Mathematicians seek out patterns whether found in numbers, space, natural science, computers, imaginary abstractions, or elsewhere. Mathematicians formulate new conjectures and establish their truth by rigorous deduction from appropriately chosen axioms and definitions. Through the use of abstraction and logical reasoning, mathematics evolved from counting, calculation, measurement, and the systematic study of the shapes and motions of physical objects. Knowledge and use of basic mathematics have always been an inherent and integral part of individual and group life. Refinements of the basic ideas are visible in mathematical texts originating in the ancient Egyptian, Mesopotamian, Indian, Chinese, Greek and Islamic worlds. Rigorous arguments first appeared in Greek mathematics, most notably in Euclid's Elements. The development continued in fitful bursts until the Renaissance period of the 16th century, when mathematical innovations interacted with new scientific discoveries, leading to acceleration in research that continues to the present day.

Mathematics has since been greatly extended, and there has been a fruitful interaction between mathematics and science, to the benefit of both. Mathematical discoveries have been made throughout history and continue to be made today. The number of papers and books included in the Mathematical Reviews database since 1940 (the first year of operation of MR) is now more than 1.9 million, and more than 75 thousand items are added to the database each year. The overwhelming majority of works in this ocean contain new mathematical theorems and their proofs. Mathematics arises wherever there are difficult problems that involve quantity, structure, space or change. At first these were found in commerce, land measurement and later astronomy; nowadays all sciences suggest problems studied by mathematicians, and many problems arise within mathematics itself. For example, the physicist Richard Feynman invented the path integral formulation of quantum mechanics using a combination of mathematical reasoning and physical insight, and today's string theory, a still-developing scientific theory which attempts to unify the four fundamental forces of nature, continues to inspire new mathematics. Some mathematics is only relevant in the area that inspired it, and is applied to solve further problems in that area. But often mathematics inspired by one area proves useful in many areas, and joins the general stock of mathematical concepts. Today mathematics is used throughout the world as an essential tool in many fields, including natural science, engineering, medicine and the social sciences such as economics and psychology. Applied mathematics, the branch of mathematics concerned with application of mathematical knowledge to other fields, inspires and makes use of new mathematical discoveries and sometimes leads to the development of entirely new disciplines. Mathematicians also engage in pure mathematics or mathematics for its own sake, without having any application in mind, although practical applications for what began as pure mathematics are often discovered later. There is debate over whether mathematical objects exist objectively by nature of their logical purity, or whether they are manmade and detached from reality. The mathematician Benjamin Peirce called mathematics «the science that draws necessary conclusions». Albert Einstein, on the other hand, stated that «as far as the laws of mathematics refer to reality, they are not certain; and as far as they are certain, they do not refer to reality.» Carl Friedrich Gauss referred to mathematics as «the Queen of the Sciences». In the original Latin Regina Scientiarum, as well as in German Königin der Wissenschaften, the word corresponding to science means (field of) knowledge. Indeed, this is also the original meaning in English, and there is no doubt that mathematics is in this sense a science. The specialization restricting the meaning to natural science is of later date. If one considers science to be strictly about the physical world, then mathematics, or at least pure mathematics, is not a science. The remarkable fact that even the «purest» mathematics often turns out to have practical applications is what Eugene Wigner has called «the unreasonable effectiveness of mathematics.» As in most areas of study, the explosion of knowledge in the scientific age has led to specialization in mathematics. One major distinction is between pure mathematics and applied mathematics: most mathematicians focus their research solely on one of these areas, and sometimes the choice is made as early as their undergraduate studies. Several areas of applied mathematics have merged with related traditions outside of mathematics and become disciplines in their own right, including statistics, operations research, and computer science. (From Wikipedia, the free encyclopedia)

Active vocabulary

Likewise; to do calculations; conjecture; rigorous deduction; argument; inherent and integral part; insight; string theory; pure mathematics; applied mathematics; to merge; operations research.

VOCABULARY AND COMPREHENSION EXERCISES

Exercise 1. Read and translate the following words and word-combinations into Ukrainian:

arise out of the need; to measure land; to predict astronomical events; broad subdivision of mathematics; imaginary abstractions; natural science; appropriately chosen axioms; integral part; refinements of the basic ideas; acceleration in research; in fitful bursts; overwhelming majority; to join the general stock of mathematical concepts; practical application; transfinite numbers.

Exercise 2. Find in the text equivalents to the following words and word-combinations:

1. connected with 2. to appear 3. to look for 4. to develop 5. basic 6. inseparable 7. by fits and starts 8. to widen 9. to advantage 10. to include 11. corresponding tradition 12. the outburst of knowledge.

Exercise 3. Translate the following words and word-combinations using active vocabulary of the text:

1. практичне застосування 2. вдосконалення основних ідей 3. переважна більшість 4. прискорення досліджень 5. образні узагальнення 6. поштовхами, сплесками 7. теоретична математика 8.точні науки 9. прикладна математика 10. виникати із потреб 11.основна відмінність 12. виключно 13. подібним образом 14. робити підрахунки 15. припущення 16. невід'ємна частина 17. трансфінітні числа.

Exercise 4. Translate the following sentences into English:

Що таке математика? Що вона вивчає? Чи існує єдина математика як система органічно пов'язаних між собою знань, чи вона є зібранням наукових дисциплін, ізольованих одна від одної за своїми методами, цілями і навіть за мовою вираження своїх результатів? Відповісти на ці питання – зовсім не легка справа. Предметом чистої математики є просторові форми і кількісні відношення дійсного світу. Всі об'єкти і процеси, які реально існують у світі, мають такі якості, котрі знаходять вираз у категоріях кількості і форми, тобто вони притаманні всій дійсності. Математики абстрагують згадані кількісні відношення і просторові форми, встановлюють зв'язки у процесах, що реально відбуваються, формулюючи їх у вигляді висловлювань, записаних символами та формальними визначеннями.

Подальший розвиток абстракцій включає в себе доведення теорем, створення нових понять, побудову нових теорій. Ці поняття, теореми, теорії застосовуються згодом для вивчення дійсності. По мірі підйому до більш високих абстракцій зв'язок теоретичної математики з практикою, з реальністю стає менш безпосереднім і здійснюється здебільшого через інші науки. По відношенню до цих наук математика виступає як метод і мова формулювання кількісних закономірностей, як засіб вирішення задач, як апарат для побудови і розробки теорій. В них вона також отримує нові поняття, завдання та імпульси для свого розвитку. Математика є лише специфічною формою процесу людського пізнання. Математичне мислення – одна із форм цього загального процесу пізнання.

Математики мислять абстракціями. Математичні абстракції мають матеріальне походження, вони втілюють певні якості реальних речей. Математичні теорії є не довільними розумовими конструкціями, а відображенням сутності речей. Математика вирізняється серед інших наук своєю універсальністю. Методи математичного дослідження є невід'ємною складовою всіх наук. Застосування математичних методів дослідження підвищує об'єктивну цінність наукових теорій. Математика має розглядатися у розвитку. Розвиток математики не означає додавання нових теорем; він охоплює якісні зміни змісту математики. Універсальність математики пояснюється широтою її предмету. Важко, якщо взагалі можливо, провести межу між математикою теоретичною і прикладною.

Штучна ізоляція окремих частин математики не відповідає об'єктивним закономірностям розвитку науки. Швидке зростання складу математики та її додатків привело до ряду революційних перетворень змісту математики, усвідомлення її значимості. Боротьба протилежних поглядів на природу та методи математики або окремих її частин загострюється в ті періоди її історії, коли відбувається становлення нової теорії, котра, у свою чергу, веде до суттєвого перегляду звичних уявлень, смислу основних понять, операцій логічного аналізу, систем вихідних висловлювань (аксіом), засобів виведення нових теорем тощо. Подібні революційні перетворення мали місце, приміром, у періоди створення математичного аналізу, формування неевклідових геометрій, введення в математику теорії множин і створення кібернетики. (Перекл. з кн.: Дорожкина В.П. «Английский язык для математиков». – С. 51)

Exercise 5. Read the text below. For questions (1–11), choose the most appropriate word from the list (A-M). Mind, that there are two extra words that you don't need to use.

Mathematical notation

Most of the mathematical notation (1) __ today was not invented until the 16th century. Before that, mathematics was (2) __ in words, a painstaking process that limited mathematical discovery. In the 18th century, Euler was (3) ___for many of the contemporary notations. Modern notation (4) __mathematics much easier for the professional, but beginners often find it daunting. It is extremely compressed: a few symbols contain a great deal of information. Like musical notation, modern mathematical notation (5) __ a strict syntax and (6)__information that would be difficult (7) in any other way. Mathematical language can also be hard for beginners. Words such as or and only have (8) __ precise meanings than in everyday speech. Additionally, words such as open and field have been given specialized mathematical meanings. Mathematical jargon includes technical terms such as homeomorphism and integrable. But there is a reason for special notation and technical jargon: mathematics requires more precision than everyday speech. Mathematicians (9)_ to this precision of language and logic as «rigor». Rigor is fundamentally a matter of mathematical proof. Mathematicians want their theorems (10) __from axioms by (11)__ of systematic reasoning.

A. responsible B. makes C. in use D. has E. more F. to follow G. means H. to write I. explained J. refer K. encodes L. offer M. written out.

Exercise 6. Read the text below. For questions (1–11), choose the most appropriate answer (A, B, C, or D).

Mathematical awards

Mathematical awards (1) __ generally kept separate from their equivalents in science. The most (2) __ award in mathematics is the Fields Medal, established in 1936 and now awarded every 4 years. It is often (3) __the equivalent of science's Nobel Prizes. The Wolf Prize in Mathematics, instituted in 1978, recognizes lifetime (4) __, and another major international award, the Abel Prize, was introduced in 2003. These are awarded for a particular body of work, which may be innovation, or resolution of an (5) problem in an established field. A famous list of 23 such open problems, called «Hilbert's problems», was compiled in 1900 by German mathematician David Hilbert. This list achieved great popularity (6) _ mathematicians, and at least nine of the problems have now been solved. A new list of seven important problems, (7) __ the «Millennium (8) __ Problems», was published in 2000. (9) __ of each of these problems (10) __ a $1 million reward, and (11) __ one (the Riemann hypothesis) is duplicated in Hilbert's problems.

1	A were	B have	C are	D had
2	A prestigious	B exciting	C expensive	D interesting
3	A considered	B offered	C supposed	D admitted
4	A goal	B result	C plan	D achievement
5	A effective	B outstanding	C easy	D well-known
6	A among	B between	C upon	D with
7	A described	B known	C titled	D encoded
8	A Pride	B Honor	C Prize	D Medal
9	A Consideration	B Decision	C Salvation	D Solution
10	A takes	B carries	C passes	D sends
11	A only	B nearly	C almost	D very

Exercise 7. Read the text and be ready to answer the question – "Is mathematics a science or art?"

The elegance of mathematics

For those who are mathematically inclined, there is often a definite aesthetic aspect to much of mathematics. Many mathematicians talk about the elegance of mathematics, its intrinsic aesthetics and inner beauty. Simplicity and generality are valued. There is beauty in a simple and elegant proof, such as Euclid's proof that there are infinitely many prime numbers, and in an elegant numerical method that speeds calculation, such as the fast Fourier transform. G. H. Hardy in A Mathematician's Apology expressed the belief that these aesthetic considerations are, in themselves, sufficient to justify the study of pure mathematics. Mathematicians often strive to find proofs of theorems that are particularly elegant, a quest Paul Erdős often referred to as finding proofs from «The Book» in which God had written down his favorite proofs. The popularity of recreational mathematics is another sign of the pleasure many find in solving mathematical questions. Mathematics and art are mutually indebted in the area of perspective and symmetry which express relations only now fully explained by the mathematical theory of groups. Nowadays mathematics from the science of number and space becomes the science of all relations, of the structure in the broadest sense. The revolutions in art and mathematics only deepen the relations between them. A mathematician, like a painter or a poet, is a maker of patterns. And these patterns must be beautiful. In mathematics as well as in art the creative process involves observation and experiment, judgement and rejection, intuition and feeling, careful calculation and analysis, sophistication and flashes of insight.

Many mathematicians feel that to call their area a science is to downplay the importance of its aesthetic side, and its history in the traditional sphere is to serve liberal arts; others feel that to ignore its connection to the sciences is to turn a blind eye to the fact that the interface between mathematics and its applications in science and engineering has driven much development in mathematics. One way this difference of viewpoint plays out is in the philosophical debate as to whether mathematics is created (as in art) or discovered (as in science). It is common to see universities divided into sections that include a division of Science and Mathematics, indicating that the fields are seen as being allied but that they do not coincide. In practice, mathematicians are typically grouped with scientists at the gross level but separated at finer levels. This is one of many issues considered in the philosophy of mathematics. (From Wikipedia, the free encyclopedia)

Exercise 8. Read Ukrainian annotation to the text “Elegance of mathematics”. Compare it with its English translation:

Текст, який ми розглядаємо, має назву „Елегантність математики”. Для людини, яка звикла до стереотипів, поєднання математики та мистецтва у рамках одного дослідження здається дивним, якщо взагалі можливим. І це дійсно так, оскільки ще з шкільних років ми твердо засвоюємо, що математика – то є серйозна наука, котра потребує багато зусиль для вивчення, а мистецтво – це щось таке, що приносить лише естетичну насолоду, чому неможна навчитися, слід лише мати до цього хист. Але це поверховий підхід до проблеми, і автор цього тексту вдало доводить це на підставі красномовних фактів. По-друге, автор наголошує на тому факті, що математик, так само як художник або поет, є творцем моделей, котрі повинні бути красивими. По-третє, в статті наголошується, що творчий процес як у сфері математики, так і у сфері мистецтва проходить через ті самі	The text under consideration is entitled “The elegance of mathematics”. For a person accustomed for stereotypes the connection of mathematics and arts within the frames of one investigation seems strange if possible at all. And it is really so, as since the school years we learn that mathematics is a serious science which requires a lot of efforts for learning, and art is something that brings only aesthetic pleasure and what can’t be learnt, one should only have a knack for it. But it is a superficial approach to the problem and the author of the text proves it successfully on the basis of convincing facts. First, he considers the structure of mathematics and visual arts and points outthe similarity of their main principles: symmetry, perspective and ideal proportions. Second, the author accentuates the fact that mathematician, like a painter or a poet is a creator of patterns which must be beautiful. Third, it is emphasized in the article that the creative process both in the sphere of mathematics and the sphere of art passes

стадіїрозвитку–спостереження і експерименту, уважного підрахунку і аналізу, спалахів прозріння та натхнення. В цілому, текст цікавий та інформативний. Логічне викладення інформації сприяє її засвоєнню і розумінню. Проте, дещо сухий академічний стиль є незначним недоліком цього тексту.	the same stages of development: observation and experiment, attentive calculation and analysis, flashes of insight and inspiration. All in all, the text is interesting and rather informative. Logic presentation of the material makes for its comprehension and understanding. But somewhat dry academic style is a slight drawback of this text.

Exercise 9. Taking exercise 8 as a pattern, write an annotation to the text "Mathematics". (See also exercise 5, p.12)

Exercise 10. Translate the following sentences into English

1. Слово „математика" має грецьке походження і означає „навчання", „наука". 2. Математика виникла з практичної потреби вимірювати час та відстань, здійснювати підрахунки. 3. Математика розвивалась у Єгипті та Вавілоні, Індії та азійських країнах, але найбільш вражаючі відкриття були зроблені саме у Давній Греції. 4.Мова математики розвивалась разом із математичною наукою. 5. Найкращі вчені всіх часів та народів створювали цю мову. 6. Математика – мова науки, і навіть ділетант повинен знати її. 7. Основні символи і знаки математики – це числа від 0 до 9, знаки додавання, віднімання, множини, ділення та знак рівності, а також літери грецької та латинської абеток. 8. За допомогою символів математики можуть переходити від однієї ідеї до іншої майже механічно. 9. Хоча математика є наукою, вона також тісно пов'язана з мистецтвом. 10. Математика і мистецтво взаємодоповнюють один одного у царині перспективи та симетрії. 11. Коли математик стикається з проблемою, він намагається вирішити її у найкрасивіший і найпростіший спосіб. 12. У математиці і мистецтві творчий процес включає спостереження і експеримент, емоції і чіткий розрахунок, аналіз і спалах інтуїції.

Exercise 11. Use the following items in the topic "I'm the student of the faculty of Mechanics and Mathematics".

1. Speak on the origin of the faculty, its first Dean.
2. Speak on the faculty of Mathematics nowadays:

a). The number of Departments.
b). The number of students studying here.
c). The teaching staff of the faculty
d). The main disciplines and subjects.

3. Explain your choice of the faculty.
4. Speak on your favourite subjects.
5. Discuss your future profession.
6. Express your attitude towards the level of education here.

a) Are you sure that you'll get adequate knowledge at this faculty?
b) What would you like to change in the curriculum, teaching methods, educational programmes, etc.?
c) If you were given another chance, would you make the same choice?

7. What do you like most of all at the faculty?
8. What do you dislike most of all at the faculty?
9. Are you satisfied with your choice of the faculty?

Exercise 12. Be ready to speak on:

1. The origin of mathematics.
2. The development of mathematics in the XX-th century.
3. The main branches of mathematics.
4. Interrelation of mathematics and art.

MIXED BAG

Exercise 1. Give opposite of the following words:

Ex.: good – bad.

1. heavy; 2. noble; 3. primary; 4. boundless; 5. curious; 6. wide; 7. active; 8. mature; 9. national; 10. severe; 11. sincere; 12. special 13. natural; 14. contemporary; 15. ignorant.

Exercise 2. Find in section B synonyms to the verbs in section A:

Section A: 1. to surprise; 2. to accumulate; 3. to evaluate; 4. to prove; 5. to specify

Section B: 1. to collect; 2. to define; 3. to astonish; 4. to confirm; 5. to gather; 6. to estimate; 7. to indicate; 8. to value; 9. to astound; 10. to pile up; 11. to verify; 12. to amaze; 13. to amass; 14. to appraise; 15. to ascertain; 16. to stupefy; 17. to store; 18. to measure; 19. to particularize.

Exercise 3. Explain the difference in the meanings of the words:

1. to appraise – to evaluate; 2. to confirm – to conform (to); 3. to calculate – to compute; 4.to compete – to oppose; 5. to invent – to discover; 6. to verify – to prove.

Exercise 4. Read the list of interesting facts and be ready to continue it:

Do you know that ...

- magnesium weighs more after it has been burned? The ashes are heavier than the metal.
- 7 minutes is the longest time any solar eclipse can last?
- a grasshopper has five eyes?

Exercise 5. Try to guess the following riddles:

If two is a company, and three is a crowd, what are four and five?

What is it that everyone can divide, but no one can see where it is divided?

What is the best way to carry water in a sieve?

Exercise 6. Put the following sentences in active voice:

Precise measurement of neural networks by practitioners is a heavy emphasis of computer vision systems. 2. Numerical analysis is performed in this study on the effects of the inflation rate and the deterioration rate on stock inventory. 3. Verification of the data accuracy is required by the site manager so that quality control within a factory is ensured.

UNIT 4

FIELDS OF MATHEMATICS

Grammar: 1. The Adverbial Modifier

1. Adverbial Modifiers

The adverbial modifiers may express: the time, location, cause, reason, aim, degree, result, etc. of the action in the sentence and can be expressed by: a) **an adverb**	**Additionally**, words such as *open* and *field* have been given specialized mathematical meanings.
b) **a noun with a preposition**	**Before the 16th century** mathematics was written out in words.
c) **sub-clauses**	Rapid development began **when mathematical innovations interacted with new scientific discoveries.** Mathematics arises **wherever there are difficult problems.**
d) **non-finite forms of the verb and corresponding constructions**	Such examples will be studied in Units 5, 7, 8.

Exercise 3. Translate the following sentences into Ukrainian and identify the adverbial modifiers.

In the XXI century string theory which attempts to unify the four fundamental forces of nature continues to inspire new mathematics. 2. The deeper properties of integers are studied in number theory, from which come such popular results as Fermat's Last Theorem. 3. As the number system is further developed, the integers are recognized as a subset of the rational numbers («fractions»). 4. From the beginning of recorded history, the major disciplines within mathematics arose out of the need to do calculations relating to taxation and commerce. 5. Topology in all its many ramifications may have been the greatest growth area in 20th century mathematics. 6. The phrase «crisis of foundations» describes the search for a rigorous foundation for mathematics that took place from approximately 1900 to 1930. 7. Quantity and space both play a role in analytic geometry, differential geometry, and algebraic geometry. 8. Vector calculus expands the field into a fourth fundamental area. 9. A number of ancient problems concerning Compass and straightedge constructions were finally solved when Galois theory was used.

WORD-FORMATION

Exercise 1. Form adjectives from the following nouns by adding suffix -"ful". Translate them into Ukrainian.
Example: care – careful
1. hope 2. thought 3. tact 4. meaning 5. play 6. fruit 7. pain 8. colour 9. help 10. use 11. duty 12. harm.
Exercise 2. Form adjectives from the following nouns by adding suffix -"less". Translate them into Ukrainian.
Example: care – careless
1. home 2. fruit 3. tact 4. meaning 5. list 6. mother 7. penny 8. hope 9. sense 10. colour 11. help 12. harm.
Exercise 3. Form nouns from the following adjectives by adding suffix "ness". Translate them into Ukrainian.
Example: careful – carefulness; careless – carelessness
1. abrupt 2. concise 3. homeless 4. colourful 5. aware 6. polite 7. thoughtful 8. compact 9. conscious 10. good 11. fruitful 12. fruitless 13. bright 14. expensive 15. thick.
Exercise 4. Translate the following words into English:
1. уважність 2. свідомість 3. усвідомлення 4. темрява 5. непродуктивність 6. компактність 7. раптовість 8. безтурботність 9. плідність. 10. тактовність 11. безнадійність 12. корисність 13. барвистість 14. безглуздість 15. обов'язковий 16. безпорадний.
Exercise 5. Make up sentences with the following words and word-combinations:
1. national awareness 2. stream of consciousness 3. fruitful ideas 4. abruptness of a decision 5. thoughtful approach to the problem 6. careful study.
Exercise 6. Translate the sentences paying attention to the underlined words:
1. Один із героїв „Дванадцятої ночі" В. Шекспіра сказав: „Немає темряви, є лише невігластво". 2. Слава Богу! Ми склали цей іспит.

3. Національна свідомість є соціально-етичним покажчиком, який залежить від багатьох факторів. 4. Компактність та стислість мови математики є головним чинником її ефективного використання. 5. Потік свідомості як новий художній метод був уперше використаний Джеймсом Джойсом. 6. Сили темряви метафорично персоніфіковані у трилогії Толкієна „Володар кілець".

Text 1.

Fields of mathematics

An abacus, a simple calculating tool was used since ancient times. As noted above, the major disciplines within mathematics first arose out of the need to do calculations in commerce, to understand the relationships between numbers, to measure land, and to predict astronomical events. These four needs can be roughly related to the broad subdivision of mathematics into the study of quantity, structure, space, and change (i.e., arithmetic, algebra, geometry, and analysis). In addition to these main concerns, there are also subdivisions dedicated to exploring links from the heart of mathematics to other fields: to logic, to set theory (foundations), to the empirical mathematics of the various sciences (applied mathematics), and more recently to the rigorous study of uncertainty.

Quantity. The study of quantity starts with numbers, first the familiar natural numbers and integers («whole numbers») and arithmetical operations on them, which are characterized in arithmetic. The deeper properties of integers are studied in number theory, from which come such popular results as Fermat's Last Theorem. Number theory also holds two widely considered unsolved problems: the twin prime conjecture and Goldbach's conjecture.

As the number system is further developed, the integers are recognized as a subset of the rational numbers («fractions»). These, in turn, are contained within the real numbers, which are used to represent continuous quantities. Real numbers are generalized to complex numbers. These are the first steps of a hierarchy of numbers that goes on to include quarternions and octonions. Consideration of the natural numbers also leads to the transfinite numbers, which formalize the concept of counting to infinity. Another area of study is size, which leads to the cardinal numbers and then to another conception of infinity: the aleph numbers, which allow meaningful comparison of the size of infinitely large sets.

Space. The study of space originates with geometry – in particular, Euclidean geometry. Trigonometry combines space and numbers, and encompasses the well-known Pythagorean theorem. The modern study of space generalizes these ideas to include higher-dimensional geometry, non-Euclidean geometries (which play a central role in general relativity) and topology. Quantity and space both play a role in analytic geometry, differential geometry, and algebraic geometry. Within differential geometry are the concepts of fiber bundles and calculus on manifolds. Within algebraic geometry is the description of geometric objects as solution sets of polynomial equations, combining the concepts of quantity and space, and also the study of topological groups, which combine structure and space. Lie groups are used to study space, structure, and change. Topology in all its many ramifications may have been the greatest growth area in 20th century mathematics, and includes the long-standing Poincaré conjecture and the controversial four color theorem, whose only proof, by computer, has never been verified by a human.

Change. Understanding and describing change is a common theme in the natural sciences, and calculus was developed as a powerful tool to investigate it. Functions arise here, as a central concept describing a changing quantity. The rigorous study of real numbers and functions of a real variable is known as real analysis, with complex analysis the equivalent field for the complex numbers. The Riemann hypothesis, one of the most fundamental open questions in mathematics, is drawn from complex analysis. Functional analysis focuses attention on (typically infinite-dimensional) spaces of functions. One of many applications of functional analysis is quantum mechanics. Many problems lead naturally to relationships between a quantity and its rate of change, and these are studied as differential equations. Many phenomena in nature can be described by dynamical systems; chaos theory makes precise the ways in which many of these systems exhibit unpredictable yet still deterministic behavior.

Structure. Many mathematical objects, such as sets of numbers and functions, exhibit internal structure. The structural properties of these objects are investigated in the study of groups, rings, fields and other abstract systems, which are themselves such objects. This is the field of abstract algebra. An important concept here is that of vectors, generalized to vector spaces, and studied in linear algebra. The study of vectors combines three of the fundamental areas of mathematics: quantity, structure, and space. Vector calculus expands the field into a fourth fundamental area, that of change. Tensor calculus studies symmetry and the behavior of vectors under rotation. A number of ancient problems concerning Compass and straightedge constructions were finally solved using Galois theory.

Foundations and philosophy. In order to clarify the foundations of mathematics, the fields of mathematical logic and set theory were developed, as well as category theory which is still in development. The phrase «crisis of foundations» describes the search for a rigorous foundation for mathematics that took place from approximately 1900 to 1930. Some disagreement about the foundations of mathematics continues to present day. The crisis of foundations was stimulated by a number of controversies at the time, including the controversy over Cantor's set theory and the Brouwer-Hilbert controversy.

Mathematical logic is concerned with setting mathematics on a rigorous axiomatic framework, and studying the results of such a framework. As such, it is home to Gödel's second incompleteness theorem, perhaps the most widely celebrated result in logic, which (informally) implies that any formal system that contains basic arithmetic, if sound (meaning that all theorems that can be proven are true), is necessarily incomplete (meaning that there are true theorems which cannot be proved in that system). Gödel showed how to construct, whatever the given collection of number-theoretical axioms, a formal statement in the logic that is a true number-theoretical fact, but which does not follow from those axioms. Therefore no formal system is a true axiomatization of full number theory. Modern logic is divided into recursion theory, model theory, and proof theory, and is closely linked to theoretical computer science.

Discrete mathematics. Discrete mathematics is the common name for the fields of mathematics most generally useful in theoretical computer science. This includes computability theory, computational complexity theory, and information theory. Computability theory examines the limitations of various theoretical models of the computer, including the most powerful known model – the Turing machine. Complexity theory is the study of tractability by computer; some problems, although theoretically solvable by computer, are so expensive in terms of time or space that solving them is likely to remain practically unfeasible, even with rapid advance of computer hardware. Finally, information theory is concerned with the amount of data that can be stored on a given medium, and hence deals with concepts such as compression and entropy. As a relatively new field, discrete mathematics has a number of fundamental open problems. The most famous of these is the «P=NP?» problem, one of the Millennium Prize Problems.

Applied mathematics. Applied mathematics considers the use of abstract mathematical tools in solving concrete problems in the sciences, business, and other areas. An important field in applied mathematics is statistics, which uses probability theory as a tool and allows the description, analysis, and prediction of phenomena where chance plays a role. Most experiments, surveys and observational studies require the informed use of statistics. (Many statisticians, however, do not consider themselves to be mathematicians, but rather part of an allied group.) Numerical analysis investigates computational methods for efficiently solving a broad range of mathematical problems that are typically too large for human numerical capacity; it includes the study of rounding errors or other sources of error in computation. (From Wikipedia, the free encyclopedia)

Active vocabulary

1. integers; 2. entropy; 3. limitations; 4. unfeasible; 5. twin prime conjecture; 6. number theory; 7. subset of the rational numbers; 8. fractions; 9. real numbers; 10. continuous quantities; 11. complex numbers; 12. hierarchy of numbers 13. quarternions; 14. octonions; 15. transfinite numbers; 16. cardinal numbers; 17. aleph numbers; 18. fiber bundles; 19. calculus on manifolds; 20. sets of polynomial equations; 21. topological groups; 22. lie groups; 23. ramifications; 24. chaos theory; 25. to make precise; 26. to exhibit unpredictable yet still deterministic behavior; 27. vector calculus; 28. tensor calculus; 29. straightedge constructions; 30. tractability; 31. framework; 32. rounding errors; 33 ramification.

VOCABULARY AND COMPREHENSION EXERCISES

Exercise 1. Translate the following words and word-combinations into English:

1. ієрархія чисел 2. рамки 3. легкість у обробці 4. округлені помилки 5. векторні числення 6. теорія хаосу 7. числення по множині 8. демонструвати непередбачену але детерміністську поведінку 9. робити точним 10. обмеження 11. такий, що не може бути виконаний 12. тензорне обчислення 13. ціле число 14. підмножина раціональних чисел 15. розподіл на гілки.

Exercise 2. Find in the text equivalents to the following words and word-combinations:

1. to investigate 2. thorough study 3. whole numbers 4. supposition (guess) 5. endless 6. division into branches 7. to prove 8. unforeseen

9. to demonstrate 10. disagreement (dispute) 11. respectively 12. unrealized (unfulfilled).

Exercise 3. Translate the following sentences into English:

Основні підрозділи математики виникли як відповідь на нагальні потреби: вести підрахунки у торгівлі, вимірювати землю, передбачувати астрономічні події та розуміти зв'язок між числами. Оці чотири потреби розвинулись в математиці в окреме вивчення кількісних (арифметика), просторових (геометрія), змінних (алгебра) та структурних (аналіз) відношень. Окрім того, досліджуються стосунки математики з іншими дисциплінами: логікою, теорією множин та емпіричною математикою, застосовною до різних наук (прикладною математикою). Основні характеристики цілих чисел досліджуються у так званій теорії чисел. По мірі того, як у подальшому розвивалась система чисел, окрім цілих чисел увагу привернули так звані раціональні числа (дробі).

Exercise 4. Be ready to speak about different departments of your faculty, which are connected with special fields of mathematics.

Exercise 5. Write an annotation to the text "Fields of mathematics".

Exercise 6. Answer the following questions and be ready to discuss them:

1. What do you know about Artificial Intelligence (A.I.)? 2. What is natural intelligence? 3. What are the central goals of A.I.? 4. Can a machine think? 5. Can you remember some books or films in which a multifaceted consideration of A.I. problem is given?

Exercise 7. Read the text "Artificial intelligence" and try to explain, in what way it is connected with the topic "Fields of mathematics".

Artificial intelligence

Artificial intelligence (AI) is the intelligence of machines and the branch of computer science that aims to create it. John McCarthy, who coined the term in 1956, defines it as «the science and engineering of making intelligent machines.»

The field was founded on the claim that a central property of humans, intelligence, can be so precisely described that it can be simulated by a machine. This raises philosophical issues about the nature of the mind and the ethics of creating artificial beings, issues which have been addressed by myth, fiction and philosophy since antiquity. Thinking machines and artificial beings appear in Greek myths, such as Talos of Crete, the bronze robot of Hephaestus, and Pygmalion's Galatea. By the 19th and 20th centuries, artificial beings had become a common feature in fiction, as in Mary Shelley's Frankenstein or Karel Čapek's R.U.R. (Rossum's Universal Robots). Stories of these creatures and their fates discuss many of the same hopes, fears and ethical concerns that are presented by artificial intelligence.

We may say that Artificial Intelligence begins with the invention of the programmable digital electronic computer, based on the work of mathematician Alan Turing and others. Turing's theory of computation suggested that a machine, by shuffling symbols as simple as «0» and «1», could simulate any conceivable act of mathematical deduction. This, along with concurrent discoveries in neurology, information theory and cybernetics, inspired a small group of researchers to begin to seriously consider the possibility of building an electronic brain.

The field of AI research was founded at a conference on the campus of Dartmouth College in the summer of 1956. The attendees, including John McCarthy, Marvin Minsky, Allen Newell and Herbert Simon, became the leaders of AI research for many decades. They and their students wrote programs that were, to most people, simply astonishing: computers were solving word problems in algebra, proving logical theorems and speaking English. AI's founders were profoundly optimistic about the future of the new field predicting that «machines will be capable, within twenty years, of doing any work a man can do».

In the 1990s and early 21st century, AI achieved its greatest success. Artificial intelligence is used for logistics, data mining, medical diagnosis and many other areas throughout the technology industry. The success was due to several factors: the increasing computational power of computers, a greater emphasis on solving specific subproblems, the creation of new ties between AI and other fields working on similar problems, and a new commitment by researchers to solid mathematical methods and rigorous scientific standards.

Nowadays artificial intelligence has become an essential part of the technology industry, providing the heavy lifting for many of the most difficult problems in computer science. AI research is highly technical and specialized, and deeply divided into subfields that often fail to communicate with each other. The central problems of AI include such traits as reasoning, knowledge, planning, learning, communication, perception and the ability to move and manipulate objects. General intelligence (or «strong AI») is still among the field's long term goals.

Exercise 8. Read the text again and tick the information that isn't mentioned:
1. Definition of A.I.
2. A.I. in fiction
3. Turing's theory of computation
4. Turing's test
5. Predictions as to application of A.I.
6. Definition of natural intelligence.

Exercise 9. Write an annotation to the text "Artificial Intelligence".

Exercise 10. Be ready to speak on:
1. The broad subdivision of mathematics.
2. The study of quantity.
3. The modern study of space.
4. Calculus as a powerful tool to investigate change.
5. The structural properties of mathematical objects.
6. Artificial intelligence

MIXED BAG

Exercise 1. Give opposite of the following words:
Ex.: good –bad.
1. fresh; 2. friendly; 3. rigid; 4. unification; 5. explicit; 6. top; 7. productive; 8. right; 9. true; 10. automatic; 11. to enlarge; 12. to intrude; 13. to enter; 14. to preserve; 15. frugal.

Exercise 2. Find in section B synonyms to the verbs in section A:
Section A: 1. to begin; 2. to confine; 3. to accomplish; 4. to widen; 5. to finish.
Section B: 1. to cease; 2. to fulfil; 3. to start; 4. to launch; 5. to augment; 6. to attain; 7. to limit; 8. to stop; 9. to restrict; 10. to expand; 11. to enclose; 12. to commence; 13. to end; 14. to achieve; 15. to restrain; 16. to execute; 17. to bound; 18. to initiate; 19. to broaden.

Exercise 3. Explain the difference in the meanings of the words:
1. to find – to found; 2. physicist – physician; 3. to ascribe – to describe; 4. to name – to label – to term; 5. to accept – to except; 6. to visualize – to imagine.

Exercise 4. Read the list of interesting facts and be ready to continue it:
Do you know that ...
- the crab, snail and worm all have blue blood?

- the length of a lightning flash is usually about half a mile?
- every day and night you are riding a spaceship at about 66,000 miles an hour?

Exercise 5. Try to guess the following riddles:

What can pass before the sun without making a shadow?
Why is your shadow like a bad friend?
Which word is shorter if you add a syllable to it?

Exercise 6. Put the following sentences in active voice:

1. The proposed model can be extended in a future study so that more realistic assumptions can be incorporated. 2. A more detailed description of the three design types is provided in Kackar and Phadke (1991). 3. The GRG algorithm may be difficult for users with limited statistical training to implement.

UNIT 5

CYBERNETICS

Grammar: Verbals (non-finite forms of the verb). Infinitive. Its functions in the sentence

The infinitive.

The infinitive of transitive verbs has six forms.

Note that the Indefinite forms refer to the Present or Future while the Perfect forms refer to prior actions.

Indefinite	Passive	Continuous
to process	**To be processed**	**to be processing**
Perfect	Perfect Passive	Perfect Continuous
to have processed	**To have been processed**	**to have been processing**

Exercise 1. Give all the possible forms of the following infinitives.

Model 1. To augment- to be augmented, to be augmenting, to have augmented, to have been augmented, to have been augmenting.

To debug, to decode, to handle, to expand, to evaluate, to model, to solve.

Functions of the Infinitive

The Subject

A. ***To do smth.***	is (was, would be, will be)	necessary important impossible simple
B. It {is, was, will be}	necessary interesting important easy difficult simple <u>urgent</u>	***to do smth***

Exercise 2. Make up sentences of your own according to these patterns A and B using the following word-combinations:
to solve this problem, to write the thesis in English, to debug the program, to make exact calculations, to find the solution, to process the data, to fulfill the operations.
Exercise 3. Translate into English.
1. Дуже важко розв'язати це рівняння. 2. Було дуже цікаво прослухати вашу лекцію. 3. Зовсім нелегко визначити цю функцію. 4. Вкрай необхідно запам'ятати висновки цієї теореми. 5. Важливо враховувати всі параметри "x" при конструюванні цієї поверхні. 6. Помилятися легко, набагато важче зрозуміти свою помилку. 7. Обчислення похибки при використанні цього методу було головною метою нашої роботи.
The Predicative

Smth.	is (was, will be)	
		to do smth.
	means (meant)	

Exercise 4. Translate into Ukrainian.
The main thing was to differentiate between these approaches. 2. The general idea was to introduce quite a new method of modeling such processes. 3. The main objective of this article is to describe some methods for defining the author's style. 4. The most important task here is to find the optimum solution for this theorem. 5. To communicate with the outer world means to receive messages from it and to send messages to it. 6. On the one hand, it means to observe and to learn, on the other – to exert our influence on the outer world. 7. Your only real defense is to build a rock solid customers relationship. 8. The essential goal of cybernetics is to understand and define the functions and processes of systems.
Exercise 5. Read the passage. Pay special attention to the sentences with the Infinitive in the functions of the Subject and the Predicative. Translate them into Ukrainian.
It is, in fact, difficult to design objects well – for that matter, it's hard to design anything well. But the intent of some experts is to design the best objects for others to consume. Successful object-oriented programming (OOP) languages incorporate not just language syntax and a compiler, but an entire development environment including a significant library of well –designed, easy to use objects. Thus, the primary job of most programmers is to use existing objects to solve their application problems.

The alternative to modeling the machine is to model the problem you are trying to solve. The goal of this chapter is to show you what object-oriented programming is and how simple it can be.

Exercise 6. Complete these sentences and translate them into English.

Метою цієї роботи є … 2. Головним напрямком його дослідження було… 3. Основною ідеєю цього експерименту буде .. 4. Одним із завдань цього дослідження є… 5. Найбільша складність полягає у…6. Найцікавішим аспектом цієї проблеми є…..

Exercise 7. Write an English introduction to your term-paper, report or an article, using sentences with the Infinitive in the functions of the Subject and the Predicative.

The object.

Remember the words after which the Infinitive is used.

agree attempt claim decide demand desire expect fail forget hesitate hope intend learn manage need offer plan prepare pretend promise refuse seem strive tend try want wish

Exercise 8. Translate these sentences into English using the Infinitive in the function of the Object.

1. Ми плануємо перевірити ці дані. 2. Вони пропонують відкласти проведення конференції 3. Ми обіцяємо виконати це завдання до кінця тижня. 4. Вони намагаються довести слушність своїх власних висновків. 5. Вона запропонувала перевірити результати експерименту. 6. Ми вимагаємо використовувати Інтернет під час написання тестів. 7. Ми маємо намір проаналізувати всі можливі розв'язання цього рівняння. 8. Йому вдалося підготувати свій виступ вчасно. 9. Ці вчені відмовилися брати участь у цій конференції. 10. Н.Вінер вирішив ввести неологізм „кібернетика" у свою наукову теорію.

The Attribute

A. Smb. is (was, will be) the first the last to do smth. the second	He was the first to solve this equation.

Exercise 9. Translate the following sentences into Ukrainian.

He was the first to apply this algorithm for calculating the DNA data. 2. Hans Berger was the first to make observations concerning certain electrical potentials which displayed themselves on the human scalp. 3. He was the last to deliver the report. 4. It was the first attempt to undermine the principles of classical physics 5. Mechanic Ktesibios was the first to invent artificial automatic regulatory system, a water clock. 6. This was the first artificial truly automatic self-regulatory device to require no outside intervention between the feedback and the controls of the mechanism. 7. Ktesibios and others such as Heron and Su Song were some of the first to study cybernetic principles. 8. Walter was one of the first to build autonomous robots as an aid to the study of animal behavior.

B. man time place to do smth. thing something	He is just the man to help us There's no time to argue about it It's not the place to be happy We have some problems to be solved

Note 1. The passive infinitive is seldom used in the attributive function. Though there's a tendency in Modern Scientific English to use it more frequently. Sometimes with reference to the future, sometimes – with modal connotation (see Note 2).
E.g. The techniques to be analysed here will be applied for the solution of such problems. There are many universities to be found now in Kyiv and Ukraine.
Note 2. The attributive infinitive besides naming an action may express a meaning corresponding to the Ukrainian слід, треба, можна.
E.g. It's the only thing to do. – Це єдине, що можна і слід зробити. He is not the man to do it. – Він не та людина, хто міг би це зробити. It's a problem to check and solve. – Таку проблему слід перевірити і вирішити.
Exercise 10. Translate the following sentences into Ukrainian.
1. He is just the person to help you with your calculations. 2. It is the greatest possible victory to be, to continue to be and to have been. 3. It is the approach to apply for measurement of concave surfaces. 4. Later Aristotle took syllogism to mean an argument with two premises and a conclusion 5. This is an effort to create a new technology that utilizes the fundamental nature of subatomic energy. 6. A pragmatic approach to meet these requirements is the usage of quantum – classical hybrid schemes. 7. First attempts to develop quantum classical models were hampered by serious

limitations. 8. During his stay in France Wiener received the offer to write a manuscript on the unifying character of this part of applied mathematics.

Exercise 11. Replace the attributive clause by an attributive infinitive. Follow the above mentioned patterns.

1. These were the ideas which had to be synthesized in my book on cybernetics. 2. Knowledge is an aspect of life which must be interpreted while we are living. 3. Bernard Rieman concluded the definition of a real-value function as an analytical expression which was coextensive with more general one in term of arbitrary correspondence. 4. In fact, it is the first IBM system which incorporates the full scope of these technologies. 5. Roots that will be found must be positive. 6. Data transmitter is initiated by writing the data which will be transmitted to the UART input/ output Register.

Exercise 12. Translate the following word-combinations into English:

1. Дані, які слід перевірити; 2. Змінні, які треба визначити; 3. Результати, які будуть підтверджені. 4. Ідеї, які повинні бути синтезовані. 5. Аспекти, які треба проінтерпретувати. 6. Система, яка включає компоненти.

Exercise 13. Translate the following sentences into English.

1. Мене цікавить проблема, яку будуть обговорювати пізніше. 2. Першими вченими, які відкрили Радій і Полоній, були П'єр та Марія Кюрі. 3. Ось деякі приклади, до яких ми звернемось у наступних розділах. 4. Цей метод, який ми будемо використовувати, можна назвати надійним евристичним програмуванням. 5. Системи, які включають багатофункціональні компоненти, також будуть розглянуті у цьому розділі. 6. Це якраз ті аспекти, на які слід звернути особливу увагу.

The Adverbial Modifier

The adverbial modifier of purpose	Smb. will do does smth. (in order) to get smth Smb. did to be given smth. has done	1. I have come here **to speak to you.** 2. He decided to write the program himself **to be independent from anybody.**

The adverbial modifier of result	Smth. is (too) easy (enough) to do smth Smb. was young to be done will be difficult to have done urgent to have been done	This theorem is easy **enough to be proved without much effort**

Exercise 14. Read the following sentences and define the type of Adverbial Modifier in them. Translate these sentences into Ukrainian.
1. To avoid the need for this test we will add points in increasing order of x-coordinates, thus guaranteeing that each newly added point is outside the current hull. 2. Use comments to document your code. 3. I had been aware that the problem of continuous spectra drives us back on the consideration of functions and curves too irregular to belong to the classical repertory of analysis. 4. To get the search for the half plane with maximum discrepancy started, we first identify a finite set of candidate half-planes. 5. In those societies which are fortunate enough to possess a good script, a large part of this communal tradition is in writing. 6. The word cybernetics was first used in the context of "the study of self-governance" by Plato in The Laws to signify the governance of people. 7. Ktesibios's device used a cone-shaped float to monitor the level of the water in its reservoir. 8. Harold S. Black used negative feedback to control amplifiers. 9. The name cybernetics was coined to denote the study of "teleological mechanisms".
Exercise 15. Translate the following sentences into English.
1. Щоб змоделювати реалістичні молекулярні події, треба застосувати числовий метод, який може обробляти дані багатовимірної динаміки. 2. Щоб сконструювати такий метод, який може надійно моделювати неадіабатичні ефекти у багатовимірних випадках, ми використовували наступні засоби. 3. Йому ще бракує досвіду, щоб проводити такі експерименти. 4. Щоб ввести цю цитату, ми повинні знати точно, звідки вона.5. Нам слід ще раз перевірити обладнання, щоб уникнути недоліків при проведенні експерименту. 6. Дві години – це не достатньо, щоб обробити цю інформацію. 7. Цей метод є недостатньо надійним, щоб користуватися ним при банківських розрахунках. 8. Щоб довести цю теорему, необхідно перш за все визначитися з параметрами функцій x та z. 9. Щоб визначити структуру, задають одне чи кілька відношень, в яких знаходяться її елементи. 10. Гордон

Паск розширив поняття „кібернетика” таким чином, щоб воно включало інформативні потоки з усіх „медіа” – від зірок до людського розуму. 11. Дж.Форрестер співпрацював з Гордоном Брауном з метою розробки систем електронного контроля для американського флоту.

Exercise 16. Translate the following sentences paying special attention to different functions of the Infinitive in them.

1. The algorithm to be outlined below can be used to solve the problem. 2. The method to be employed may be called “reliable heuristic programming”. 3. To double the size of the high-speed memory, to increase the number of tape units from four to eight, to add a substantial storage device, to move from card to magnetic tape input etc. represent too fundamental a change to be coped with in a simple manner. 4. To manufacture these parts would require very high runs of each part to justify their cost. 5. All three of the preceding studies raise more or less serious problem regarding the function to be maximized as the result of optimal decision. 6. The last factor to be considered is the cost of the interview . 7. Facility problems were the first of the three categories to be studied in any detail and have had the most attention. 8. These problems tend to be relatively obvious, concrete and easy to recognize. 9. To prevent the auto-repair function from being unintentionally invoked you shouldn’t manually delete or rename any of the installed C++ directories. 10. To conserve disk space you have to perform a custom installation selecting only the options you require. 11. The failure of the original language to include argument types in the type signature of a function was a significant weakness. 12. The first and most interesting issue is to select a function whose distribution provides a good signature for the shape of a 3D polygonal model. 13. It is easy to see that one parable can contribute more than once to the beach line. 14. We use our incoming observations to increase the effectiveness of our outgoing commands. 15. It is not easy to read such irregular oscillations. 16. The assumptions and the terms we choose to work with and the theorems to prove are usually suggested by the experience. 17. Coast Capital Saving Bank has prospered because it implemented technology to support its growth strategy to increase market share in the face of fierce competition.

WORD-FORMATION

Exercise 1. Form verbs from the following nouns and adjectives by adding prefix “en” – (“em”). Translate them into Ukrainian.

Example: large – enlarge
1. rich 2. danger 3. chain 4. code 5. circle 6. courage 7. gender 8. body 9. force 10. frame 11. list 12. trap 13. trust 14. title 15. cipher 16. brace 17. act 18. place

Exercise 2. Form words with opposite meaning by adding prefix "dis" - . Translate them into Ukrainian.

Example: armament – disarmament
1. ability 2. agreement 3. proportion 4. accord 5. appear 6. advantage 7. belief 8. balance 9. credit 10. inherit 11. courage 12. illusion 13. join 14. honor 15. persuade 16. regard 17. remember 18. trust 19. qualify 20. similar 21. colour.

Exercise 3. Translate the following words and word-combinations into English:

1. довірити 2. кодувати 3. збагачувати 4. породжувати 5. втілювати 6. нездатність 7. недолік 8. розхолоджувати 9. порушення рівноваги 10. втілювати 11. забувати.

Exercise 4. Make up sentences with the following words and word-combinations:

1. to encode the program; numerical encoding 2. the main disadvantages of such a method 3. to discourage non-specialists 4. to disregard some errors in the program 5. to embrace a whole number of techniques 6. dissimilar conjectures.

Exercise 5. Translate the sentences paying attention to the underlined words:

1. Раби на римских галерах були прикуті ланцюгами до весел. 2. Маєток був оточений чудовим парком. 3. З найдавніших часів люди почали кодувати найважливішу інформацію. 4. Вболівальники намагалися підбадьорити свою команду. 5. Насильство породжує гнів та бажання помсти. 6. Ця книга суттєво збагатила мій словниковий запас новими термінами та словосполученнями. 7. Свої „Кентерберійські оповідання" Дж. Чосер вписав у контекст історії мандрів пілігримів до Кентербері.

Text 1.

Cybernetics

Cybernetics is the interdisciplinary study of the structure of regulatory systems. Cybernetics is closely related to control theory and systems theory. Both in its origins and in its evolution in the second-half of the 20th century, cybernetics is equally applicable to physical and social (that is, language-based) systems. The term cybernetics stems from the Greek kybernētēs, meaning steersman, governor, pilot, or rudder – the same root as government). The word cybernetics was first used in the context of «the study of self-governance» by Plato in The Laws to signify the governance of people. The word «cybernétique» was also used in 1834 by the physicist André-Marie Ampère (1775–1836) to denote the sciences of government in his classification system of human knowledge. Mechanic Ktesibios was the first to invent artificial automatic regulatory system, a water clock. In his water clocks, water flowed from a source such as a holding tank into a reservoir, then from the reservoir to the mechanisms of the clock. Ktesibios's device used a cone-shaped float to monitor the level of the water in its reservoir and adjust the rate of flow of the water accordingly to maintain a constant level of water in the reservoir, so that it neither overflowed nor was allowed to run dry. This was the first artificial truly automatic self-regulatory device to require no outside intervention between the feedback and the controls of the mechanism. Although they did not refer to this concept by the name of Cybernetics (they considered it a field of engineering), Ktesibios and others such as Heron and Su Song are considered to be some of the first to study cybernetic principles. Contemporary cybernetics began as an interdisciplinary study connecting the fields of control systems, electrical network theory, mechanical engineering, logic modeling, evolutionary biology and neuroscience in the 1940s. Electronic control systems originated with the 1927 work of Bell Telephone Laboratories engineer Harold S. Black on using negative feedback to control amplifiers. The ideas are also related to the biological work of Ludwig von Bertalanffy in General Systems Theory. Early applications of negative feedback in electronic circuits included the control of gun mounts and radar antenna during World War Two. Jay Forrester, a graduate student at the Servomechanisms Laboratory, during WWII was working with Gordon S. Brown to develop electronic control systems for the U.S. Navy. Later he applied these ideas to social organizations such as corporations and cities as an original organizer of the School of Industrial Management at the Sloan School of Management. Forrester is known to be the founder of System Dynamics. Cybernetics as a discipline was firmly established by Wiener, McCulloch and others, such as W. Ross Ashby and W. Grey Walter. Walter was one of the first to build autonomous robots as an aid to the study of animal behavior. Together with the US and UK, an important geographical locus of early cybernetics was France. In the spring of 1947, Wiener was invited to a congress on harmonic analysis, held in Nancy, France.

During this stay in France Wiener received the offer to write a manuscript on the unifying character of this part of applied mathematics, which is found in the study of Brownian motion and in telecommunication engineering. The following summer, back in the United States, Wiener decided to introduce the neologism cybernetics into his scientific theory. The name cybernetics was coined to denote the study of «teleological mechanisms» and was popularized through his book Cybernetics, or Control and Communication in the Animal and Machine (Hermann & Cie, Paris, 1948). In the UK this became the focus for the Ratio Club. Wiener popularized the social implications of cybernetics, drawing analogies between automatic systems (such as a regulated steam engine) and human institutions in his best-selling The Human Use of Human Beings : Cybernetics and Society (Houghton-Mifflin, 1950). Cybernetics is a broad field of study, but the essential goal of cybernetics is to understand and define the functions and processes of systems that have goals, and that participate in circular, causal chains that move from action to comparison with desired goal, and again to action. Studies in cybernetics provide a means for examining the design and function of any system, including social systems such as business management and organizational learning, including for the purpose of making them more efficient and effective. Cybernetics was defined by Norbert Wiener, in his book of that title, as the study of control and communication in the animal and the machine. Stafford Beer called it the science of effective organization and Gordon Pask extended it to include information flows «in all media» from stars to brains. It includes the study of feedback, black boxes and derived concepts such as communication and control in living organizms, machines and organizations including self-organization. Its focus is how anything (digital, mechanical or biological) processes information, reacts to information, and changes or can be changed to better accomplish the first two tasks.

A more philosophical definition, suggested in 1956 by Louis Couffignal, one of the pioneers of cybernetics, characterizes cybernetics as «the art of ensuring the efficacy of action». The most recent definition has been proposed by Louis Kauffman, President of the American Society for Cybernetics, «Cybernetics is the study of systems and processes that interact with themselves and produce themselves from themselves». Concepts studied by cyberneticists (or, as some prefer, cyberneticians) include, but are not limited to: learning, cognition, adaptation, social control, emergence, communication, efficiency, efficacy and interconnectivity. These concepts are studied by other subjects such as engineering and biology, but in cybernetics these are removed from the context of the individual organizm or device.

Other fields of study which have influenced or been influenced by cybernetics include game theory; system theory (a mathematical counterpart to cybernetics); psychology, especially neuropsychology, behavioral psychology, cognitive psychology; philosophy; anthropology and even architecture. Recent endeavors into the true focus of cybernetics, systems of control and emergent behavior, by such related fields as Game Theory (the analysis of group interaction), systems of feedback in evolution, and Metamaterials (the study of materials with properties beyond the newtonian properties of their constituent atoms), have led to a revived interest in this increasingly relevant field. (From Wikipedia, the free encyclopedia)

Active vocabulary

negative feedback; to control amplifiers; gun mounts; revived interest; to accomplish; teleological mechanisms; cone-shaped float; contemporary; causal chains; to ensure; the efficacy of action;

VOCABULARY AND COMPREHENSION EXERCISES

Exercise 1. Translate the following words and word-combinations into English.

гарматні установки; негативний зворотній зв'язок; контролювати підсилювачі; механізми з певною метою; конусовидний поплавок; сучасний; каузальні ланцюги; ефективність дії; забезпечувати; здійснювати; зростаючий інтерес.

Exercise 2. Find in the text English equivalents to the following words and word-combinations:

1. stabilizing system; 2. to originate from; 3. to mean, to denote, 4. to control 5. to arise 6. to be invented 7. target 8. learning 9. understanding 10. attempts 11. renewed interest 12. to handle information.

Exercise 3. Translate the following text into English paying attention to active vocabulary.

Слово кібернетика, яке означає „контроль", „управління", „спостереження" було вперше використано Н.Вінером як назва для книги. Зараз це слово пов'язано з вирішенням проблем, що стосуються діяльності комп'ютерів. Комп'ютери – це складні цифрові (автоматичні) пристрої, що розширюють продуктивність і ефективність людського мозку. Здатність комп'ютерів записувати, обробляти та передавати інформацію дозволяє вирішувати найскладніші проблеми у будь-якій сфері людської діяльності. Розвиток сучасної медицини, наприклад, неможливий без застосування різних комп'ютерних засобів, які дозволяють побачити та проаналізувати стан будь-яких внутрішніх органів людини. Кібернетика – відносно нова наука, але вона все більше і більше використовується у різних галузях промисловості та наукового дослідження. Вона намагається відповісти на два головних питання – найкращого контролю процесів та найкращого використання машин для такого контролю.

Exercise 4. Translate the following text into English. Pay special attention to the functions of infinitive in these sentences.

Відомо, що Норберт Вінер, батько кібернетики, є автором 200 наукових статей та 11 книжок. Очевидно, математичний талант дозволив дев'ятнадцятирічному юнаку захистити докторьку дисертацію. Вважається, що він заклав підгрунтя нової науки і надав їй назву „кібернетика". Хоча використання слова „кібернетика" вважається більш давнім, воно використовувалось ще Платоном. Давньогрецький філософ був першим, хто застосував цей термін до науки навігації. Французький вчений Ампер (XIX ст.) застосував той самий термін „кібернетика" для вивчення суспільного контролю. Сучасною тенденцією є розгляд кібернетики або як комп'ютерної науки, або як філософського підходу до теоретичних і прикладних наук. Важко сказати, що очікує на кібернетику у майбутньому. Людина створює все більш потужні комп'ютери з 1940 року. Тим не менш, людина залишається рабом комп'ютера, оскільки вона вимушена контролювати його роботу. Проте не за горами той час, коли буде створене нове покоління комп'ютерів, здатних до самоконтролю. Саме тому ми маємо всі підстави вважати Кібернетику королевою наук. (Перекл. з кн.: Дорожкина В.П. Английский язык для математиков. – С. 268)

Exercise 5. Read the text. Be ready to fill in the gaps with prepositions where necessary:

Subdivisions of the field

Cybernetics is an earlier but still-used generic term (…) many subject matters. These subjects also extend into many other areas of science, but are united (…) their study of control of systems.

Pure cybernetics studies systems of control as a concept, attempting to discover the basic principles underlying such things (…) Artificial intelligence; Robotics; Computer Vision; Control systems; Emergence; Learning organization; New Cybernetics; Second-order cybernetics; Interactions (…) Actors Theory; Conversation Theory

Cybernetics in biology is the study of cybernetic systems present (…) biological organizms, primarily focusing (…) how animals adapt to their environment, and how information in the form of genes is passed (…) generation (…) generation. There is also a secondary focus on cyborgs. It includes Bioengineering, Biocybernetics, Bionics, Homeostasis, Medical cybernetics, Synthetic Biology, Systems Biology.

Complexity Science attempts to analyze the nature of complex systems, and the reasons behind their unusual properties. The main trends here are: Complex Adaptive System , Complex systems, Complexity theory.

Computer science directly applies the concepts of cybernetics (…) the control of devices and the analysis of information, such as: Robotics, Decision support system, Cellular automaton, Simulation.

Cybernetics (…) engineering is used to analyze cascading failures and System Accidents, in which the small errors and imperfections (…) a system can generate disasters. Other topics studied include: an artificial heart, example of a biomedical engineering; adaptive systems; engineering cybernetics; ergonomics; biomedical engineering; systems engineering.

Mathematical Cybernetics is focused on the factors of information, interaction (…) parts in systems, and the structure of systems. The subdivisions of Mathematical Cybernetics are: Dynamical system, Information theory, Systems theory.

Exercise 6. Read the text. Each sentence, from 1 to 11 may contain an unnecessary word. Write the unnecessary word in the box. Indicate the correct sentences with a plus (+).

1. German military have used the Enigma machine during World War II for communication they thought to be secret. 2. The large-scale decryption of Enigma traffic which at Bletchley Park was an important factor that

contributed to Allied victory in WWII. 3. Despite of its relatively short history as a formal academic discipline, computer science has made a number of fundamental contributions to science and society. 4. The beginning of the «digital revolution» includes the current Information Age and the Internet. 5. A formal definition of computation and computability as well as proof that there are computationally unsolvable and intractable problems also influenced greatly on this revolution. 6. Apart from that we should take into account the concept of a programming language which is a tool for the precise expression of methodological information using at various levels of abstraction. 7. Scientific computing enabled advanced study of the mind. 8. And mapping of the human genome became possible with Human Genome Project. 9. Distributed computing projects such as Folding @ home explore protein folding. 10. Algorithmic trading has had increased the efficiency and liquidity of financial markets. 11. It became possible by using artificial intelligence, machine learning, and other statistical and numerical techniques on a large scale.

1	2	3	4	5	6	7	8	9	10	11

Exercise 7. Read the article and put the phrases a-g in the gaps 1–7.

The Three Laws of Robotics

One of the major spheres of interest for cybernetics is artificial intelligence. In the XX-th century this problem was widely developed in Science fiction.

As a result, in 1942 the Three Laws of Robotics (____(1)) were introduced into Science Fiction. These rules state: 1. A robot may not injure a human being or, through inaction, allow a human being to come to harm. 2. A robot must obey any orders given to it by human beings, ____(2). 3. A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.

The Three Laws form an organizing principle and unifying theme for Asimov's robotic-based fiction. Other authors working in Asimov's fictional universe have adopted these Laws _____ (3). Asimov himself made slight modifications in various books and short stories to further develop how robots would interact with humans and each other. Thus

Asimov's stories test his Three Laws in a wide variety of circumstances leading to proposals and rejection of modifications. A bit later the author also added a fourth, or zeroth law, to precede the others: 0. A robot may not harm humanity, or, by inaction, allow humanity to come to harm. The Three Laws, and the zeroth, have pervaded science fiction ____(4). It is recognized that they are inadequate to constrain the behavior of robots, but it is hoped that the basic premise underlying them, to prevent harm to humans, will ensure that robots are acceptable to the general public. _____(5), the majority of artificial intelligence in fiction followed the Frankenstein pattern. Asimov found this unbearably tedious. He explained in 1964 that ... one of the stock plots of science fiction was the following – (6). Knowledge has its dangers, but a retreat from knowledge isn't an adequate response. ____ (7) he began, in 1940, to write robot stories of a new variety. Never was one of his robots to turn stupidly on his creator. In a later essay Asimov points out that analogues of the Laws are implicit in the design of almost all tools: A tool must be safe to use. Hammers have handles, screwdrivers have hilts.A tool must perform its function efficiently. A tool must remain intact during its use unless its destruction is required for its use or for safety.

A. With all this in his mind
B. robots were created and destroyed by their creator
C. a set of rules devised by a science fiction author Isaac Asimov
D. unless such orders would conflict with the First Law
E. and are referred to in many books, films, and other media
F. Before Asimov began writing
G. and frequently refer to them, though sometimes in a humorous style.

Exercise 8. Read the article again and be ready to answer the questions.

Who was the first to introduce the Three Laws of Robotics?
Why was this idea widely supported in Science Fiction?
Are these Laws still valid for modern Science Fiction writers?

Exercise 9. Write an annotation to the text "Cybernetics".

Exercise 10. Be ready to speak on:

1. The major problems of cybernetics;
2. Artificial intelligence;
3. N.Wiener is the father of cybernetics;
4. Glushkov's contribution to national cybernetics.

MIXED BAG

Exercise 1. Give opposite of the following words:
Ex.: good –bad.
1. shy, modest; 2. polite; 3. ripe; 4. vulnarable; 5. wicked; 6. urban; 7. foggy, dark; 8. aggressive; 9. exquisite; 10. skilful; 11. attention; 12. hypocrisy; 13. to quarrel; 14. to conceal; 15. to augment.
Exercise 2. Find in section B synonyms to the nouns in section A:
Section A: 1. agreement; 2. donation; 3. conclusion; 4. custom; 5. belief.
Section B: 1. confidence; 2. bargain; 3. decision; 4. faith; 5. treaty; 6. result; 7. inference; 8. understanding; 9. contribution; 10. contract; 11. gift; 12. corollary; 13. grant; 14. habit; 15. benefaction; 16. tradition; 17. trust.
Exercise 3. Explain the difference in the meanings of the words:
1. to object – to dislike; 2. to define – to determine; 3. to differ – to differentiate; 4. to draw – to paint; 5. to study – to research; 6. to translate – to interpret.
Exercise 4. Read the list of interesting facts and be ready to continue it:
Do you know that ...
- for two hours your heart generates enough energy to lift a weight of 65 tons one foot into the air?
- when you don't sleep, you spend about 5 minutes of each hour with your eyes shut?
- it requires many more muscles to frown than to smile?

Exercise 5. Try to guess the following riddles:
What is it that cannot think, cannot speak, but tells the truth to all the world?
Why does a man's hair usually turn grey sooner than his moustouche?
How can you divide seventeen apples equally among eleven boys if four of the apples are very small?
Exercise 6. Put the following sentences in active voice:
1. Modification of the heuristics was made by Lacksonen and Enscore (1993) to solve the dynamic layout problem. 2. Minimization of total operating costs is achieved by a planning horizon. 3. A description of the layout cost evaluation method is made by introducing the following notations in this section.

UNIT 6

INFORMATICS

Grammar:
Complexes with the Infinitive:
1. For plus Infinitive Construction
2. Complex Object with the Infinitive

I. For plus Infinitive Construction

It (Smth)	is was will be	**too**	important cheap necessary costly easy	for smb to do smth
It (Smth)	is was will be	important good necessary interesting urgent	**enough**	for smb to do smth

Exercise 1. Translate the following sentences using the models.
1. Мені цікаво завершити цю программу самостійно. 2. Це завдання було занадто важливим, щоб я відкладав його. 3. За цю роботу дуже непогано платять, щоб я відмовлявся від неї. 4. Цей експеримент занадто важкий, щоб я виконала його за одну добу. 5. Ця теорема достатньо складна, щоб я могла довести її самостійно. 6. Нам вкрай необхідно перевірити всі ці дані ще раз. 7. Запропонована діаграма є занадто важливою для нас, щоб ми її відкидали. 8. Для них було дуже важливим перевірити вірність суждень. 9. Йому було дуже важливо відзначити, що він використав поняття "незкінченності" у кількісному сенсі. 10. Нам достатньо цікаво відзначити, що математичні тексти формалізуються згідно з правилами математичної логіки. 11. Для математиків дуже легко відбити кількісні відношення і просторові форми за допомогою символів. 12. Вам вкрай необхідно провести межу між застосуванням цих двох методів.

Complex Object with the Infinitive

a noun in the common case a pronoun in the objective case (me, him, her, us, you, them)	+ Infinitive

Complex Object with the Infinitive is used after the following verbs:
I.

to see, to hear, to feel, to observe, to watch, to let, to have, to make	Don't let them play computer games all the time.

Note that after these verbs we use Infinitive without particle "to".
II.

to consider, to expect, to know, to order, to allow, to want, to prefer, to think, to assume	We expect this firm to bear all responsibility for mistakes in the program. I consider him to be a real scientist They want them to finish this experiment without delay.

Exercise 2. Transform the following complex sentences into simple ones with the Complex Object with the Infinitive: Follow the model:
We know <u>that he is a reliable person</u>
We know <u>him to be a reliable person</u>
1. We know that Mathematics is the queen of sciences. 2. We know that Mathematics and Arts are closely connected. 3. Bernard Riemann concluded that the definition of a real-valued function as an analytical expression is coextensive with the ostensibly more general one in term of arbitrary correspondence. 4. The scientists consider that the discovery of such types of functions is largely the result of a deeper understanding of infinite sets. 5. The scientists consider that Lebesque's work uses term-by-term integration of sequence and series that may not converge uniformly. 6. The scientists assume that the question of term-by-term integration is of particular theoretical importance in the theory of trigonometric series. 7. We know that continual union of continual sets is a continual set. 8. We know that Standard Template library has become a universal tool. 9. Modern mathematicians consider that Riemann is a real founder of analytic number theory.

Exercise 3. Translate into English using the Complex Object with the Infinitive Construction.

1. Ми вважаємо, що таке реструктурування є вкрай небажаним. 2. Вони вважають, що моделе-формуюча система є однорідною і ізотропною. 3. Він вважає, що це рівняння має кілька розв'язків. 4. Автор статті очікує, що отримані результати будуть мати універсальне значення. 5. Зав лабораторією віддав розпорядження, щоб експерименти були проведені терміново. 6. Ми очікуємо, що ці методи будуть особливо ефективними при вимірюванні кривих поверхонь. 7. Я знаю, що це рівняння було розв'язане неправильно. 8. Вони хотіли, щоб всі дані цього експерименту були перевірені ще раз. 9. Автор вважає, що всі значення змінної будуть задовольняти значенням "x". 10. Ця група вчених з'ясувала (found), що порушення ізотропії системи є найпоширенішою серед проблем цього типу. 11. Цей засіб визначає ті команди, які дозволяють вам створювати та маніпулювати з інтерфейсом користувача.

WORD-FORMATION

Exercise 1. Form abstract nouns from the following nouns and adjectives by changing final "t" ("te") into -"cy" -. Translate them into Ukrainian.

Example: urgent – urgency

1. excellent 2. private 3. accurate 4. intimate 5. obstinate 6. illiterate 7. delicate 8. autocrat 9. aristocrat 10. decent 11. secret 12. democrat 13. efficient 14. emergent 15. despondent 16. adequate 17. candidate

Exercise 2. Form abstract nouns from the following verbs by adding suffixes -"ance" or -"ence". Translate them into Ukrainian.

Example: attend – attendance

1. enter 2. admit 3. ignore 4. inherit 5. exist 6. disturb 7. accord 8. accept 9. perform 10. confer 11. diverge 12. excel.

Exercise 3. Give English equivalents to the following words.

1. впертість 2. акуратність 3. ефективність 4. аристократія 5. неписьменність 6. делікатність 7. спадщина 8. відповідність 9.вистава 10. конференція 11. невігластво 12. розходження 13. існування 14. вхід 15. доступ 16.присутність 17. порушення рівноваги (безлад) 18. визнання.

Exercise 4. Make up sentences with the following words and word-combinations:

1. accuracy of the experiment 2. the atmosphere of the utmost secrecy 3. in emergency cases 4. efficiency of these methods 5. minimal divergence 6. unprecedented ignorance 7. in accordance with these principles.

Exercise 5. Translate the sentences paying attention to the underlined words:

1. Усе це повинно проводитися в атмосфері повної секретності. 2. Вирішення цього питання потребує, з одного боку, швидких дій, а з іншого – виваженості (акуратності). 3. Ми не знайдемо суттєвих розбіжностей у висновках цих двох комісій, що працювали цілком незалежно. 4. Існування інших гіпотез лише доводить глибину цієї проблеми. 5. Ви можете користуватися цим приладом лише у випадку невідкладної потреби.

Text 1.

Informatics

Informatics is the science of information, the practice of information processing, and the engineering of information systems. Informatics studies the structure, algorithms, behavior, and interactions of natural and artificial systems that store, process, access and communicate information. It also develops its own conceptual and theoretical foundations and utilizes foundations developed in other fields. Since the advent of computers, individuals and organizations increasingly process information digitally. This has led to the study of informatics that had computational, cognitive and social aspects, including study of the social impact of information technologies. In some situations, information science and informatics are used interchangeably. However, information science is considered to be a subarea of the more general field of informatics.

Used as a compound, in conjunction with the name of a discipline, as in medical informatics, bioinformatics, etc., it denotes the specialization of informatics to the management and processing of data, information and knowledge in the named discipline, and the incorporation of informatics' concepts and theories to enrich the other discipline; it has a similar relationship to library science. In 1957 the German computer scientist Karl Steinbuch coined the word Informatik by publishing a paper called «Informatics: Automatic Information Processing». The English term Informatics is sometimes assumed to mean the same as computer science. However, «computer science» is known to have a more restricted connotation.

The French term informatique was coined in 1962 by Philippe Dreyfus together with various translations—informatics (English), also proposed independently and simultaneously by Walter F.Bauer who cofounded Informatics General, Inc., and informatica (Italian, Spanish, Romanian, Portuguese, Dutch), referring to the application of computers to store and process information.

This term was adopted across Western Europe, and, except in English, developed a meaning roughly translated by the English 'computer science', or 'computing science'. The English informatics, as a name for the theory of scientific information, emphasized that it was necessary for a broader meaning to be included into study of the use of information technology in various communities (for example, scientific) and of the interaction of technology and human organizational structures. Nowadays we consider informatics to be the discipline of science which investigates the structure and properties of scientific information, as well as the regularities of scientific information activity, its theory, history, methodology and organization.

Usage has since modified this definition in three ways. First, the restriction to scientific information is removed, as in business informatics or legal informatics. Second, since most information is known to be digitally stored, computation is now central to informatics. Third, the representation, processing and communication of information are added as objects of investigation, since they have been recognized as fundamental to any scientific account of information. If we regard information as the central focus of study, then we have to distinguish informatics — which includes study of biological and social mechanisms of information processing, from computer science — where digital computation plays a distinguished central role. Similarly, in the study of representation and communication, informatics is indifferent to the substrate that carries information. For example, it encompasses the study of communication using gesture, speech and language, as well as digital communications and networking.

A broad interpretation of informatics, as «the study of the structure, algorithms, behavior, and interactions of natural and artificial computational systems,» was introduced by the University of Edinburgh in 1994 when it formed the grouping that is now its School of Informatics. This meaning is now increasingly used in the United Kingdom.

Informatics encompasses the study of systems that represent, process, and communicate information, including all computational, cognitive and social aspects. The central notion is the transformation of information — whether by computation or communication, whether by organizms or artifacts. In this sense, informatics can be considered to encompass computer science, cognitive science, artificial intelligence, information science and related fields. We know informatics to extend substantially the scope of computer science and to encompass computation in natural, as well as engineered computational systems. The 2008 Research Assessment Exercise, of the UK Funding Councils, includes a new, Computer Science and Informatics, unit of assessment (UoA), whose scope is described as follows: The UoA includes the study of methods for acquiring, storing, processing, communicating and reasoning about information, and the role of interactivity in natural and artificial systems, through the implementation, organization and use of computer hardware, software and other resources. The subjects are characterized by the rigorous application of analysis, experimentation and design.

At the Indiana University School of Informatics, informatics is defined as «the art, science and human dimensions of information technology» and «the study, application, and social consequences of technology.» It is also defined in Informatics I101, Introduction to Informatics as «the application of information technology to the arts, sciences, and professions.» These definitions are known to be widely accepted in the United States, and differ from British usage in omitting the study of natural computation.

In the English-speaking world the term informatics was first widely used in the compound, 'medical informatics', taken to include «the cognitive, information processing, and communication tasks of medical practice, education and research, including information science and the technology to support these tasks». Many such compounds are now in use; they can be viewed as different areas of applied informatics.One of the most significant areas of applied informatics is that of organizational informatics. Organizational informatics is fundamentally interested in the application of information, information systems and ICT within organizations of various forms including private sector, public sector and voluntary sector organizations. As such, organizational informatics can be seen to be sub-category of Social informatics and a super-category of Business Informatics. A practitioner of informatics may be called an informatician. (From Wikipedia, the free encyclopedia)

Active vocabulary

Information processing, to store, to access, advent, cognitive, in conjunction with, restricted connotation, simultaneously, regularities, to encompass, artifacts, artificial intelligence, unit of assessment , scope, implementation, rigorous, human dimensions, consequences, to omit.

VOCABULARY AND COMPREHENSION EXERCISES

Exercise 1. Translate the following words and word-combinations:
1. мати доступ 2. зберігати 3. штучний інтелект 4. обмежена конотація 5. блок оцінки 6. масштаб 7. пізнавальний 8. одночасний 9. використання 10. чіткий 11. обробка інформації 12. наслідки.

Exercise 2. Find in the text equivalents to the following words and word-combinations:
1. to handle 2. to preserve (keep) 3. influence 4. together with 5. limited 6. different 7. to differentiate 8. to embrace (to include) 9. to exclude 10. realization 11. to be regarded.

Exercise 3. Translate the following text into English paying attention to active vocabulary.
Інформатика – теоретична та прикладна (технічна, технологічна) дисципліна, що вивчає структуру і загальні властивості інформації, а також методи і (технічні) засоби її створення, перетворення, зберігання, передачі та використання в різних галузях людської діяльності. Основне теоретичне завдання інформатики полягає у визначенні загальних закономірностей, відповідно до яких створюється інформація, відбувається її перетворення, передавання та використання у різних сферах діяльності людини. Прикладні завдання інформатики полягають у розробці найефективніших методів і засобів здійснення інформаційних процесів, у визначенні способів оптимізації наукової комунікації у самій науці та між наукою і виробництвом.

Exercise 4. Translate the following text into English. Pay special attention to the functions of infinitive in these sentences.
Багато проблем, що сьогодні вирішує інформатика, давно розроблялись в річищі інших дисциплін: бібліотечній справі, бібліографії, лінгвістики тощо. Ще на початку 20 століття бельгійський юрист і учений П.Отле запропонував об'єднати комплекс процесів із збирання, обробки, зберігання, пошуку і розповсюдження наукових документів під загальною назвою «документація», що іноді служить синонімом терміну «інформатика». В 1931 Міжнародний бібліографічний інститут, заснований П. Отле і бельгійським юристом і громадським діячем А. Лафонтеном в 1895, було перейменовано в Міжнародний інститут документації, а в 1938 – в Міжнародну федерацію з документації, яка й надалі лишається основною міжнародною організацією, що об'єднує спеціалістів з інформатики і науково-інформаційної діяльності.

В 1945 з'явилась стаття американського вченого та інженера В. Буша «Можливий механізм нашого мислення», в якій вперше широко ставилось питання про необхідність механізації інформаційного пошуку. Міжнародні конференції з наукової інформації (Лондон, 1948; Вашингтон, 1958) знаменували перші етапи розвитку інформатики. Важливе значення мало вивчення закономірностей розсіювання наукових публікацій, проведене С. Бредфордом (Великобританія, 1948). До середини 60-х років 20 століття розроблялись в основному принципи і методи інформаційного пошуку та технічні засоби їх реалізації. У. Баттен (Великобританія), К. Муерс і М. Таубе (США) заклали основи координатного індексування; Б. Вікері, Д. Фоскет (Великобританія), Дж. Перрі, А. Кент, Дж. Костелло, Г. П. Лун, Ч. Берньер (США), Ж. К. Гарден (Франція) розробили основи теорії і методики інформаційного пошуку; С. Клевердон (Великобританія) вивчили методи порівняння технічної ефективності інформаційно-пошукових систем різного типу; Р. Шоу (США) і Ж. Самен (Франція) створили перші інформаційно пошукові пристрої на мікрофільмах і діамікрокартах, що стали прообразами багатьох спеціальних інформаційних машин; К. Мюллер і Ч. Карлсон (США) запропонували нові методи репродукування документів, які лягли в основу сучасної техніки репрографії. Сучасний етап розвитку характеризується глибшим розумінням загальнонаукового значення науково-інформаційної діяльності та все ширшим застосуванням в ній електронних обчислювальних машин. (From Wikipedia, the free encyclopedia)

Exercise 5. Be ready to speak about those departments of your faculty, which are connected with informatics.

Exercise 6. Write an annotation to the text "Informatics".

Exercise 7. Read the following. Fill in the blank spaces with the words from the list below. Mind that there are two extra words that you don't need to use.

How to write a business letter

The letter heading gives all necessary (1) about the subject. It is usually (2) on the paper. If unheaded paper is used, the address (3) the name of the sender is usually typed on the (4) hand side. The address of the person receiving the letter is typed on the (5) against the margin. When a letter is written to a man the form "(6)" is used. To a married woman we write "(7) but "(8) is used both for married and unmarried women. The attention line is typed (9) the salutation. If you don't know the name of the person you are writing to, begin your letter with "(10)" if it is a man, or "(11)" if it is a woman. Use "(12)" or "(13)" when writing to a firm/company. In business letters the sentences and paragraphs should be (14) because it is much easier to read such a letter. The letter usually consists of three (15). In the first (16) the writer should refer to (17) correspondence, confirming the receipt of a letter. In the second, a stating of (18) should follow. The third and the last should concern the future (19) suggested by the writer of the letter. The letters should be always signed by (20) and in (21). Since many signatures are illegible it is good practice to (22) the name of signer and to place his signature (23) it.

1. hand 2. print 3. above 4. ink 5. previous 6. information 7. Mrs. 8. right 9. Mr. 10. without 11. left 12. attached 13. printed 14. Ms 15. above 16. below 17. Dear Sir 18. Dear Madam 19. Dear Sirs 20. Gentlemen 21. parts 22. part 23. facts 24. short 25. action.

Exercise 8. Read the following e-mails and pay attention to their semi-formal business style:

A. Sending an invitation
To petrenko@gmail.com
Subject An invitation to attend a conference
Dear Mr. Petrenko
I'm writing on behalf of the Organising Committee to invite you to the 10th International Conference "Differential Equations" which will take place in London from November 12th to 15th this year. A detailed program of the Conference is attached. We hope you will be able to accept our invitation and we would appreciate your confirmation by e-mail.
Best wishes
Sandra Brown, Secretary
Equadif Organising Committee
London
email: SandraBr.@gmail.equadif.com

B. Accepting an invitation
To SandraBr.@gmail.equadif.com
Subject An invitation to attend a conference
Dear Ms.Sandra
I was pleased to receive your invitation to attend the conference. I shall be happy to participate in the work of your conference. Please include my report "Periodic motions of non-autonomous Toda Lattices" in the work of Section 3.
Looking forward to meeting you.

Yours sincerely
Oleg Petrenko
Post graduate student
Taras Shevchenko National University
Kiev
email: petrenko@gmail.com

Exercise 9. Imagine that you are a Secretary of the Organising Committee. Send e-mails inviting different specialists to participate in your conference.

Exercise 10. Reply to an invitation to attend a conference.

MIXED BAG

Exercise 1. Give opposite of the following words, using prefixes: dis-; de-; in-; un-; il-.

Ex.: to arm – to disarm.

agree, ability, connection, advantage, credit, orientation, accord, persuade, mobilize, stabilize, compose, cipher, ascend, increase, induce,capable, definite, organic, direct, competent, defined, solved, perturbed, reliable, logic, legal, legitimate, literate.

Exercise 2. Find in section B synonyms to the nouns in the section A:

Section A: 1. reference; 2. purpose; 3. statement; 4. meaning; 5. obligation

Section B: 1. utterance; 2. aim; 3. remark; 4. connotation; 5. duty; 6. quotation; 7. objective; 8. notion; 9. announcement; 10. liability; 11. allusion; 12. goal; 13. target; 14. implication; 15. citation; 16. end; 17. declaration; 18. sense; 19. responsibility.

Exercise 3. Form adjectives of Latin origin from the following nouns:

Ex.: brain – cerebral

1. law, 2. life, 3. death, 4. sea, 5. town, 6. village, 7. year, 8. money, 9. letter

Exercise 4. Read the list of interesting facts and be ready to continue it:

Do you know that ...

- without bees we would have no apples, pears, plums, cherries, melons, etc?
- the name December comes from the Latin word “decem” which means “ten”?
- the mean temperature of the regions around the South Pole is lower than the mean temperature in the far North?

Exercise 5. Try to guess the following riddles:

What is it which never uses its teeth for eating?
What does everybody give and few take?
What is it that every Englishman once was?

Exercise 6. Choose the correct form of the verb in the following sentences.

The scientist decided (accepting/to accept) the proposed model.
They appreciate (having/to have) this information.
His academic advisor doesn't approve of his (to choose/choosing) the traditional approach. 4. We found it very difficult (to reach/reaching) a decision.

UNIT 7

SET THEORY

Grammar: 1. Complex Subject with the Infinitive

Complex Subject with the Infinitive:

a noun in the common case a pronoun in the nominative case	+Infinitive (any of the six forms)

The complex is considered to be the subject of the sentence and is mostly translated into Ukrainian by a subordinate clause.
E.g. She was heard to deliver the report
Чули, що вона читала доклад
This construction is mainly used with the following verbs:

In **passive form**	to hear, to expect, to tell, to order, to ask, to allow, to know, to suppose, to assume, to believe, to consider	He is told to be working in the computer class now She was heard to deliver the report
In **active form**	to seem, to appear, to turn out, to prove, to happen, to chance	He seems to have solved all the equations correctly
With word-groups	to be sure, to be likely, to be unlikely, to be certain	He is unlikely to agree to your proposition*

****Note:*** Sentences of this kind are rendered in Ukrainian by a simple sentence with a modal word – напевне, обов'язково, вірогідно, навряд чи.
He is unlikely to agree to your proposition. Навряд чи він погодиться на вашу пропозицію.

Exercise 1. Translate the following sentences into Ukrainian:

1. However information science is considered to be a subarea of the more general field of informatics. 2. A broader meaning is sure to be included into study of the use of information technology in various communities. 3. Informatics is considered to be the discipline of science which investigates the structure and properties of scientific information. 4. Most information is known to be digitally stored. 5. Informatics is known to extend substantially the scope of computer science and to encompass computation in natural, as well as engineered, computational systems. 6. In this sense, informatics can be considered to encompass computer science, cognitive science, artificial intelligence, information science and related fields. 7. As such, organizational informatics can be seen to be sub-category of Social informatics and a super-category of Business Informatics. 8. These definitions are known to be widely accepted in the United States.

Exercise 2. Transform the following complex sentences into simple ones with the Complex Subject with the Infinitive. Follow the model:

It is unlikely that he will find a correct solution

He is unlikely **to** <u>**find** a correct solution</u>

1. It seems that the attempts to define verbally the "meaning" of mathematical terms lead to confusion and ambiguity. 2. It is well known that a mathematical formula has a direct real physical counterpart. 3. It turned out that mathematicians do not rely on their intuitive judgement but seek to give a rigorous proof. 4. It is considered that the proof is a thread connecting the statements in a mathematical theory. 5. It is certain that the need for careful and exact reasoning in proofs is not at once apparent for a layman. 6. It is known that symbolism often leads to misunderstanding among mathematicians. 7. It is almost certain that the strains are so concentrated that at some place or other the bridge will break and collapse. 8. It seems that the extensive areas of the brain are devoted to the different aspects of speech and hearing. 9. By the end of the nineteenth century it seemed that the basic fundamental principles governing the behavior of the physical universe were known. 10. They say that all of the different representations of the same graph are isomorphic to one another. 11. It is allowed that you may use only one side of the chip. 12. It is known that these axioms, together with the additional axiom of replacement proposed by Abraham Fraenkel, are called Zermelo–Fraenkel set theory (ZF). 13. It is considered that

Principia Mathematica is one of the most influential works of the 20th century. 14. It wasn't proved that the framework of type theory was as popular as a foundational theory for mathematics. 15. It is known that this counterintuitive fact is named as Skolem's paradox.

Exercise 3. Read the passage. Analyse the Infinitival Complexes. Translate them into Ukrainian.

Pattern formation in weakly anisotropic systems.

Forced symmetry breaking is known to be of great interest in the theory of pattern formation.

The pattern-forming system is frequently assumed to be homogeneous and isotropic.

And the resulting patterns are then also homogeneous and isotropic. In applications neither idealization usually holds and the development of techniques for studying the resulting imperfect system is therefore of paramount importance. The breaking of the isotropy of the system is known to be the simplest among problems of this type since invariance under translation is retained. A typical example studied by [1] is provided by the effect of shear flow on pattern formation in convection. The technique described below allows us to construct the most general isotropy-breaking terms and thereby analyse the most general effects a shear flow can have on pattern formation in 1, 2, 3 dimensions.

Vocabulary:

forced symmetry breaking – примусове порушення симетрії

pattern formation – моделе формування

a shear flow – потік зрізу

Exercise 4. Translate into English using the Complex Subject with the Infinitive Construction.

1. Він безперечно вирішить цю проблему. 2. Навряд чи вона погодиться прийняти участь у цьому експерименті. 3. Вони виявились хорошими спеціалістами. 4. Ми випадково знайшли цю інформацію у підручнику. 5. Ми обов'язково доберемося до суті справи. 6. Очікується, що ці проекти принесуть нове фінансування. 7. Навряд чи ми зможемо виконати це завдання за такий короткий термін. 8. Цілком несподівано ми знайшли шифр для розкодування програми. 9. Здавалось, що всі зусилля були марні. 10. Вважається, що цей прилад лікує деякі серцево-судинні захворювання.

Exercise 5. Read the passage and translate it into English

Введення в теорію об'єктів.

Виявилось, що об'єктно орієнтоване програмування має величезний вплив на тих, хто розробляє програмне забезпечення. Ми знаємо, що об'єктно орієнтоване програмування (ООП) стає цікавим для використання на багатьох рівнях. Воно має велику кількість переваг для менеджерів, аналітиків, дезайнерів та програмістів. Але водночас виявилось, що висока ціна навчання є недоліком ООП. У цьому розділі будуть введені багато ідей із Яви та об'єктно орієнтованого програмування на концептуальному рівні, але слід пам'ятати, що не очікується, що ви будете в змозі писати повноцінні Ява програми після ознайомлення з цим розділом.

WORD-FORMATION

Exercise 1. Form verbs from the following adjectives and nouns by adding suffix - "en".

Example: threat - threaten

1. short 2. wide 3. strength 4. length 5. deep 6. soft 7. weak 8. hard 9. white 10. like 11. broad.

Exercise 2. Form nouns from the following verbs by adding suffixes "tion" ("sion"), "ence" ("ance"), "ment".

1. depend 2. agree 3. intensify 4. constitute 5. explain 6. achieve 7. estrange 8. express 9. admit 10. converge 11. diverge 12. expand 13. pollute 14. create 15. perform 16. multiply 17. exist 18. expect 19. assume 20. deduce 21. attach 22. amend 23. improve 24. ignore.

Exercise 3. Give English equivalents to the following words:

1. забруднення. 2. підсилення 3. зводимість 4. домовленість 5. залежність 6. пояснення 7. існування 8. припущення 9. очікування 10. відданість 11. виправлення (поліпшення) 12. досягнення 13. відчуження 14. розширення 15. творення.

Exercise 4. Make up sentences with the following words and word-combinations:

1. to widen the scope of investigation; 2. to deepen the study of such phenomena; 3. pollution threatens…; 4. to weaken the influence; 5. to strengthen the achieved results; 6. to shorten the period of data procession.

Exercise 5. Translate the sentences paying attention to the underlined words:

1. Таке припущення дозволяє <u>розширити</u> коло підозрюваних. 2. Щоб <u>порівняти</u> ці події, нам слід спочатку з'ясувати усі деталі 3. Ра-

діоактивне забруднення загрожує не лише здоров'ю, а й взагалі самому існуванню людства. 4. Ми не можемо ігнорувати той факт, що вживання антибіотиків послаблює імунітет. 5. Ця теорія розширює горизонти пізнання.

Text 1.

Set theory and paradoxes

Ernst Zermelo (1904) gave a proof that every set could be well-ordered, a result George Cantor had been unable to obtain. To achieve the proof, Zermelo introduced the axiom of choice, which drew heated debate and research among mathematicians and the pioneers of set theory. The immediate criticism of the method led Zermelo to publish a second exposition of his result, directly addressing criticisms of his proof (Zermelo 1908). This paper led to the general acceptance of the axiom of choice in the mathematics community.

Skepticism about the axiom of choice was reinforced by recently discovered paradoxes in naive set theory. Cesare Burali-Forti (1897) was the first to state a paradox: the Burali-Forti paradox shows that the collection of all ordinal numbers cannot form a set. Very soon thereafter, Bertrand Russell discovered Russell's paradox in 1901, and Jules Richard (1905) discovered Richard's paradox. Zermelo (1908) provided the first set of axioms for set theory. These axioms, together with the additional axiom of replacement proposed by Abraham Fraenkel, are known to be called Zermelo–Fraenkel set theory (ZF). Zermelo's axioms incorporated the principle of limitation of size to avoid Russell's paradox.

In 1910, the first volume of Principia Mathematica by Russell and Alfred North Whitehead was published. This seminal work developed the theory of functions and cardinality in a completely formal framework of type theory, which Russell and Whitehead developed in an effort to avoid the paradoxes. Principia Mathematica is considered to be one of the most influential works of the 20th century, although the framework of type theory did not prove to be as popular as a foundational theory for mathematics (Ferreirós 2001, p. 445).

Fraenkel (1922) proved that the axiom of choice cannot be proved from the remaining axioms of Zermelo's set theory with urelements. Later work by Paul Cohen (1966) showed that the addition of urelements is not needed, and the axiom of choice is unprovable in ZF. Cohen's proof developed the method of forcing, which is now an important tool for establishing independence results in set theory.

Leopold Löwenheim (1918) and Thoralf Skolem (1919) obtained the Löwenheim–Skolem theorem, which says that first-order logic cannot control the cardinalities of infinite structures. Skolem realized that this theorem would apply to first-order formalizations of set theory, and it implies that any such formalization has a countable model. This counterintuitive fact is known to be named as Skolem's paradox.

In his doctoral thesis, Kurt Gödel (1929) proved the completeness theorem, which establishes a correspondence between syntax and semantics in first-order logic. Gödel used the completeness theorem to prove the compactness theorem, demonstrating the finitary nature of first-order logical consequence. These results helped establish first-order logic as the dominant logic used by mathematicians.

In 1931, Gödel published On Formally Undecidable Propositions of Principia Mathematica and Related Systems, which proved the incompleteness (in a different meaning of the word) of all sufficiently strong, effective first-order theories. This result, known as Gödel's incompleteness theorem, establishes severe limitations on axiomatic foundations for mathematics, striking a strong blow to Hilbert's program. It showed the impossibility of providing a consistency proof of arithmetic within any formal theory of arithmetic. Hilbert, however, did not acknowledge the importance of the incompleteness theorem for some time.

Gödel's theorem shows that a consistency proof of any sufficiently strong, effective axiom system cannot be obtained in the system itself, if the system is consistent, nor in any weaker system. This leaves open the possibility of consistency proofs that cannot be formalized within the system they consider. Gentzen (1936) proved the consistency of arithmetic using a finitistic system together with a principle of transfinite induction. Gentzen's result introduced the ideas of cut elimination and proof-theoretic ordinals, which became key tools in proof theory. Gödel (1958) gave a different consistency proof, which reduces the consistency of classical arithmetic to that of intuitivistic arithmetic in higher types. Alfred Tarski developed the basics of model theory.

Beginning in 1935, a group of prominent mathematicians collaborated under the pseudonym Nicolas Bourbaki to publish a series of encyclopedic mathematical texts. These texts, written in an austere and axiomatic style, emphasized rigorous presentation and set-theoretic foundations which were widely adopted throughout mathematics.

The study of computability came to be known as recursion theory, because early formalizations by Gödel and Kleene relied on recursive definitions of functions. When these definitions were shown to be equivalent to Turing's formalization involving Turing machines, it became clear that a new concept – the computable function – had been discovered, and that this definition was robust enough to admit numerous independent characterizations. In his work on the incompleteness theorems in 1931, Gödel lacked a rigorous concept of an effective formal system; he immediately realized that the new definitions of computability could be used for this purpose, allowing him to state the incompleteness theorems in generality that could only be implied in the original paper.

Numerous results in recursion theory were obtained in the 1940s by Stephen Cole Kleene and Emil Leon Post. Kleene (1943) introduced the concepts of relative computability, foreshadowed by Turing (1939), and the arithmetical hierarchy. Kleene later generalized recursion theory to higher-order functionals. Kleene and Kreisel studied formal versions of intuitivistic mathematics, particularly in the context of proof theory. (From Wikipedia, the free encyclopedia)

Active vocabulary

To obtain; to achieve; to draw heated debate; acceptance; to reinforce; to avoid; limitation of size; cardinality; urelements; correspondence between syntax and semantics; consistency proof; acknowledge; cut elimination; proof-theoretic ordinals; austere; arithmetical hierarchy; recursion theory; axiom of replacement; axiom of choice; set-theoretic language; set-theoretic antinomies; set-theoretic foundation; set-theoretic ideas.

VOCABULARY AND COMPREHENSION EXERCISES

Exercise 1. Give English equivalents to the following words and word-combinations:

1. натуральне число 2. множина 3. натуральний ряд 4. антиномія 5. аксіоматизація 6. фінітна математика 7. арифметична ієрархія 8. обмеження розміру 9. ряд кардинальних чисел 10. зведення елімінації 11. доказово-теоретичний ряд 12. рекурсивна теорія 13. доказ логічності (послідовності) 14. аксіома заміни 15. аксіома вибору 16. теоретико-множинні уявлення 17. теоретико множинні антиномії 18. теоретико-множинна мова.

Exercise 2. Find in the text equivalents to the following words and word-combinations:

1. severe 2. to fail to get 3. representation of results 4. substitution 5. the stem (structure) 6. contradiction (absurdity) 7. set of cardinal numbers 8. correlation 9. rigorous restrictions 10. to admit 11. to be logical 12. main techniques.

Exercise 3. Translate the following text into English paying special attention to active vocabulary.

Наївна теорія множин

Теорія множин – розділ математики, в якому вивчаються загальні властивості множин. Теорія множин лежить в основі більшості математичних дисциплін; вона зробила глибокий вплив на розуміння предмету самої математики. До другої половини 19 століття поняття «множини» не розглядалося як математичне («безліч книг на полиці», «безліч людських чеснот» і т.д. – все це чисто побутові обороти мови). Становище змінилося, коли німецький математик Г. Кантор розробив програму стандартизації математики, в рамках якої будь-який математичний об'єкт повинен був виявлятися тією або іншою «множиною». Наприклад, натуральне число, за Кантором, слід було розглядати як множину, що складається з єдиного елемента іншої множини, званої «натуральним рядом» – який, у свою чергу, сам є множиною, що задовольняє так званим аксіомам Пеано. Програма Кантора викликала різкі протести з боку багатьох сучасних йому крупних математиків. Особливо виділявся своїм непримиренним до неї ставленням Леопольд Кронекер, що вважав, що математичними об'єктами можуть вважатися лише натуральні числа і те, що до них безпосередньо зводиться (відома його фраза про те, що «бог створив натуральні числа, а все інше – справа рук людських»). Проте, деякі інші математики – зокрема, Готлоб Фреге і Давид Гільберт – підтримали Кантора в його намірі перекласти всю математику на теоретико-множинну мову. Проте незабаром з'ясувалося, що установка Кантора на відсутність обмежень при операціях з множинами є початково недосконалою. А саме, було знайдено ряд теоретико-множинних антиномій: виявилося, що при використанні теоретико-множинних уявлень деякі твердження можуть бути доведені разом зі своїми запереченнями (а тоді, згідно правилам класичної логіки висловів, може бути «доведено» абсолютно будь-яке твердження!). Антиномії ознаменували собою повний провал програми Кантора. (From Wikipedia, the free encyclopedia)

Exercise 4. Translate the following text into English paying special attention to infinitival complexes.

Аксіоматична теорія множин

Відомо, що на початку 20 століття Бертран Рассел прийшов до парадоксу, вивчаючи наївну теорію множин. З тих пір цей парадокс відомий як парадокс Рассела. Таким чином, була продемонстрована неспроможність наївної теорії множин і, пов'язаної з нею канторівскої програми стандартизації математики. Після цього, як виявилось, частина математиків (наприклад, Л. Е. Я. Брауер і його школа) вирішила повністю відмовитися від використовування теоретико-множинних уявлень. Інша ж частина математиків, очолена Д. Гільбертом, зробила ряд спроб обґрунтувати ту частину теоретико-множинних уявлень, яка здавалася їм якнайменше відповідальною за виникнення антиномій, на основі явно надійної фінітної математики. З цією метою були розроблені різні аксіоматизації теорії множин.

Особливістю аксіоматичного підходу є відмова від закладеного у програму Кантора уявлення про дійсне існування множин в деякому ідеальному світі. В рамках аксіоматичних теорій множини «існують» винятково формальним чином, і їх «властивості» можуть істотно залежати від вибору аксіоматики. Цей факт завжди був мішенню для критики з боку тих математиків які не погоджувалися (як на тому наполягав Гільберт) визнати математику, позбавленої всякого змісту, грою в символи. Зокрема, М. М. Лузін писав, що «потужність континууму, якщо тільки мислити його як безліч точок є єдина реальність», місце якої у ряді кардинальних чисел не може залежати від того, чи признається як аксіома континуум-гіпотеза, або ж її заперечення.

В даний час найпоширенішою аксіоматичною теорією множин є ZFC – теорія Цермело-Френкеля з аксіомою вибору. Питання про несуперечність цієї теорії (а тим більше – про існування моделі для неї) залишається невирішеним. (From Wikipedia, the free encyclopedia)

Exercise 5. Read the passage and insert the prepositions where it is necessary.

Pattern formation in weakly anisotropic systems.

Forced symmetry breaking is known to be (…) great interest in the theory of pattern formation.The pattern-forming system is frequently assumed to be (…) homogeneous and isotropic.And the resulting patterns are then also homogeneous and isotropic. (…) applications neither idealization usually holds and the development of techniques (…) studying the resulting imperfect system is therefore (…) paramount importance. The breaking of the isotropy of the system is known to be the simplest (…) problems of this type since invariance under translation is retained. A typical example studied here is provided (…) the effect of shear flow (…) pattern formation in convection. The technique described below allows us to construct the most general isotropy-breaking terms and thereby analyse the most (…) general effects a shear flow can have (…) pattern formation in 1, 2, 3 dimensions.

Exercise 6. Write an annotation to the text "Set Theory and Paradoxes".
Exercise 7. Read the abridged story and be ready to discuss it.

Text 2.

The Nine Billion Names of God (abridged)

«This is a slightly unusual request,» said Dr. Wagner. «As far as I know, it's the first time anyone's been asked to supply a Tibetan monastery with an Automatic Sequence Computer. I don't wish to be inquisitive, but could you explain just what you intend to do with it?»

«Gladly,» replied the lama, readjusting his silk robes. «Your Mark V Computer can carry out any routine mathematical operation involving up to ten digits. However, we are interested in letters, not numbers. We wish you to modify the output circuits and the machine will be printing words, not columns of figures. This is a project on which we have been working for the last three centuries–since the lamasery was founded, in fact. We have been compiling a list which shall contain all the possible names of God. We have reason to believe that all such names can be written with no more than nine letters in an alphabet we have devised. We expected it would take us about fifteen thousand years to complete the task.»

«Oh,» Dr. Wagner looked a little dazed. « But what is the purpose of this project?»

The lama hesitated for a fraction of a second. «Call it ritual, if you like, but it's a fundamental part of our belief. All the names of the Supreme Being—God, Jehovah, Allah, and so on—they are only man-made labels. There is a philosophical problem of some difficulty here, which I do not propose to discuss, but somewhere among all the possible combinations of letters that can occur are what one may call the real names of God. By systematic permutation of letters, we have been trying to list them all.»

«I see. You've been starting at AAAAAAA . . . and working up to ZZZZZZZZ.»

«Exactly—though we use a special alphabet of our own. Modifying the typewriters to deal with this is, of course, trivial. A rather more interesting problem is that of devising suitable circuits to eliminate ridiculous combinations. For example, no letter must occur more than three times in succession. I am afraid it would take too long to explain why, even if you understood our language. Luckily, it will be a simple matter to adapt your Automatic Sequence Computer for this work, since once it has been programmed properly it will permute each letter in turn and print the result. What would have taken us fifteen thousand years it will be able to do in a hundred days.»

Dr. Wagner was scarcely conscious of the faint sounds from the Manhattan streets far below. He was in a different world, a world of high mountains, where these monks had been patiently at work, generation after generation, compiling their lists of meaningless words. Was there any limit to the follies of mankind? Still, he must give no hint of his inner thoughts. The customer was always right. «There's no doubt,» replied the doctor, «that we can modify the Mark V to print lists of this nature. I'm much more worried about the problem of installation and maintenance. Getting out to Tibet, in these days, is not going to be easy.»

«We can arrange that. The components are small enough to travel by air—that is one reason why we chose your machine. If you can get them to India, we will provide transport from there.»

«And you want to hire two of our engineers?»

«Yes, for the three months that the project should occupy.»

«I've no doubt that Personnel can manage that,» and Dr. Wagner scribbled a note on his desk pad.

After three months of hard work the engineers, George and Chuck, have almost completed the monk's project and were eager to return home. The tough little mountain ponies carried them down the winding road. George turned in his saddle and stared back up the mountain road. This was the last place from which one could get a clear view of the lamasery. He knew exactly what was happening up on the mountain at this very moment. The high lama and his assistants would be sitting in their silk robes, inspecting the sheets as the junior monks carried them away from the typewriters and pasted them into the great volumes. No one would be saying anything. The only sound would be the incessant patter, the never-ending rainstorm of the keys hitting the paper, for the Mark V itself was utterly silent as it flashed through its thousands of calculations a second.

Three months of this, thought George, was enough to start anyone climbing up the wall. «There she is!» called Chuck, pointing down into the valley. The battered old DC3 lay at the end of the runway like a tiny silver cross. In two hours she would be bearing them away to freedom and sanity. The swift night of the high Himalayas was now almost upon them. The sky overhead was perfectly clear, and ablaze with the familiar, friendly stars. George glanced at his watch. «I wonder if the computer's finished its run. It was due about now.» Chuck didn't reply, so George swung round in his saddle. He could just see Chuck's face, a white oval turned toward the sky. «Look,» whispered Chuck, and George lifted his eyes to heaven. Overhead, without any fuss, the stars were going out. (Arthur Clarke)

Exercise 7. Read the story again and be ready to answer the following questions:

1. Do you know that the story "The nine billion names of God" is one of A. Clarke's favourite? 2. What is your own attitude to the story? 3. Can you state, that the idea of this story is somehow connected with set theory? 4. What is the peculiarity of its application? 5. Can the fact that the story's basic arithmetic was later challenged by J. B. S. Haldane influence your perception of the story? 6. What makes the story really interesting? 7. What several mutually incompatible things can you find in the story? 8. In what way does the paradoxal character of this story promote for its philosophical depth? 9. What is the main message of the story? 10. How can you prove the author's own statement that he managed to have created a durable myth? (Not long ago, a radio talk on the BBC referred to the opening situation of this story as actual fact). 11. Don't you think, that now, when IBM computers have entered the field of biblical scholarship, this theme is coming a little closer to reality?

Exercise 8. You are going to read a conversation between two engineers from A. Clarke's story "The nine billion names of God". For questions 1-6, choose the answer from the list (A-H) to complete the conversation. There are two extra items that you do not need to use.

Chuck: «Listen, George, I've learned something that means trouble.»

George: (1)………………………………………………

Chuck: «No – it's nothing like that. I've just found what all this is about.»

George: (2)……………………………………………………..

Chuck: «Sure – we know what the monks are trying to do. But we didn't know why. It's the craziest thing –"

George: (3)………………………………………………………

Chuck: «Well, they believe that when they have listed all His names – and they reckon that there are about nine billion of them – God's purpose will be achieved. The human race will have finished what it was created to do, and there won't be any point in carrying on."
George: (4)..
Chuck: «There's no need for that. When the list's completed, God steps in and simply winds things up . . . bingo!»
George: (5)..
Chuck: «That's just what I said to high lama. And do you know what happened? He looked at me in a very queer way, like I'd been stupid in class, and said, 'It's nothing as trivial as that.'»
George: (6)..
A. «What do you mean? I thought we knew.» B. «Then what do they expect us to do? Commit suicide?» C. «What's wrong? Isn't the machine behaving?» D. "Yes, I remember that. I just don't get it". E. «That's what I call taking the Wide View. But what should we do about it? I don't see that it makes the slightest difference to us, though I don't like the situation one little bit.» F. «She looks rather attractive" G. «Oh, I get it. When we finish our job, it will be the end of the world.» H. " She was going to help us."
Exercise 9. Discuss the paradoxes of set theory in general and paradoxes of mathematics in particular.

MIXED BAG

Exercise 1. Give opposite of the following words:
Ex.: good –bad.
1. superiority, 2. minority, 3. eclectic, 4. separated, 5. elation, 6. to improve, 7. to encourage, 8. to specify, 9. to converge, 10. to accept, 11. to minimize, 12. eternity, 13. to go ahead, 14. to help, 15. friendly.
Exercise 2. Find in section B synonyms to the nouns in the section A:
Section A: 1. method; 2. composition; 3. decay; 4. bottom; 5. area
Section B: 1. decline; 2. approach; 3. base; 4. domain; 5. groundwork; 6. realm; 7. basis; 8. decadence; 9. procedure; 10. compound; 11. decomposition; 12. constitution; 13. deterioration; 14. formation; 15. technique; 16. foundation; 17. region.
Exercise 3. Form adjectives of Latin origin from the following nouns:
Ex.: brain – cerebral
1. father, 2. mother, 3. brother, 4. hand, 5. head, 6. heart, 7. heat, 8. house, 9. king.

Exercise 4. Read the list of interesting facts and be ready to continue it:
Do you know that ...
- radon, although it is a gas, is four times as heavy as iron?
- a seal never sleeps more than 1.5 minutes at a time?
- there are about 1.000.000 earthquakes each year?

Exercise 5. Try to guess the following riddles:
Can you make a match burn under water?
What is it that was born almost at the same time as the world, will live as long as the world, but is never five weeks old?
When Columbus discovered America, where did he first stand?

Exercise 6. Choose the correct form of the verb in parentheses in the following sentences.
They are interested in (introducing/to introduce) new technologies.
He had no intention of (turning down/to turn down) that argument.
She is eager (to finish/finishing) her thesis up to the end of the term.
He refused (to continue/continuing) the experiment without financial support.

UNIT 8

MATHEMATICAL LOGIC

Grammar:
1. Participles and their functions in the sentence.
2. Absolute Participial Construction

Form	Active	Passive
Participle I	**Modeling** моделюючий, моделюючи	**being modeled** змодельований
Perfect Participle I	**Having modeled** Змоделювавши	**having been modeled** після того, як був змодельований
Participle II		**Modeled** Змодельований

Functions of the participle in the sentence.

As an attribute	1. Mathematical logic is a subfield of mathematics and logic **having** close connections to computer science and philosophical logic. 2. Systematic mathematical treatments of logic **presented by** George Boole and then Augustus De Morgan appeared in the middle of the nineteenth century.
As an adverbial modifier	1. **Having built upon the work of Boole**, Charles Peirce developed a logical system for relations and quantifiers. 2. **Considered from this point of view,** the problem may get quite a different interpretation.

Exercise 1. Translate the following sentences into Ukrainian. Pay special attention to the functions of the participle.

1. The themes unifying mathematical logic include the study of the expressive power of formal systems and the deductive power of formal proof systems. 2. Their work building on work by algebraists such as George Peacock, extended the traditional Aristotelian doctrine of logic into a sufficient framework for the study of foundations of mathematics. 3. The first half of the 20th century saw an explosion of fundamental results, accompanied by vigorous debate over the foundations of mathematics. 4. In addition to the independence of the parallel postulate, established by Nikolai Lobachevsky in 1826 (Lobachevsky 1840), mathematicians discovered that certain theorems taken for granted by Euclid were not in fact provable from his axioms. 5. Hilbert (1899) developed a complete set of axioms for geometry, building on previous work by Pasch (1882). 6. In 1891 Cantor published a new proof of the uncountability of the real numbers introducing the diagonal argument.

Exercise 2. Translate the following sentences into English. Pay special attention to the participle in the function of an attribute:

1. Цей засіб, розроблений в нашій лабораторії, дозволяє уникнути помилок при обчисленні. 2. Результати цього експерименту, проведеного у нашому дослідницькому інституті, виявились достатньо цікавими.3. Це рівняння, яке було розв'язане неправильно, стало предметом для багатьох дискусій. 4. Всі ці факти, що були зазначені вище, потребують ретельної перевірки. 5. Така тенденція, що була нами щойно розглянута, прослідковується на всіх стадіях експерименту. 6. Ця унікальна ідея, запропонована нашими вченими, може зберегти багато зусиль при вирішенні цієї теореми. 7. Такий метод, розроблений нашою фірмою, допомагає уникнути помилок при підрахунку грошових потоків.

Exercise 3. Translate the following sentences into English. Pay special attention to the participle in the function of an adverbial modifier:

1. При перевірці роботи пристрою не торкайтесь до реле, а лише спостерігайте за його роботою. 2. Визначивши тип повідомлення, оператор повинен поінформувати сканер, що інформація готова. 3. Надавши всі інструкції, менеджер спостерігає за їх виконанням. 4. Коли ми створювали цю програму, ми зіткнулись з великою кількістю проблем. 5. Збільшивши кількість функцій, ми досягли відмінної роботи цього пристрою.

Absolute Participial Construction

Absolute Participial Construction is used in the function of an adverbial modifier:

of time	The value of "y" being given, we may find the value of "x".
of cause	Other parameters being unknown, they couldn't solve this problem
of attendant circumstances	We managed to finish this experiment, all the circumstances being rather unfavourable.
of condition	Other conditions being equal, the acceleration will be the same.

Exercise 4. Translate the following sentences into Ukrainian

1. Mathematical logic is divided into the subfields of set theory, model theory, recursion theory and proof theory, all these areas sharing basic results on logic, particularly first-order logic, and definability. 2. Previous conceptions of a function as a rule for computation or a smooth graph being no longer adequate, Weierstrass began to advocate the arithmetization of analysis. 3. The completeness theorem having been proved, Kurt Gödel established a correspondence between syntax and semantics in first-order logic. 4. These rays being unexplained, Roentgen called them x-rays. 5. The number of possible applications of this method being rather significant, we may predict its wide implementation. 6. The temperature having increased by several degrees, we couldn't continue our experiment.

Exercise 5. Translate the following sentences into English

1. Ми знаємо всі складові цієї моделі, причому всі вони були визначені окремо. 2. Сучасні мікропроцесори різняться за своєю архітектурою, причому їх виробництво залежить від певної напівпровідникової технології. 3. Оскільки число застосувань мікропроцесорів збільшується з кожним днем, вимоги до них суттєво зростають. 4. Оскільки всі інші підходи вже визначені, ми можемо більш детально проаналізувати нашу методику. 5. Після того, як нам представили програму, ми почали аналізувати її. 6. В цій статті аналізуються основні характеристики доповнення, причому основний акцент робиться на тих його рисах, що представляють інтерес для подальшого вивчення.

7. Оскільки результати експерименту були перевірені, ми зможемо їх використати для нашого дослідження. 8. Оскільки робота була виконана, ми вирішили перепочіти. 9. Якщо проект буде дорогим, його не затвердять.

WORD-FORMATION

Exercise 1. Form nouns from the following adjectives by adding suffix -"th" ("t"). Translate them into Ukrainian.
Example: wide – width
1. long 2. broad 3. strong 4. warm 5. deep 6. high
Exercise 2. Add to the following words (nouns, adjectives, adverbs, prepositions) suffix -"ward" to form adjectives or adverbs referring to direction or position. Translate them into Ukrainian.
Example: back – backward
1. lee 2. wind 3. sea 4. sun 5. star 6. down 7. up 8. to 9. in 10. out 11. for 12. on 13. home 14. way 15. west 16. south 17. east 18. north.
Exercise 3. Give English equivalents to the following words:
1. захищений (від вітру); 2. по вітру; 3.вперед; 4.всередину; 5. назовні; 6. поступовий (рух); 7. непокірний, загубивший шлях; 8. спрямований до зірок; 9. висота; 10. сила; 11. тепло; 12.глибина.
Exercise 4. Make up sentences with the following words and word-combinations:
1. the width of one's views; 2. the breadth of interpretation 3. the strength of mind; the strength of words; by strength of arm; the strength of current; the strength of field. 4. upward motion 5. inward hesitations; 6. backward country.
Exercise 5. Translate the sentences paying attention to the underlined words:
1. Широта наукового світогляду мислителів доби Ренесансу вражає сучасних дослідників. 2. Психологія приділяє значну увагу дослідженню глибин людської свідомості. 3. Коректне застосування наукових методів сприяє досягненню нових висот у процесі пізнання. 4. Спелеологи продовжували просуватися вгору, доки не побачили яскраве світло в кінці тунеля. 5. Для того, щоб впевнено рухатися вперед шляхом реформ, необхідно сформувати цілісне бачення ситуації в країні.

Text 1.

Mathematical logic

Mathematical logic is a subfield of mathematics and logic having close connections to computer science and philosophical logic. The field includes the mathematical study of logic and the applications of formal logic to other areas of mathematics. The themes unifying mathematical logic include the study of the expressive power of formal systems and the deductive power of formal proof systems.

Mathematical logic is divided into the subfields of set theory, model theory, recursion theory and proof theory, all these areas sharing basic results on logic, particularly first-order logic, and definability.

Sophisticated theories of logic were developed in many cultures, including China, India, Greece, and the Islamic world. The works most familiar to Western mathematicians in the 19th century were Aristotle's theory of syllogisms and Euclid's axioms for planar geometry. In the 18th century, attempts to treat the operations of formal logic in a symbolic or algebraic way had been made by philosophical mathematicians including Leibniz and Lambert, but their labors remained isolated and little known.

In the middle of the nineteenth century, George Boole and then Augustus De Morgan presented systematic mathematical treatments of logic. Their work building on work by algebraists such as George Peacock, extended the traditional Aristotelian doctrine of logic into a sufficient framework for the study of foundations of mathematics .

Having built upon the work of Boole, Charles Peirce developed a logical system for relations and quantifiers, which he published in several papers from 1870 to 1885. Gottlob Frege presented an independent development of logic with quantifiers in his work, published in 1879. Frege's work remained obscure, however, until Bertrand Russell began to promote it near the turn of the century. The two-dimensional notation developed by Frege was never widely adopted and is unused in contemporary texts.

From 1890 to 1905, Ernst Schröder published his work in three volumes. This work summarized and extended the work of Boole, De Morgan, and Peirce, and was a comprehensive reference to symbolic logic as it was understood at the end of the 19th century.

Since its inception, mathematical logic has contributed to, and has been motivated by, the study of foundations of mathematics. This study began in the late 19th century with the development of axiomatic frameworks for geometry, arithmetic, and analysis. In the early 20th century it was shaped by David Hilbert's program to prove the consistency of foundational theories. Results of Kurt Gödel, Gerhard Gentzen, and others provided partial resolution to the program, and clarified the issues involved in proving consistency. Work in set theory showed that almost all ordinary mathematics can be formalized in terms of sets, although there are some theorems that cannot be proven in common axiom systems for set theory. Contemporary work in the foundations of mathematics often focuses on establishing which parts of mathematics can be formalized in particular formal systems, rather than trying to find theories in which all of mathematics can be developed.

Mathematical logic began diverging as a distinct field in the mid-19th century. Until then, logic was studied with rhetoric, through the syllogism, and with philosophy. The first half of the 20th century saw an explosion of fundamental results, accompanied by vigorous debate over the foundations of mathematics.

The development of formal logic, together with concerns that mathematics had not been built on a proper foundation, led to the development of axiom systems for fundamental areas of mathematics such as arithmetic, analysis, and geometry.

In logic, the term arithmetic refers to the theory of the natural numbers. Giuseppe Peano (1888) published a set of axioms for arithmetic that came to bear his name, using a variation of the logical system of Boole and Schröder but adding quantifiers. Peano was unaware of Frege's work at the time. Around the same time Richard Dedekind showed that the natural numbers are uniquely characterized by their induction properties. Dedekind (1888) proposed a different characterization, which lacked the formal logical character of Peano's axioms. Dedekind's work, however, proved theorems inaccessible in Peano's system, including the uniqueness of the set of natural numbers (up to isomorphism) and the recursive definitions of addition and multiplication from the successor function and mathematical induction.

In the mid-19th century, flaws in Euclid's axioms for geometry became known. In addition to the independence of the parallel postulate, established by Nikolai Lobachevsky in 1826 (Lobachevsky 1840), mathematicians discovered that certain theorems taken for granted by Euclid were not in fact provable from his axioms. Among these is the theorem that a line contains at least two points, or that circles of the same radius whose centers are separated by that radius must intersect. Hilbert (1899) developed a complete set of axioms for geometry, building on previous work by Pasch (1882). The success in axiomatizing geometry motivated Hilbert to seek complete axiomatizations of other areas of mathematics, such as the natural numbers and the real line. This would prove to be a major area of research in the first half of the 20th century.

The 19th century saw great advances in the theory of real analysis, including theories of convergence of functions and Fourier series. Mathematicians such as Karl Weierstrass began to construct functions that stretched intuition, such as nowhere-differentiable continuous functions. Previous conceptions of a function as a rule for computation or a smooth graph being no longer adequate, Weierstrass began to advocate the arithmetization of analysis, which sought to axiomatize analysis using properties of the natural numbers. The modern "ε-δ" definition of limits and continuous functions was developed by Bolzano and Cauchy between 1817 and 1823. In 1858, Dedekind proposed a definition of the real numbers in terms of Dedekind cuts of rational numbers, a definition still employed in contemporary texts.

Having developed the fundamental concepts of infinite set theory, George Cantor proved that the real numbers and the natural numbers have different cardinalities. Over the next twenty years, Cantor worked out a theory of transfinite numbers in a series of publications. In 1891, he published a new proof of the uncountability of the real numbers introducing the diagonal argument, and used this method to prove Cantor's theorem that no set can have the same cardinality as its power set. Cantor believed that every set could be well-ordered, but was unable to produce a proof for this result, leaving it as an open problem in 1895. In the early decades of the 20thcentury, the main areas of study were set theory and formal logic. The discovery of paradoxes in informal set theory caused some to wonder whether mathematics itself is inconsistent, and to look for proofs of consistency.

In 1900, Hilbert posed a famous list of 23 problems for the next century. The first two of these were to resolve the continuum hypothesis and prove the consistency of elementary arithmetic, respectively; the tenth was to produce a method that could decide whether a multivariate polynomial equation over the integers has a solution. Subsequent work to resolve these problems shaped the direction of mathematical logic, as did the effort to resolve Hilbert's problem, posed in 1928. This problem asked for a procedure that would decide, given a formalized mathematical statement, whether the statement is true or false. (From Wikipedia, the free encyclopedia)

Active vocabulary

Subfield; recursion theory; first-order logic; definability; syllogisms; mathematical treatments; sufficient; framework; foundations of mathematics; quantifier; obscure; comprehensive; inception; consistency; diverging; vigorous; to lack; the successor function; to seek; convergence of functions; cardinality; well-ordered; reasoning; procedure; number (natural, real, rational, odd, even); argument; statement; premises; conclusion; syllogism.

VOCABULARY AND COMPREHENSION EXERCISES

Exercise 1. Translate the following words and word-combinations:
1. визначеність 2. логіка першого порядку 3. достатній 4. послідовність (логічність) 5. структура 6. конвергенція 7. всебічний 8. бракувати 9. шукати 10. зводимість функцій 11. добре впорядкований 12. процедура 13. підрозділ 14.початок 15. процедура 16. означник кількості 17. математична трактовка 18. кількісність 19. міркування 20. засновки 21. висновок 22. судження 23. висловлювання.
Exercise 2. Find in the text equivalents to the following words and word-combinations:
1. connecting 2. having smth. in common 3. flat (plane) 4. handling 5. foggy (not clear) 6. modern 7. origin 8. to prove validity 9. separating 10. to support 11. to consider proved 12. drawback.
Exercise 3. Translate the following sentences into Ukrainian:
1. Mathematical logic, which is a subfield of mathematics and logic, includes the mathematical study of logic and the applications of formal logic to other areas of mathematics. 2. Set theory, model theory, recursion theory and proof theory are somehow related to logic, particularly first-order logic, and definability. 3. In the work of George Peacock the traditional Aristotelian doctrine of logic was extended into a sufficient framework for the study of foundations of mathematics. 4. In the 19th century great progress was made in the theory of real analysis, including theories of convergence of functions and Fourier series. 5. George Cantor proved that the real numbers and the natural numbers have different cardinalities. 6. Cantor put forward a new proof of the uncountability of the real numbers introducing the diagonal argument, and used this method to prove Cantor's theorem that no set can have the same

cardinality as its power set. 7. Hilbert tried to resolve the continuum hypothesis and prove the consistency of elementary arithmetic.

Exercise 4. Translate the following sentences into English.

Антична логіка, яка заклала основи сучасної математичної логіки, з'явилась у Давній Греції як один із напрямів філософії. Термін „логіка" походить від давньогрецького слова „логос", що означає „слово". У стародавній Греції „логос" належав до категорії філософських термінів. Геракліт був першим, хто назвав логосом вічну і всезагальну необхідність, певну стійку закономірність. Однак справжнім засновником логіки вважається Аристотель, який ввів певні поняття і принципи логіки. На думку Аристотеля, логіка дозволяє кожному, хто нею оволодів, отримати певний метод дослідження будь-якої проблеми. Філософ називав такий метод „силогістичним" методом, оскільки будь-яке доведення можна побудувати у вигляді певного силогізму, тобто міркування. Недоліком аристотелевої теорії силогізмів було те, що в ній не використовувалась математична символіка та математичні методи. Багато джерел античної логіки було втрачено, але з упевненістю можна сказати, що ми знаємо античну логіку набагато краще, ніж середньовічну або ж ренесансну логіку. Засновником нової логіки можна вважати німецького вченого Готфріда Лейбніца, який жив у XVII столітті, однак його праці випереджали свою епоху на декілька століть. Нова логіка, як продовження традиційної аристотелевої логіки, виникла у XIX столітті, коли такі математики як Буль, Пірс, Вайтхед та Рассел почали цікавитися теорією обчислення класів та обчислення суджень. Трішки пізніше, наприкінці XIX століття, з'явились нові напрямки у алгебрі та геометрії, які мали значний вплив на розвиток математичної логіки. Зараз математична логіка включає чотири основних компоненти: 1) стару логіку; 2) ідею автоматичної мови для висловлення суджень; 3) ідею про частини математики як ланцюги логічних суджень; 4) нові напрацювання в алгебрі та геометрії. Метаматематика як нова галузь математичної логіки розглядає частини математики як системи дедукції (виведень). Зараз методи та категорії математичної логіки широко застосовуються у багатьох наукових дослідженнях.

Exercise 5. Read the text. Its summary is provided after the text. The statements of the summary are mixed up. Put the statements (A-H) in the chronological order of the events in the text. Mind, that there are two extra statements, which you don't have to take into account.

Aristotelean Logic

Historically, logic, as the science of formal principles of reasoning or correct inference, originated with the ancient Greek philosopher Aristotle. Aristotle's collection of logical treatises is known as the Organon. Of these treatises, the "Prior Analytics" contains the most systematic discussion of formal logic. In addition to the Organon, the Metaphysics also contains relevant material. In his works Aristotle managed to formulate the basic concepts of logic (terms, premises, syllogisms, etc.) in a neutral way, independent of any particular philosophical orientation. Thus Aristotle seems to have viewed logic not as part of philosophy but rather as a tool or instrument to be used by philosophers and scientists alike.

According to Aristotle reasoning is any argument in which certain assumptions or premises are laid down and then something other than these necessarily follows. Thus logic is the science of necessary inference. Any type of reasoning, both scientific and non-scientific, must take place within the logical framework, but it is only a framework, nothing more. This is what is meant by saying that logic is a formal science.

Aristotelean logic begins with the familiar grammatical distinction between subject and predicate. A subject is typically an individual entity, for instance a man or a house or a city. It may also be a class of entities, for instance all men. A predicate is a property or attribute or mode of existence which a given subject may or may not possess. For example, an individual man (the subject) may or may not be skillful (the predicate), and all men (the subject) may or may not be brothers (the predicate). The fundamental principles of predication are: identity, non-contradiction and either-or. According to Aristotelean logic, the basic unit of reasoning is the syllogism. Every syllogism consists of two premises and one conclusion.

Logic was further developed and systematized by the Stoics and by the medieval scholastic philosophers. From the Renaissance through the 20th century, Aristotle's ideas about the nature of mathematical objects have been neglected and ignored. Though, of course, some principles of Aristotelean logic were fruitfully developed in the late 19th and 20th centuries. In this period of time logic saw explosive growth, which has continued up to the present. Nowadays the logic of Aristotle is universally recognized as one of the towering scientific achievements of ancient Greece.

A. Definitions of the basic concepts of logic; B. The structure of the basic unit; C. The origin of logic. D. Further development of logic; E. The assessment of Aristotle's contribution to modern science. F. The impact of Aristotle's logic on the works of the Stoics. G. The first treatises of logic. H. Classification of syllogisms.

Exercise 6. Answer the following questions:

What sciences is mathematical logic connected with?
What themes unify mathematical logic?
What was Aristotle's contribution to mathematical logic?
How did philosophical mathematicians try to treat the operations of formal logic in the 18th century?
Who presented systematic mathematical treatments of logic in the middle of the nineteenth century?
What led to the development of axiom systems for fundamental areas of mathematics such as arithmetic, analysis, and geometry?
What theories and proofs were worked out by Cantor?
What reason made some mathematicians doubt consistency of mathematics?
What problems were posed by Hilbert?

Exercise 7. Agree or disagree with the following statements. Use the phrases:

I fully agree with you	I'm afraid, I can't agree with you
Quite right you are	It is not quite so. Just the reverse

1. Sophisticated theories of logic hadn't been developed before the 19th century.
2. Systematic mathematical treatments of logic appeared only in the beginning of the 20th century.
3. G.Boole and A. De Morgan extended the traditional Aristotelian doctrine of logic into a sufficient framework for the study of foundations of mathematics.
4. An independent development of logic with quantifiers was presented by Frege.
5. Since its inception, mathematical logic developed quite independently.
6. In the first half of the 20th century the development of axiom systems for fundamental areas of mathematics was explained by the growth of interest in philosophy.
7. Giuseppe Peano (1888) based a set of axioms for arithmetic on Frege's work.
8. George Cantor was the first to prove that the real numbers and the natural numbers have different cardinalities.

9. The first two tasks set by Hilbert in his famous list of 23 problems for the next century were to resolve the continuum hypothesis and prove the consistency of elementary arithmetic.

Exercise 8. Write an annotation to the text "Mathematical logic".

Exercise 9. Discuss the following topics.

1. Aristotle's contribution to mathematical logic.
2. Development of mathematical logic in the 19th century.
3. Subfields of mathematical logic.
4. Mathematical logic and its importance for contemporary science.

MIXED BAG

Exercise 1. Give opposite of the following words:
Ex.: good –bad.
1. polite, 2. up-to-date, 3. safety, 4. certainty, 5. absolute, 6.to terminate, 7. shallow, 8. to precede, 9. to add, 10. to verify, 11. sophisticated, 12. similar, 13. to divide, 14. permission, 15. legitimate, 16. sincere, 17. severity, 18. arid.

Exercise 2. Find in section B synonyms to the verbs in the section A:
Section A: 1. to decipher; 2. to develop; 3. to receive; 4. to add; 5. to forecast.
Section B: 1. to anticipate; 2. to complement; 3. to cultivate; 4. to decode; 5. to evolve; 6. to find the meaning; 7. to progress; 8. to obtain; 9. to contribute; 10. to unravel; 11. to get; 12. to supplement; 13. to foresee; 14. to attach; 15. to predict.

Exercise 3. Form adjectives of Latin origin from the following nouns:
Ex.: brain – cerebral
1. sun, 2. time, 3. tongue, 4. war, 5. wave, 6. iron, 7. body, 8. citizen, 9. earth.

Exercise 4. Read the list of interesting facts and be ready to continue it:
Do you know that ...
- most flashes of lightning last only a few millionths of a second?
- there can be no other side of a rainbow, because we can see a rainbow only on the side opposite to the sun?
- the name Smith is the most popular name in Scotland?

Exercise 5. Try to guess the following riddles:
What has six feet and can sing?
Which is heavier, a half or a full moon?

What are the two largest ladies in the USA?

Exercise 6. Choose the correct form of the verb in the following sentences.

1. They regret (to be/being) responsible for some serious mistakes in the program. 2 They hope (to find/finding) the best possible solution. 3. We are not ready (to stop/stopping) the research at this time. 4. He is looking forward to (publish/publishing) the results of his investigation in a special journal.

UNIT 9

ENVIRONMENTAL PROTECTION

Grammar: 1. Gerund. Its functions. 2. Gerundial Complexes.

The Gerund

The Gerund developed from the verbal noun. Objective (transitive) verbs have four forms of the Gerund.

Indefinite	Passive
upgrading	***being upgraded***
Perfect	Perfect Passive
having upgraded	***having been upgraded***

Note, that there's a tendency at present to avoid using the Perfect forms of the gerund.

We say that the gerund has verbal features because it has tense and voice forms, can take a direct object and be modified by an adverb.

The gerund has also nominal features. It is very often used with the preposition. Most of its syntactical functions strongly remind us of the noun because the gerund can be the subject and the object of the sentence. Like the noun the gerund can be modified by a possessive pronoun or a noun in the possessive case.

Sentence Patterns with the Gerund

The Subject

A.

	is	no use	
It		useless	doing smth
	was	no good	
		worth	

E.g. 1. It's no use checking all the data. Дарма перевіряти усі дані.

2. It was no good trying to decode the program. Спроба декодувати програму не мала сенсу.

B.

	Is	
There		no doing smth
	Was	

E.g. 1. There is no hiding these facts. Ці факти не приховаєш.

	is		use		
There		no (little)	point	in	doing smth
	was		sense		
			harm		

E.g. 1. There is little sense in holding this experiment once again
Мало сенсу в тому, щоб проводити цей експеримент ще раз.

	does smth
Doing smth	did smth
	will do smth
	is smth

E.g. 1. Studying these facts will help us to understand this phenomenon.
Вивчення цих фактів допоможе нам зрозуміти це явище.

Exercise 1.Translate the following sentences into Ukrainian.

1. Controlling a hardware I/O interface from a high-level language typically requires accessing the hardware I/O registers. 2 Restructuring nature was not part of the bargain. 3. Going ahead in this direction may be not only unwise but dangerous. 4. There is no use in seeking for a final knowledge in an asymptotic state of the universe. 5. Sampling without replacement plays an important role in applied statistics. 6. It is worth noticing that Kepler put to use mathematical knowledge which had been developed by the Greeks almost two thousand years earlier. 7. Development is fast because of the rapid turnaround – there is no waiting for long compilations. 8. Development aids and debugging are also covered in this chapter. 9. Overloading is the ability to define properties, methods or procedures that have the same name but use different data types. 10. Multithreading makes your applications more responsive to user input.

Exercise 2. Translate into English. Use A, B, C patterns.

1. Безглуздо доводити цю теорему. 2. Немає сенсу визначати ці змінні. 3. Такі рівняння не розв'яжеш. 4. Перевірка програми потребує

певного часу. 5. Обробка даних вимагає особливої уважності. 6. Немає потреби перевіряти всі файли з самого початку.

The Predicative.

Smb's	wish objective duty task	is/ was	doing smth

E.g. The main thing was getting there in time.- Головне було потрапити туди вчасно.

Note, that the Gerund in the function of the Predicative is also used after the following verbs:

To begin , to start, to stop, to go on, to keep on, to give up, etc

Exercise 3. Translate the following sentences into Ukrainian.

1. We can't say that the only way out was telling scientists not to venture further in certain directions. 2. Our aim is solving problems in different ways and with new techniques. 3. Seeing is believing. 4. He stopped making his calculations as he found virus in the program. 5. W. Gates discovered his interest in software and began programming computers at the age of 13. 6. Guided by a belief that the computer would be a valuable tool on every office desktop and in every home, he began developing software for personal computers. 7. A good analogy for this is sharpening your pencil.

Exercise 4. Translate into English using pattern A.

1. Метою цього дослідження є впровадження нових методів обчислення кривих поверхонь. 2. Головним є підтвердження правильності цієї гипотези. 3. Головною проблемою було здати іспит. 4. Нашим завданням було перевірити результати проведеного експерименту. 5. Він дуже рано почав розробляти програми. 6. Вони продовжували дискутувати, доки не знайшли рішення, яке б влаштовувало усіх. 7. Він взагалі перестав провадити експерименти.

The Direct Object

Remember the verbs after which the gerund is used:

admit	appreciate	avoid	can't help	consider	delay	deny	enjoy
finish	mind	need*	miss	postpone	practice	quit	recall
regret	report	resent	resist	resume	risk	suggest	
to be worth	can't afford						

E.g. We shouldn't risk making this experiment without preliminary preparation.
They couldn't avoid making the same mistake.
This hypothesis is worth analyzing.
Note, that the word need is followed by the infinitive if a living being is the subject and is followed by the gerund- if a thing (an inanimate object) is the subject.
E.g. You don't need to go into details.
These data need checking.

Exercise 5. Translate into English using the table.

1.Терпіти не можу кожного разу кодувати ці програми. 2. Я не міг уникнути розмови з нею. 3. Ці визначення потребують уточнення. 4. Цей метод заслуговує на те, щоб його використовували. 5. Я нічого не маю проти того, щоб ще раз перевірити дані.6. Вони затримують нарахування відсотків на банківських рахунках. 7. Він жалкує, що він сказав це. 8. Ця гіпотеза потребує доказів. 9. Ці дані слід обробити.

Note the verbs after which both the infinitive and the gerund are used.

can't stand	begin	start	continue	
like	love	hate	prefer	dread

E.g. Wherever huge dams are built the earth starts shuddering.

The Prepositional Object

to think of; to suspect of; to accuse of; to be afraid of; to object to; to be used to; to look forward to; to succeed in; to be engaged in; to insist on; to depend on; to apologize for; to be grateful for; to be responsible for; to thank for; to blame for; to be clever at; to prevent from	doing smth being done having done smth having been done

Exercise 6. Translate the following sentences into Ukrainian.

1. If we want to avoid misunderstanding we may call the first kind of interval a closed interval. 2. They succeeded in solving the problem quite easily. 3. They insist on reconsidering this question. 4. N.I. Lobachevsky entered the University of Kazan at the age of 14 and due to his brilliant work he succeeded in taking a Master's degree four years later. 5. In this

case it would hardly be possible to avoid carrying over into the new language the logically unsatisfactory features of English. 6. In brief, it amounts to formulating a mathematical theory as a logical system augmented by further axioms.

Exercise 7. Translate the following sentences into English

1. Нарешті мені пощастило знайти рішення. 2. Він наполягав на тому, щоб розширили програму. 3. Він був зайнятий обробкою інформації. 4. Він вам вдячний за те, що йому дали кілька цінних порад. 5. Я проти того, щоб використовували результати мого дослідження. 6. Ми залежимо від проведення цього експерименту.

The Attribute

	Of	
Smth	in	doing smth
	For	

E.g. This is a good idea for implementing.– Це хороша ідея для втілення

They had no intention of checking these results. – Вони не мали намірів перевіряти ці результати.

Exercise 8. Translate the following sentences into Ukrainian.

1. The art of reading such irregular oscillations is not easy. 2. It is the battle for learning which is significant, and not the victory. 3. In such a world, knowledge is in its essence the process of knowing. 4. Thus, high-level programming languages are being adopted with the goal of reducing the high costs of developing and maintaining system software 5. Since this central logic for scheduling is similar for many programs, a natural development is to include it in the language. 6. I had no particular qualification for solving the problem on which he requested help. 7. This was the sort of weapon which our greatest actual enemy would have no hesitation in using.

Exercise 9. Translate the following sentences into English.

1. Це гарний спосіб пояснити, як це робиться. 2. У нього не було ніякого наміру наполягати на своїх висновках. 3. Наші шанси розкодувати програму були дуже малі. 4. Не буде ніяких труднощів в тому, щоб поновити цю роботу. 5. Немає ніякої небезпеки у тому, щоб підвищити тиск і напругу. 6. Він взявся за написання роботи з метою підтвердження своєї гіпотези.

The Adverbial Modifier.

On after before by through because of without in spite of	doing smth

E.g. You can find this file by pushing this key. He left without saying good bye.

Exercise 10. Translate the following sentences into Ukrainian.

1. Like the Red Queen, we cannot stay where we are without running as fast as we can. 2. By using assembly language, an experienced system programmer can generate compact, efficient code. 3. The SPL (System Programming Language) must enable program development to be decentralized by providing separate compilation. 4. We can avoid a catastrophe of this sort not by waiting until the catastrophe is upon us but by much thinking over the solution. 5. His business is to accomplish a certain purpose by going through certain procedures in a given succession. 6. There is no lack of ideas for balancing the environment.

Exercise 11. Translate the following sentences into English.

1. Програма працювала без зупинки вже кілька діб. 2. Все це слід обговорити до того, як приймати рішення. 3. Ви зможете виправити всі помилки, перевіряючи всі формули одну за іншою. 4. Не робіть цього, не продумавши все як слід. 5. Він дасть відповідь після проведення роботи. 6. Він упустив можливість виступити на конференції тому що був хворий.

Exercise12. Translate the sentences paying attention to gerund in different functions.

1. Professor Sir Peter Mansfield, the Nobel Prize winner for Medicine, was responsible for creating a mathematical method of swiftly deciphering the signals from the scanner. 2. He was instrumental in bringing magnetic resonance (MRI) scanners into hospitals. 3. Quantum technology posits a world where computers operate without being turned on and objects are found without looking for them. 4. But a modern community can destroy its land and still import food, thus possibly destroying ever more distant lands without knowing or caring 5. Despite this assumption

this model is frequently used for simulating large molecular systems. 6. Euclidian Minimal Data Spanning Tree is a special data structure for circumventing a planar set of points. 7. The first mathematicians well known for studying the real significance of infinitesimals were Newton, Leibnitz and the Bernoulli brothers. 8. Nicole Oresme, bishop of Lisieux, was the first medieval scientist to research the distance and area covered by a moving object without supposing its constant velocity. 9. Inferring that quantities occurring in continuum mechanics must be interpreted as certain particular averages is a wrong supposition. 10. This method achieves a satisfactory accuracy without requiring much computation.

The Gerundial Complexes.

The Gerundial Complex is a construction which mainly consists of a noun in the possessive case (sometimes – a noun in the common case) or a possessive pronoun and the gerund.

boy's boy my (his, her, your, our, their)	doing smth

The Gerundial Complex has practically the same functions as the gerund and is used in most of its patterns.

E.G. It is useless your going there now (Subject)

I am against your going there alone (Predicative)

I can't stand his making mistakes. (Direct Object)

Much depends on Mary's taking the job.(Prepositional Object)

I had no idea of his being here (Attribute)

All that was after their leaving the place. (Adverbial Modifier)

Exercise 15. Translate the following sentences into Ukrainian paying special attention to Gerundial Complexes.

1. Another popular approach to shape analysis and matching is based on our comparing high-level representations of shape. 2. The main contribution of this paper is the idea of our using random sampling to produce a continuous probability distribution. 3. In recent years experimental and theoretical studies of molecular dynamics have induced a drastic increase in our understanding of many processes in chemistry and physics. 4. There is no lack of hopeful ideas for our balancing the environment, and the most encouraging today is the swell of public opinion. 5. His being overburdened with teaching and administration did not keep Lobachevsky from creating one of the greatest masterpieces

of mathematics – non-Euclidean Geometry. 6. His having discovered this law contributed much to world science. 7. Our thinking about what we are and what other people are has got to be restructured. 8. After a system crash or after someone accidentally turns off the computer without his exiting the Windows properly, the Sun Disk Program automatically runs. 9. Mere mechanization is a muscular action, in other words, our limbs can move without our having to use our brain.

Exercise 16. Translate into English paying attention to Gerundial Complexes:

1. Я не бачу ніякої проблеми в тому, що він заново перевірить всі формули. 2. Хто за те, щоб ми переписали цей тест наступного разу? 3. Вона дуже вдячна за те, що ви погодились стати її науковим керівником. 4. Ми звикли до того, що вони суперечать нам в усьому.5 Ти можеш пригадати, щоб він згадував цей факт ще комусь? 6. Ти наполягаєш на тому, що наші висновки є необгрунтованими? 7. Я боюсь, що вони запустять програму без її попередньої перевірки.

WORD-FORMATION

Exercise 1. Form new verbs by adding prefixes "over" – and "under"-.
Example: to work – to overwork, to underwork.

1. to load 2. to act 3. to bid 4. to charge 5. to run 6. to praise 7. to do 8. to shoot 9. to value 10. to estimate 11. to feed.

Exercise 2. Form nouns from the following verbs by adding - "y".
Example: discover – discovery

1. recover 2. assemble 3. treasure 4. deliver 5. inquire 6. entreat 7. enter.

Exercise 3. Translate the following words into Ukrainian

1. відкриття 2. переоцінити 3. недооцінити 4. переливатися через вінця 5. одужання 6. зібрання 7. розслідування 8. вхід 9. перевантажувати 10. постачання 11. скарбниця 12. прохання.

Exercise 4. Make up sentences with the following words and word-combinations:

1. to be difficult to overestimate; 2. to overlook some mistakes; 3. to underestimate the danger of pollution; 4. to overpraise one's contribution to smth. 5. among the greatest discoveries are…; 6. UN's General Assembly….

Exercise 5. Translate the sentences paying attention to the underlined words:

1. Маємо визнати, що ми <u>недооцінювали</u> важливість та актуальність

цієї проблеми. 2. Відкриття рентгенівських променів дозволило побачити те, що раніше було прихованим від людського ока. 3. Астронавти мають наполегливо тренуватися, щоб витримати стартові перевантаження. 4. Розслідування аварії літака суттєво просунулося після знаходження „чорної скриньки". 5. Постачання зброї у зону конфліктів забороняється спеціальними рішенннями ООН.

Text 1.

Last chance for mother Earth

The U.S. environment is seriously threatened by the garbage of the economy. The Apollo 10 astronauts could see Los Angeles as a camerous smudge from 25,000 miles in outer space. What most Americans now breathe is closer to filth than to air. Americans know pollution well. It is car-clogged streets and junk-filled landscape – their country's visible decay.California's air pollution is already so bad that on many days Los Angeles school children are warned not to breathe too deeply because of the heavy smog conditions.

The United States is far from alone in its pollution and waste. The smog is dense in Tokyo. Some of Norway's legendary fjords are awash with stinking industrial wastes. Sections of the Rhine River which flows through the industrial Rhur Valley to the North sea are so toxic that even hardy eels have difficulty surviving. In Sweden, not long ago, black snow fell on the province of Smoland.

The earth has its own waste-disposal system, but it has limits. The winds that ventilate the earth are only six miles high; toxic garbage can kill the tiny organisms that normally clean rivers. Meanwhile, modern technology is pressuring nature with tens of thousand of synthetic substances, many of which almost totally resist decay. This includes aluminium cans that do not rust, inorganic plastics that may last for decades, floating oil that can change the thermal reflectivity of oceans and radioactive wastes whose toxicity lingers for centuries.

Where do most of the pollutants end up? Probably in the oceans, which cover 70 per cent of the globe and have vast powers of self-purification. Yet even the oceans can't absorb so much filth; many scientists are worried about the effects on plankton – passively floating plants and animals, which produce about one-fifth of the earth's oxygen. Emerging now is the importance of the science of survival – ecology. Trying to awaken a sense of urgency about the situation, ecologists sometimes do not hesitate to predict the end of the world. Yet they hold out hope too.

Ecology is the study of how living organisms and the non-living environment function together as a whole, or ecosystem, in the biosphere – that extraordinarily thin global envelope which sustains the only known life in the universe. Hundreds of millions years ago, plant life enriched the earth's atmosphere to a life supporting mixture of 20 per cent oxygen, plus nitrogen, argon, carbon dioxide and water vapour. The mixture has been maintained ever since by plants, animals and bacteria, which use and return the gases at equal rates. The result is a closed system, a balanced cycle, in which nothing is wasted and everything counts. The process is governed by distinct laws of life and balance. One is adaptation; each species finds a precise niche in the ecosystem. Another law is the necessity of diversity: the more different species are in an area, the less chance that any single type will destroy the balance. Man has violated these laws – and endangered nature as well as himself.

A primitive community could harm only its own immediate environment. When it ran out of food, it had to move on or perish. But a modern community can destroy its land and still import food, thus possibly destroying ever more distant land without knowing or caring. Technological man forgets that his pressure upon nature may provoke revenge. What most appalls ecologists is that technological man remains so ignorant of his impact. Neither the politicians nor the physicists who developed the first atomic bomb were fully aware of the consequences of radioactive fallout. The men who designed the automobile did not foresee that its very success would turn cities into parking lots and destroy greenery in favour of highways all over the world. Man's inadvertence has even upset the interior conditions of the earth. Wherever huge dams are built the earth starts shuddering. The enormous weight of the water in the reservoirs behind the dams puts a new stress on the subsurface strata. In consequence the earth quivers. If technology got man into this environment crisis and pollution mess, surely technology can get him out of it again. There's no lack of hopeful ideas for balancing the environment, and the most encouraging today is the swell of public opinion. We are at least starting to combat gross pollution. Even so, real solutions will be extremely difficult and expensive. Ideally, entire environment should be subjected to computer analysis. Whole cities and industries could measure their inputs and outputs via air, land and water. But this is a far-off dream. Far more knowledge is needed. Even the simplest ecosystem is so complex that the largest computer cannot fully unravel it. Technological man is bewitched by the dangerous illusion that he can build bigger and bigger industrial society with scant regard for the iron laws of nature. Pessimists argue that only a catastrophe can change that attitude – too late. By contrast, the hopeful ecologists put their faith in man's ability. (Е.Л. Власова. Twenty texts for discussion)

Active vocabulary

camerous smudge, to be threatened, garbage of the economy, industrial waste, junk, radioactive fallout, subsurface strata, pollutant, toxic, waste disposal system, to survive, to destroy greenery, thermal reflectivity, environment, hardy, to pollute, filth, to violate the law.

VOCABULARY AND COMPREHENSION EXERCISES

Exercise 1. Find in the text synonyms to the following words and word-combinations.

1. to be endangered 2. dirt 3. underground layers 4. to ruin plants 5. to break the law 6. nuclear precipitation 7. poisonous 8. dark spot 9. surrounding 10. carelessness

Exercise 2. Explain what is meant by:

1. waste disposal system 2. fjords 3. greenery 4. radioactive fallout 5. ecology 6. ecological niche.

Exercise 3. Translate the following words and word-combinations into English

1. підземні пласти 2. знищувати зелені насадження 3. отруйні речовини 4. радіоактивні опади 5.система переробки відходів 6. довкілля 7. невибагливий 8. відходи промисловості 9. життєдайна суміш 10. токсичне сміття 11. самоочистка 12. необхідність різноманіття.

Exercise 4. Translate the following sentences into Ukrainian

Зараз проблема довкілля є надзвичайно важливою майже для кожної країни на глобусі. Зростання промислового виробництва неминуче призводить до забруднення води, грунту, повітря. І хоча очисна система землі потужно працює, у неї також є свої обмеження. Із-за забруднення, яке постійно зростає, багато видів живих організмів, навіть найбільш невибагливих, виживає з трудом, а деякі види взагалі зникають. Високий рівень технологічного розвитку привів до того факту, що забруднення – це не лише засмічений ландшафт, щільний смог, а й радіоактивні відходи, які є надзвичайно шкідливими для здоров'я. Саме тому екологи та захисники природи намагаються бити на сполох стосовно цієї ситуації, інакше людство приречене на поступове вимирання. Лише об'єднані зусилля науковців, дослідників, фінансових груп, різних державних та суспільних організацій можуть допомогти вирішити цю надзвичайно важливу проблему, яка постала перед людством.

Exercise 5. Each sentence, from 1 to 11, may contain an unnecessary word. Find the unnecessary words and indicate the correct sentences.

Text 2

1. In the German town of Espenhain is the world's biggest solar power plant was opened. 2. Hidden behind the trees in the middle of the countryside the solar plant is invisible from the road. 3. It's only when you drive through the gate and onto the site itself that you are confronted with a vast field full of 335000 shimmering gray panels are tilted towards the sun at precisely 30 degrees – at the optimum angle for absorbing radiation. 4. This field was a deposit of brown coal and was so contaminated that it couldn't be used for anything else. 5. Each panel, consisting of high performance modules made of monocrystalline silicon, produces for 150 watts of energy. 6. The plant costs 22 million euros and is capable of generating 5 megawatts of electricity. 7. The opening of this plant became possible due to Germany's pioneering Renewable energy Law which was passed out four years ago. 8. According to this Law any electricity producer, including private individuals, gets paid for the amount they feed into the national grid. 9. This has encouraged thousands of people to install of solar panels on their houses. 10. Nowadays, the amount of electricity generated by renewable sources of energy has more than doubled – from 4 to 9 percent. 11. The Government plans to increase with this share to 20% in 2020 and 50% by 2050. **Vocabulary: Renewable energy** – (alternative energy) – енергія, що самовідновлюється; **High performance** modules – високоякісні модулі; National grid – національна енергосистема.

Exercise 6. Read the text again and be ready to express your attitude to the problem of renewable energy. Is it possible to use this technology in Ukraine?

Exercise 7. Answer the following questions and discuss the energy problem.
1. What other sources of alternative energy do you know? 2. Which of them can be applied in our country? 3. What are the preferences of traditional sources of energy? 4. What are the drawbacks of these sources of energy? 5. What are advantages and disadvantages of renewable energy? 6. What are weak and strong points of nuclear energy? 7. In what way is the problem of alternative energy connected with the problem of environmental protection?
Exercise 8. Participate in a round-table discussion "Environmental protection on the threshold of the third millennium" Act as :
environmentalist, biologist, businessman, meteorologist, specialist in renewable energy, clergyman, science fiction writer, journalist.
Exercise 9. Sum up a discussion. Use the following phrases:
Summing it up… On the whole…
Summarizing the discussion I'd like to say that…
1. Pollution has grown into an urgent problem. 2. Nature is seriously damaged by civilization. 3. Immediate measures must be taken to change the grave situation. 4. The consequences of this violation of nature are hard to foretell. 5. Measures must be taken to balance the environment. 6. Computers must be of much help in solving the problem.

MIXED BAG

Exercise 1. Give opposite of the following words:
Ex.: good –bad.
1. humid, 2. convex, 3. inner, 4. input, 5. internal, 6. forward, 7. inward, 8. odd, 9. pointless, 10. fresh, 11. flexible, 12. to conduct, 13. to persuade, 14. coherent, 15. strength, 16. pure, 17. busy, 18. sharp, 19. unilateral, 20. variable, 21. cause.
Exercise 2. Find in section B synonyms to the nouns in the section A:
Section A: 1. quality; 2. puzzle; 3. cause; 4. opinion; 5. similarity.
Section B: 1. enigma; 2. motive; 3. attribute; 4. ground; 5. characteristic; 6. view; 7. impression; 8. problem; 9. resemblance; 10. reason; 11. property; 12. riddle; 13. uniformity; 14. feature; 15. judgement; 16. alikeness
Exercise 3. Form adjectives of Latin origin from the following nouns:
Ex.: brain – cerebral
1. gold, 2. light, 3. man, 4. woman, 5. mind, 6. side, 7. sky, 8. son, 9. star.
Exercise 4. Read the list of interesting facts and be ready to continue it:
Do you know that ...

- the sea water is salty because of the salt that the rivers have been carrying to it for ages?
- the Earth moves 100 times faster than the most modern jet airliner?
- every word we pronounce requires the use of 72 muscles?

Exercise 5. Try to guess the following riddles:
1. What is it that we often see being made, but never see it after it is made? 2. What is too much for one, very good for two, but nothing for three? 3. When somebody falls into the water, what is the first thing he does?

Exercise 6. Choose the correct form of the verb in the following sentences.
1. He demands (to know/knowing) all the parameters of this function. 2. He agreed (to augment/augmenting) the scope of his research. 3. They intend (to proceed/proceeding) the experiment. 4. We suggest (to call/calling) the airport. They'll give us ample information about the Flight.

UNIT 10

DISTINGUISHED MATHEMATICIANS

Text 1.

Archimedes of Syracuse

Archimedes of Syracuse (c. 287 BC – c. 212 BC) was a Greek mathematician, physicist, engineer, inventor, and astronomer. Although few details of his life are known, he is regarded to be one of the leading scientists in classical antiquity. Among his advances in physics are the foundations of hydrostatics, statics and the explanation of the principle of the lever. He is credited with designing innovative machines, including siege engines and the screw pump that bears his name. Modern experiments have tested claims that Archimedes designed machines capable of lifting attacking ships out of the water and setting ships on fire using an array of mirrors.

Archimedes is generally considered to be the greatest mathematician of antiquity and one of the greatest of all time. He used the method of exhaustion to calculate the area under the arc of a parabola with the summation of an infinite series, and gave a remarkably accurate approximation of pi. He also defined the spiral bearing his name, formulas for the volumes of surfaces of revolution and an ingenious system for expressing very large numbers.

Unlike his inventions, the mathematical writings of Archimedes were little known in antiquity. Mathematicians from Alexandria read and quoted him, but the first comprehensive compilation was not made until c. AD 530 by Isidore of Miletus, while commentaries on the works of Archimedes written by Eutocius in the sixth century AD opened them to wider readership for the first time. The relatively few copies of Archimedes' written work that survived through the Middle Ages were an influential source of ideas for scientists during the Renaissance, while the discovery in 1906 of previously unknown works by Archimedes in the Archimedes Palimpsest has provided new insights into how he obtained mathematical results.

Archimedes was born c. 287 BC in the seaport city of Syracuse, Sicily, at that time a colony of Magna Graecia. The date of birth is based on a statement by the Byzantine Greek historian John Tzetzes that Archimedes lived for 75 years. In The Sand Reckoner, Archimedes gives his father's name as Phidias, an astronomer about whom nothing is known. Plutarch wrote in his Parallel Lives that Archimedes was related to King Hiero II, the ruler of Syracuse. A biography of Archimedes was written by his friend Heracleides but this work has been lost, leaving the details of his life obscure. It is unknown, for instance, whether he ever married or had children. During his youth Archimedes may have studied in Alexandria, Egypt, where Conon of Samos and Eratosthenes of Cyrene were contemporaries. He referred to Conon of Samos as his friend, while two of his works (The Method of Mechanical Theorems and the Cattle Problem) have introductions addressed to Eratosthenes.

Archimedes died c. 212 BC during the Second Punic War, when Roman forces under General Marcus Claudius Marcellus captured the city of Syracuse after a two-year-long siege. According to the popular account given by Plutarch, Archimedes was contemplating a mathematical diagram when the city was captured. A Roman soldier commanded him to come and meet General Marcellus but he declined, saying that he had to finish working on the problem. The soldier was enraged by this, and killed Archimedes with his sword. Plutarch also gives a lesser-known account of the death of Archimedes which suggests that he may have been killed while attempting to surrender to a Roman soldier. According to this story, Archimedes was carrying mathematical instruments, and was killed because the soldier thought that they were valuable items. General Marcellus was reportedly angered by the death of Archimedes, as he considered him a valuable scientific asset and had ordered that he not be harmed.

The last words attributed to Archimedes are "Do not disturb my circles", a reference to the circles in the mathematical drawing that he was supposedly studying when disturbed by the Roman soldier. This quote is often given in Latin as "Noli turbare circulos meos," but there is no reliable evidence that Archimedes uttered these words and they do not appear in the account given by Plutarch. A sphere has 2/3 the volume and surface area of its circumscribing cylinder. A sphere and cylinder were placed on the tomb of Archimedes at his request.

The tomb of Archimedes carried a sculpture illustrating his favorite mathematical proof, consisting of a sphere and a cylinder of the same height and diameter. Archimedes had proven that the volume and surface area of the sphere are two thirds that of the cylinder including its bases. In 75 BC, 137 years after his death, the Roman orator Cicero was serving as quaestor in Sicily. He had heard stories about the tomb of Archimedes, but none of the locals was able to give him the location. Eventually he found the tomb near the Agrigentine gate in Syracuse, in a neglected condition and overgrown with bushes. Cicero had the tomb cleaned up, and was able to see the carving and read some of the verses that had been added as an inscription. The standard versions of the life of Archimedes were written long after his death by the historians of Ancient Rome. The account of the siege of Syracuse given by Polybius in his Universal History was written around seventy years after Archimedes' death, and was used subsequently as a source by Plutarch and Livy. It sheds little light on Archimedes as a person, and focuses on the war machines that he is said to have built in order to defend the city.

The most widely known anecdote about Archimedes tells of how he invented a method for determining the volume of an object with an irregular shape. According to Vitruvius, a new crown in the shape of a laurel wreath had been made for King Hiero II, and Archimedes was asked to determine whether it was of solid gold, or whether silver had been added by a dishonest goldsmith. Archimedes had to solve the problem without damaging the crown, so he could not melt it down into a regularly shaped body in order to calculate its density. While taking a bath, he noticed that the level of the water in the tub rose as he got in, and realized that this effect could be used to determine the volume of the crown. For practical purposes water is incompressible, so the submerged crown would displace an amount of water equal to its own volume. By dividing the weight of the crown by the volume of water displaced, the density of the crown could be obtained. This density would be lower than that of gold if cheaper and less dense metals had been added. Archimedes then took to the streets naked, so excited by his discovery that he had forgotten to dress, crying "Eureka!" (meaning in Greek:"I have found it!"). The story about the golden crown does not appear in the known works of Archimedes, but in his treatise On Floating Bodies he gives the principle known in hydrostatics as Archimedes' Principle. This states that a body immersed in a fluid experiences a buoyant force equal to the weight of the displaced fluid.

The Archimedes screw

A large part of Archimedes' work in engineering arose from fulfilling the needs of his home city of Syracuse. The Greek writer Athenaeus of Naucratis described how King Hieron II commissioned Archimedes to design a huge ship, the Syracusia, which could be used for luxury travel, carrying supplies, and as a naval warship. The Syracusia is said to have been the largest ship built in classical antiquity. According to Athenaeus, it was capable of carrying 600 people and included garden decorations, a gymnasium and a temple dedicated to the goddess Aphrodite among its facilities. Since a ship of this size would leak a considerable amount of water through the hull, the Archimedes screw was purportedly developed in order to remove the bilge water. Archimedes' machine was a device with a revolving screw-shaped blade inside a cylinder. It was turned by hand, and could also be used to transfer water from a low-lying body of water into irrigation canals. The Archimedes screw is still in use today for pumping liquids and granulated solids such as coal and grain. The Archimedes screw described in Roman times by Vitruvius may have been an improvement on a screw pump that was used to irrigate the Hanging Gardens of Babylon.

The Claw of Archimedes

The Claw of Archimedes is a weapon that he is said to have designed in order to defend the city of Syracuse. Also known as «the ship shaker,» the claw consisted of a crane-like arm from which a large metal grappling hook was suspended. When the claw was dropped onto an attacking ship the arm would swing upwards, lifting the ship out of the water and possibly sinking it. There have been modern experiments to test the feasibility of the claw, and in 2005 a television documentary entitled Superweapons of the Ancient World built a version of the claw and concluded that it was a workable device.

The Archimedes Heat Ray – myth or reality?

Archimedes may have used mirrors acting collectively as a parabolic reflector to burn ships attacking Syracuse. The 2nd century AD historian Lucian wrote that during the Siege of Syracuse (c. 214–212 BC), Archimedes repelled an attack by Roman soldiers with a burning-glass.[23] The device was used to focus sunlight on to approaching ships, causing them to catch fire. This purported weapon, sometimes called the «Archimedes heat ray,» has been the subject of ongoing debate about its credibility since the Renaissance. René Descartes rejected it as false, while modern researchers have attempted to recreate the effect using only the means that would have been available to Archimedes.[24] It has been suggested that a large array of highly polished bronze or copper shields acting as mirrors could have been employed to focus sunlight on to a ship. This would have used the principle of the parabolic reflector in a manner similar to a solar furnace.

A test of the Archimedes heat ray was carried out in 1973 by the Greek scientist Ioannis Sakkas. The experiment took place at the Skaramagas naval base outside Athens. On this occasion 70 mirrors were used, each with a copper coating and a size of around five by three feet (1.5 by 1 m). The mirrors were pointed at a plywood mock-up of a Roman warship at a distance of around 160 feet (50 m). When the mirrors were focused accurately, the ship burst into flames within a few seconds. The plywood ship had a coating of tar paint, which may have aided combustion.

In October 2005 a group of students from the Massachusetts Institute of Technology carried out an experiment with 127 one-foot (30 cm) square mirror tiles, focused on a mock-up wooden ship at a range of around 100 feet (30 m). Flames broke out on a patch of the ship, but only after the sky had been cloudless and the ship had remained stationary for around ten minutes. It was concluded that the device was a feasible weapon under these conditions. The MIT group repeated the experiment for the television show "Myth Busters", using a wooden fishing boat in San Francisco as the target. Again some charring occurred, along with a small amount of flame. In order to catch fire, wood needs to reach its flash point, which is around 300 degrees Celsius (570 °F).

When MythBusters broadcast the result of the San Francisco experiment in January 2006, the claim was placed in the category of «busted» (or failed) because of the length of time and the ideal weather conditions required for combustion to occur. It was also pointed out that since Syracuse faces the sea towards the east, the Roman fleet would have had to attack during the morning for optimal gathering of light by the mirrors. MythBusters also pointed out that conventional weaponry, such as flaming arrows or bolts from a catapult, would have been a far easier way of setting a ship on fire at short distances.

Mathematics

While he is often regarded as a designer of mechanical devices, Archimedes also made contributions to the field of mathematics. Plutarch wrote: «He placed his whole affection and ambition in those purer speculations where there can be no reference to the vulgar needs of life.»

Archimedes used the method of exhaustion to approximate the value of π. Archimedes was able to use infinitesimals in a way that is similar to modern integral calculus. By assuming a proposition to be true and showing that this would lead to a contradiction, he could give answers to problems to an arbitrary degree of accuracy, while specifying the limits within which the answer lay. This technique is known as the method of exhaustion, and he employed it to approximate the value of π

(pi). He did this by drawing a larger polygon outside a circle and a smaller polygon inside the circle. As the number of sides of the polygon increases, it becomes a more accurate approximation of a circle. When the polygons had 96 sides each, he calculated the lengths of their sides and showed that the value of π lay between 3 + 1/7 (approximately 3.1429) and 3 + 10/71 (approximately 3.1408). He also proved that the area of a circle was equal to π multiplied by the square of the radius of the circle.

In Measurement of a Circle, Archimedes gives the value of the square root of 3 as being more than 265/153 (approximately 1.7320261) and less than 1351/780 (approximately 1.7320512). The actual value is approximately 1.7320508, making this a very accurate estimate. He introduced this result without offering any explanation of the method used to obtain it. This aspect of the work of Archimedes caused John Wallis to remark that he was: «as it were of set purpose to have covered up the traces of his investigation as if he had grudged posterity the secret of his method of inquiry while he wished to extort from them assent to his results.»

As proven by Archimedes, the area of the parabolic segment in the upper figure is equal to 4/3 that of the inscribed triangle in the lower figure.

In The Quadrature of the Parabola, Archimedes proved that the area enclosed by a parabola and a straight line is 4/3 times the area of a corresponding inscribed triangle as shown in the figure at right. He expressed the solution to the problem as an infinite geometric series with the common ratio 1/4.

If the first term in this series is the area of the triangle, then the second is the sum of the areas of two triangles whose bases are the two smaller secant lines, and so on. This proof uses a variation of the series 1/4 + 1/16 + 1/64 + 1/256 + · · · which sums to 1/3.

In The Sand Reckoner, Archimedes set out to calculate the number of grains of sand that the universe could contain. In doing so, he challenged the notion that the number of grains of sand was too large to be counted. He wrote: «There are some, King Gelo (Gelo II, son of Hiero II), who think that the number of the sand is infinite in multitude; and I mean by the sand not only that which exists about Syracuse and the rest of Sicily but also that which is found in every region whether inhabited or uninhabited.» To solve the problem, Archimedes devised a system of counting based on the myriad. The word is from the Greek μυριάς murias, for the number 10,000. He proposed a number system using powers of a myriad of myriads (100 million) and concluded that the number of grains of sand required to fill the universe would be 8 vigintillion, or 8×1063.

Text 2.

Pythagoras

Pythagoras of Samos (Greek «Pythagoras the Samian») was born between 580 and 572 BC, died between 500 and 490 BC. He was an Ionian Greek mathematician and founder of the religious movement called Pythagoreanism. He is often revered as a great mathematician, mystic and scientist; however some have questioned the scope of his contributions to mathematics and natural philosophy. Herodotus referred to him as «the most able philosopher among the Greeks». His name led him to be associated with Pythian Apollo; Aristippus explained his name by saying, «He spoke the truth no less than did the Pythian (Pyth),» and Iamblichus tells the story that the Pythia prophesied that his pregnant mother would give birth to a man supremely beautiful, wise, and beneficial to humankind.

He is best known for the Pythagorean theorem, which bears his name. Known as «the father of numbers», Pythagoras made influential contributions to philosophy and religious teaching in the late 6th century BC. Because legend and obfuscation cloud his work even more than with the other pre-Socratics, one can say little with confidence about his life and teachings. We do know that Pythagoras and his students believed that everything was related to mathematics and that numbers were the ultimate reality and, through mathematics, everything could be predicted and measured in rhythmic patterns or cycles. According to Iamblichus of Chalcis, Pythagoras once said that «number is the ruler of forms and ideas and the cause of gods and daemons.»

He was the first man to call himself a philosopher, or lover of wisdom, and Pythagorean ideas exercised a marked influence on Plato. Unfortunately, very little is known about Pythagoras because none of his writings have survived. Many of the accomplishments credited to Pythagoras may actually have been accomplishments of his colleagues and successors.

Life

Pythagoras was born on Samos, a Greek island in the eastern Aegean, off the coast of Asia Minor. He was born to Pythais (his mother, a native of Samos) and Mnesarchus (his father, a Phoenician merchant from Tyre). As a young man, he left his native city for Croton, Calabria, in Southern Italy, to escape the tyrannical government of Polycrates. According to Iamblichus, Thales, impressed with his abilities, advised Pythagoras to head to Memphis in Egypt and study with the priests there who were renowned for their wisdom. He was also discipled in the temples of Tyre and Byblos in Phoenicia. It may have been in Egypt where he learned some geometric principles which eventually inspired his formulation of the theorem that is now called by his name. This possible inspiration is presented as an extraordinaire problem in the Berlin Papyrus. Upon his migration from Samos to Croton, Calabria, Italy, Pythagoras established a secret religious society very similar to (and possibly influenced by) the earlier Orphic cult.

Pythagoras undertook a reform of the cultural life of Croton, urging the citizens to follow virtue and form an elite circle of followers around himself called Pythagoreans. Very strict rules of conduct governed this cultural center. He opened his school to both male and female students uniformly. Those who joined the inner circle of Pythagoras's society called themselves the Mathematikoi. They lived at the school, owned no personal possessions and were required to assume a mainly vegetarian diet (meat that could be sacrificed was allowed to be eaten). Other students who lived in neighboring areas were also permitted to attend Pythagoras's school. Known as Akousmatikoi, these students were permitted to eat meat and own personal belongings. Richard Blackmore, in his book The Lay Monastery (1714), saw in the religious observances of the Pythagoreans, «the first instance recorded in history of a monastic life.»

According to Iamblichus, the Pythagoreans followed a structured life of religious teaching, common meals, exercise, reading and philosophical study. Music featured as an essential organizing factor of this life: the disciples would sing hymns to Apollo together regularly; they used the lyre to cure illness of the soul or body; poetry recitations occurred before and after sleep to aid the memory.

Flavius Josephus, in his polemical Against Apion, in defence of Judaism against Greek philosophy, mentions that according to Hermippus of Smyrna, Pythagoras was familiar with Jewish beliefs, incorporating some of them in his own philosophy.

Towards the end of his life he fled to Metapontum because of a plot against him and his followers by a noble of Croton named Cylon. He died in Metapontum around 90 years old from unknown causes.

Bertrand Russell, in A History of Western Philosophy, contended that the influence of Pythagoras on Plato and others was so great that he should be considered the most influential of all western philosophers.

Pythagoreans

The so-called Pythagoreans, who were the first to take up mathematics, not only advanced this subject, but saturated with it, they fancied that the principles of mathematics were the principles of all things.

The organization was in some ways a school, in some ways a brotherhood, and in some ways a monastery. It was based upon the religious teachings of Pythagoras and was very secretive. At first, the school was highly concerned with the morality of society. Members were required to live ethically, love one another, share political beliefs, practice pacifism, and devote themselves to the mathematics of nature.

Pythagoras's followers were commonly called «Pythagoreans». They are generally accepted as philosophical mathematicians who had an influence on the beginning of axiomatic geometry, which after two hundred years of development was written down by Euclid in The Elements.

The Pythagoreans observed a rule of silence called echemythia, the breaking of which was punishable by death. This was because the Pythagoreans believed that a man's words were usually careless and misrepresented him and that when someone was «in doubt as to what he should say, he should always remain silent». Another rule that they had was to help a man «in raising a burden, but do not assist him in laying it down, for it is a great sin to encourage indolence», and they said «departing from your house, turn not back, for the furies will be your attendants»; this axiom reminded them that it was better to learn none of the truth about mathematics, God, and the universe at all than to learn a little without learning all. (The Secret Teachings of All Ages by Manly P. Hall).

The Pythagoreans are known for their theory of the transmigration of souls, and also for their theory that numbers constitute the true nature of things. They performed purification rites and followed and developed various rules of living which they believed would enable their soul to achieve a higher rank among the gods.

Much of their mysticism concerning the soul seem inseparable from the Orphic tradition. The Orphics advocated various purificatory rites and practices as well as incubatory rites of descent into the underworld. Pythagoras is also closely linked with Pherecydes of Syros, the man ancient commentators tend to credit as the first Greek to teach a transmigration of souls. Ancient commentators agree that Pherekydes was Pythagoras's most intimate teacher. Pherekydes expounded his teaching on the soul in terms of a pentemychos («five-nooks», or «five hidden cavities») — the most likely origin of the Pythagorean use of the pentagram, used by them as a symbol of recognition among members and as a symbol of inner health (ugieia).

Musical theories and investigations

Pythagoras was very interested in music, and so were his followers. The Pythagoreans were musicians as well as mathematicians. Pythagoras wanted to improve the music of his day, which he believed was not harmonious enough and was too hectic.

According to legend, the way Pythagoras discovered that musical notes could be translated into mathematical equations was when one day he passed blacksmiths at work, and thought that the sounds emanating from their anvils being hit were beautiful and harmonious and decided that whatever scientific law caused this to happen must be mathematical and could be applied to music. He went to the blacksmiths to learn how this had happened by looking at their tools, he discovered that it was because the anvils were «simple ratios of each other, one was half the size of the first, another was 2/3 the size, and so on.» (See Pythagorean tuning.)

The Pythagoreans elaborated on a theory of numbers, the exact meaning of which is still debated among scholars. Pythagoras believed in something called the «harmony of the spheres.» He believed that the planets and stars moved according to mathematical equations, which corresponded to musical notes and thus produced a symphony. The Pythagorean theorem: The sum of the areas of the two squares on the legs (a and b) equals the area of the square on the hypotenuse (c). Since the fourth century AD, Pythagoras has commonly been given credit for discovering the Pythagorean theorem, a theorem in geometry that states that in a right-angled triangle the square of the hypotenuse (the side opposite the right angle), c, is equal to the sum of the squares of the other two sides, b and a—that is, $a^2 + b^2 = c^2$.

While the theorem that now bears his name was known and previously utilized by the Babylonians and Indians, he, or his students, are often said to have constructed the first proof. It must, however, be stressed that the way in which the Babylonians handled Pythagorean numbers, implies that they knew that the principle was generally applicable, and knew some kind of proof, which has not yet been found in the (still largely unpublished) cuneiform sources. Because of the secretive nature of his school and the custom of its students to attribute everything to their teacher, there is no evidence that Pythagoras himself worked on or proved this theorem.

For that matter, there is no evidence that he worked on any mathematical or meta-mathematical problems.(From Wikipedia, the free encyclopedia)

Text 3.

Gottfried Leibniz

Gottfried Wilhelm Leibniz (1 July 1646 [OS: 21 June] – 14 November 1716) was a German polymath who wrote primarily in Latin and French. He occupies an equally grand place in both the history of philosophy and the history of mathematics. He invented infinitesimal calculus independently of Newton, and his notation is the one in general use since then. He also invented the binary system, foundation of virtually all modern computer architectures. In philosophy, he is mostly remembered for optimism, i.e. his conclusion that our universe is, in a restricted sense, the best possible one God could have made. He was, along with René Descartes and Baruch Spinoza, one of the three greatest 17th-century rationalists, but his philosophy also looks back to the scholastic tradition and anticipates modern logic and analysis. Leibniz also made major contributions to physics and technology, and anticipated notions that surfaced much later in biology, medicine, geology, probability theory, psychology, linguistics, and information science. He also wrote on politics, law, ethics, theology, history, and philology, even occasional verse. His contributions to this vast array of subjects are scattered in journals and in tens of thousands of letters and unpublished manuscripts. As of 2008, there is no complete edition of Leibniz's writings.

Biography

Gottfried Leibniz was born on 1 July 1646 in Leipzig to Friedrich Leibniz and Catherina Schmuck. His father died when he was six, so he learned his religious and moral values from his mother. These would exert a profound influence on his philosophical thought in later life. As an adult, he often styled himself «von Leibniz», and many posthumous editions of his works gave his name on the title page as «Freiherr [Baron] G. W. von Leibniz.» However, no document has been found confirming that he was ever granted a patent of nobility.

When Leibniz was six years old, his father, a Professor of Moral Philosophy at the University of Leipzig, died, leaving a personal library to which Leibniz was granted free access from age seven onwards. By

12, he had taught himself Latin, which he used freely all his life, and had begun studying Greek.

He entered his father's university at age 14, and completed university studies by 20, specializing in law and mastering the standard university courses in classics, logic, and scholastic philosophy. However, his education in mathematics was not up to the French and British standards. In 1666 (age 20), he published his first book, also his habilitation thesis in philosophy, On the Art of Combinations. When Leipzig declined to assure him a position teaching law upon graduation, Leibniz submitted the thesis he had intended to submit at Leipzig to the University of Altdorf instead, and obtained his doctorate in law in five months. He then declined an offer of academic appointment at Altdorf, and spent the rest of his life in the service of two major German noble families.

Leibniz's first position was as a salaried alchemist in Nuremberg, even though he knew nothing about the subject. He soon met Johann Christian von Boineburg (1622–1672), the dismissed chief minister of the Elector of Mainz, Johann Philipp von Schönborn. Von Boineburg hired Leibniz as an assistant, and shortly thereafter reconciled with the Elector and introduced Leibniz to him. Leibniz then dedicated an essay on law to the Elector in the hope of obtaining employment. The stratagem worked; the Elector asked Leibniz to assist with the redrafting of the legal code for his Electorate. In 1669, Leibniz was appointed Assessor in the Court of Appeal. Although von Boineburg died late in 1672, Leibniz remained under the employment of his widow until she dismissed him in 1674.

Von Boineburg did much to promote Leibniz's reputation, and the latter's memoranda and letters began to attract favorable notice. Leibniz's service to the Elector soon followed a diplomatic role. He published an essay, under the pseudonym of a fictitious Polish nobleman, arguing (unsuccessfully) for the German candidate for the Polish crown. The main European geopolitical reality during Leibniz's adult life was the ambition of Louis XIV of France, backed by French military and economic might. Meanwhile, the Thirty Years' War had left German-speaking Europe exhausted, fragmented, and economically backward. Leibniz proposed to protect German-speaking Europe by distracting Louis as follows. France would be invited to take Egypt as a stepping stone towards an eventual conquest of the Dutch East Indies. In return, France would agree to leave Germany and the Netherlands undisturbed. This plan obtained the Elector's cautious support. In 1672, the French government invited Leibniz to Paris for discussion, but the plan was soon overtaken by events and became irrelevant. Napoleon's failed invasion of Egypt in 1798 can be seen as an unwitting implementation of Leibniz's plan.

Thus Leibniz began several years in Paris. Soon after arriving, he met Dutch physicist and mathematician Christian Huygens and realised that his own knowledge of mathematics and physics was spotty. With Huygens as mentor, he began a program of self-study that soon pushed him to making major contributions to both subjects, including inventing his version of the differential and integral calculus. He met Malebranche and Antoine Arnauld, the leading French philosophers of the day, and studied the writings of Descartes and Pascal, unpublished as well as published. He befriended a German mathematician, Ehrenfried Walther von Tschirnhaus; they corresponded for the rest of their lives.

When it became clear that France would not implement its part of Leibniz's Egyptian plan, the Elector sent his nephew, escorted by Leibniz, on a related mission to the English government in London, early in 1673. There Leibniz came into acquaintance of Henry Oldenburg and John Collins. After demonstrating a calculating machine he had been designing and building since 1670 to the Royal Society , the first such machine that could execute all four basic arithmetical operations, the Society made him an external member. The mission ended abruptly when news reached it of the Elector's death, whereupon Leibniz promptly returned to Paris and not, as had been planned, to Mainz.

The sudden deaths of Leibniz's two patrons in the same winter meant that Leibniz had to find a new basis for his career. In this regard, a 1669 invitation from the Duke of Brunswick to visit Hanover proved fateful. Leibniz declined the invitation, but began corresponding with the Duke in 1671. In 1673, the Duke offered him the post of Counsellor which Leibniz very reluctantly accepted two years later, only after it became clear that no employment in Paris, whose intellectual stimulation he relished, or with the Habsburg imperial court was forthcoming.

Leibniz managed to delay his arrival in Hanover until the end of 1676, after making one more short journey to London, where he possibly was shown some of Newton's unpublished work on the calculus. This fact was deemed evidence supporting the accusation, made decades later, that he had stolen the calculus from Newton. On the journey from London to Hanover, Leibniz stopped in The Hague where he met Leeuwenhoek, the discoverer of microorganisms. He also spent several days in intense discussion with Spinoza, who had just completed his masterwork, the Ethics. Leibniz respected Spinoza's powerful intellect, but was dismayed by his conclusions that contradicted both Christian and Jewish orthodoxy.

In 1677, he was promoted, at his request, to Privy Counselor of Justice, a post he held for the rest of his life. Leibniz served three consecutive rulers of the House of Brunswick as historian, political adviser, and most consequentially, as librarian of the ducal library. He thenceforth employed his pen on all the various political, historical, and theological matters involving the House of Brunswick; the resulting documents form a valuable part of the historical record for the period.

Among the few people in north Germany to warm to Leibniz were the Electress Sophia of Hanover (1630–1714), her daughter Sophia Charlotte of Hanover (1668–1705), the Queen of Prussia and her avowed disciple, and Caroline of Ansbach, the consort of her grandson, the future George II. To each of these women he was correspondent, adviser, and friend. In turn, they all warmed to him more than did their spouses and the future king George I of Great Britain.

The population of Hanover was only about 10,000, and its provinciality eventually grated on Leibniz. Nevertheless, to be a major courtier to the House of Brunswick was quite an honor, especially in light of the meteoric rise in the prestige of that House during Leibniz's association with it. In 1692, the Duke of Brunswick became a hereditary Elector of the Holy Roman Empire. The British Act of Settlement 1701 designated the Electress Sophia and her descent as the royal family of the United Kingdom, once both King William III and his sister-in-law and successor, Queen Anne, were dead. Leibniz played a role in the initiatives and negotiations leading up to that Act, but not always an effective one. For example, something he published anonymously in England, thinking to promote the Brunswick cause, was formally censured by the British Parliament.

The Brunswicks tolerated the enormous effort Leibniz devoted to intellectual pursuits unrelated to his duties as a courtier, pursuits such as perfecting the calculus, writing about other mathematics, logic, physics, and philosophy, and keeping up a vast correspondence. He began working on the calculus in 1674; the earliest evidence of its use in his surviving notebooks is 1675. By 1677 he had a coherent system in hand, but did not publish it until 1684. Leibniz's most important mathematical papers were published between 1682 and 1692, usually in a journal which he and Otto Mencke founded in 1682, the Acta Eruditorum. That journal played a key role in advancing his mathematical and scientific reputation, which in turn enhanced his eminence in diplomacy, history, theology, and philosophy.

The Elector Ernst August commissioned Leibniz to write a history of the House of Brunswick, going back to the time of Charlemagne or earlier, hoping that the resulting book would advance his dynastic ambitions. From 1687 to 1690, Leibniz traveled extensively in Germany, Austria, and Italy, seeking and finding archival materials bearing on this project. Decades went by but no history appeared; the next Elector became quite annoyed at Leibniz's apparent dilatoriness. Leibniz never finished the project, in part because of his huge output on many other fronts, but also because he insisted on writing a meticulously researched and erudite book based on archival sources, when his patrons would have been quite happy with a short popular book, one perhaps little more than a genealogy with commentary, to be completed in three years or less. They never knew that he had in fact carried out a fair part of his assigned task: when the material Leibniz had written and collected for his history of the House of Brunswick was finally published in the 19th century, it filled three volumes.

In 1711, John Keill, writing in the journal of the Royal Society and with Newton's presumed blessing, accused Leibniz of having plagiarized Newton's calculus. Thus began the calculus priority dispute which darkened the remainder of Leibniz's life. A formal investigation by the Royal Society (in which Newton was an unacknowledged participant), undertaken in response to Leibniz's demand for a retraction, upheld Keill's charge. Historians of mathematics writing since 1900 or so have tended to acquit Leibniz, pointing to important differences between Leibniz's and Newton's versions of the calculus.

In 1711, while traveling in northern Europe, the Russian Tsar Peter the Great stopped in Hanover and met Leibniz, who then took some interest in matters Russian over the rest of his life. In 1712, Leibniz began a two year residence in Vienna, where he was appointed Imperial Court Councillor to the Habsburgs. On the death of Queen Anne in 1714, Elector Georg Ludwig became King George I of Great Britain, under the terms of the 1701 Act of Settlement. Even though Leibniz had done much to bring about this happy event, it was not to be his hour of glory. Despite the intercession of the Princess of Wales, Caroline of Ansbach, George

I forbade Leibniz to join him in London until he completed at least one volume of the history of the Brunswick family his father had commissioned nearly 30 years earlier. Moreover, for George I to include Leibniz in his London court would have been deemed insulting to Newton, who was seen as having won the calculus priority dispute and whose standing in British official circles could not have been higher. Finally, his dear friend and defender, the dowager Electress Sophia, died in 1714.

Leibniz died in Hanover in 1716: at the time, he was so out of favor that neither George I (who happened to be near Hanover at the time) nor any fellow courtier other than his personal secretary attended the funeral. Even though Leibniz was a life member of the Royal Society and the Berlin Academy of Sciences, neither organization saw fit to honor his passing. His grave went unmarked for more than 50 years. Leibniz was eulogized by Fontenelle, before the Academie des Sciences in Paris, which had admitted him as a foreign member in 1700. The eulogy was composed at the behest of the Duchess of Orleans, a niece of the Electress Sophia.

Leibniz never married. He complained on occasion about money, but the fair sum he left to his sole heir, his sister's stepson, proved that the Brunswicks had, by and large, paid him well. In his diplomatic endeavors, he at times verged on the unscrupulous, as was all too often the case with professional diplomats of his day. On several occasions, Leibniz backdated and altered personal manuscripts, actions which cannot be excused or defended and which put him in a bad light during the calculus controversy. On the other hand, he was charming, well-mannered, and not without humor and imagination; he had many friends and admirers all over Europe.

Symbolic thought

Leibniz believed that much of human reasoning could be reduced to calculations of a sort, and that such calculations could resolve many differences of opinion:

The only way to rectify our reasonings is to make them as tangible as those of the Mathematicians, so that we can find our error at a glance, and when there are disputes among persons, we can simply say: Let us calculate [calculemus], without further ado, to see who is right. Leibniz's calculus ratiocinator, which resembles symbolic logic, can be viewed as a way of making such calculations feasible. Leibniz wrote memoranda[17] that can now be read as groping attempts to get symbolic logic and thus his calculus off the ground. But Gerhard and Couturat did not publish these writings until modern formal logic had emerged in Frege's Begriffsschrift and in writings by Charles Peirce and his students in the 1880s, and hence well after Boole and De Morgan began that logic in 1847.

Leibniz thought symbols were important for human understanding. He attached so much importance to the invention of good notations that he attributed all his discoveries in mathematics to this. His notation for the infinitesimal calculus is an example of his skill in this regard. Charles Peirce, a 19th-century pioneer of semiotics, shared Leibniz's passion for symbols and notation, and his belief that these are essential to a well-running logic and mathematics.

But Leibniz took his speculations much further. Defining a character as any written sign, he then defined a «real» character as one that represents an idea directly and not simply as the word embodying the idea. Some real characters, such as the notation of logic, serve only to facilitate reasoning. Many characters well-known in his day, including Egyptian hieroglyphics, Chinese characters, and the symbols of astronomy and chemistry, he deemed not real. Instead, he proposed the creation of a characteristica universalis or «universal characteristic», built on an alphabet of human thought in which each fundamental concept would be represented by a unique «real» character:

It is obvious that if we could find characters or signs suited for expressing all our thoughts as clearly and as exactly as arithmetic expresses numbers or geometry expresses lines, we could do in all matters insofar as they are subject to reasoning all that we can do in arithmetic and geometry. For all investigations which depend on reasoning would be carried out by transposing these characters and by a species of calculus.

Complex thoughts would be represented by combining characters for simpler thoughts. Leibniz saw that the uniqueness of prime factorization suggests a central role for prime numbers in the universal characteristic, a striking anticipation of Gödel numbering. Granted, there is no intuitive or mnemonic way to number any set of elementary concepts using the prime numbers.

Because Leibniz was a mathematical novice when he first wrote about the characteristic, at first he did not conceive it as an algebra but rather as a universal language or script. Only in 1676 did he conceive of a kind of «algebra of thought», modeled on and including conventional algebra and its notation. The resulting characteristic included a logical calculus, some combinatorics, algebra, his analysis situs (geometry of situation), a universal concept language, and more.

What Leibniz actually intended by his characteristica universalis and calculus ratiocinator, and the extent to which modern formal logic does justice to the calculus, may never be established.

Formal logic

Main article: algebraic logic

Leibniz is the most important logician between Aristotle and 1847, when George Boole and Augustus De Morgan each published books that began modern formal logic. Leibniz enunciated the principal properties of what we now call conjunction, disjunction, negation, identity, set inclusion, and the empty set. The principles of Leibniz's logic and, arguably, of his whole philosophy, reduce to two:

1. All our ideas are compounded from a very small number of simple ideas, which form the alphabet of human thought.
2. Complex ideas proceed from these simple ideas by a uniform and symmetrical combination, analogous to arithmetical multiplication.

With regard to the first point, the number of simple ideas is much greater than Leibniz thought. As for the second, logic can indeed be grounded in a symmetrical combining operation, but that operation is analogous to either of addition or multiplication. The formal logic that emerged early in the 20th century also requires, at minimum, unary negation and quantified variables ranging over some universe of discourse.

Leibniz published nothing on formal logic in his lifetime; most of what he wrote on the subject consists of working drafts. In his book History of Western Philosophy, Bertrand Russell went so far as to claim that Leibniz had developed logic in his unpublished writings to a level which was reached only 200 years later.

Mathematician

Although the mathematical notion of function was implicit in trigonometric and logarithmic tables, which existed in his day, Leibniz was the first, in 1692 and 1694, to employ it explicitly, to denote any of several geometric concepts derived from a curve, such as abscissa, ordinate, tangent, chord, and the perpendicular. In the 18th century, «function» lost these geometrical associations.

Leibniz was the first to see that the coefficients of a system of linear equations could be arranged into an array, now called a matrix, which can be manipulated to find the solution of the system, if any. This method was later called Gaussian elimination. Leibniz's discoveries of Boolean algebra and of symbolic logic, also relevant to mathematics, are discussed in the preceding section. A comprehensive scholarly treatment of Leibniz's mathematical writings has yet to be written.

Calculus

Leibniz is credited, along with Isaac Newton, with the discovery of infinitesimal calculus. According to Leibniz's notebooks, a critical breakthrough occurred on 11 November 1675, when he employed integral calculus for the first time to find the area under a function $y = f(x)$. He introduced several notations used to this day, for instance the integral sign ∫ representing an elongated S, from the Latin word summa and the d used for differentials, from the Latin word differentia. This ingenious and suggestive notation for the calculus is probably his most enduring mathematical legacy. Leibniz did not publish anything about his calculus until 1684. The product rule of differential calculus is still called «Leibniz's law». In addition, the theorem that tells how and when to differentiate under the integral sign is called the Leibniz integral rule.

Leibniz's approach to the calculus fell well short of later standards of rigor (the same can be said of Newton's). We now see a Leibniz «proof» as being in truth mostly a heuristic hodgepodge mainly grounded in geometric intuition. Leibniz also freely invoked mathematical entities he called infinitesimals, manipulating them in ways suggesting that they had paradoxical algebraic properties. George Berkeley, in a tract called The Analyst and elsewhere ridiculed this and other aspects of the early calculus, pointing out that natural science grounded in the calculus required just as big of a leap of faith as theology grounded in Christian revelation.

From 1711 until his death, Leibniz's life was envenomed by a long dispute with John Keill, Newton, and others, over whether Leibniz had invented the calculus independently of Newton, or whether he had merely invented another notation for ideas that were fundamentally Newton's.

Modern, rigorous calculus emerged in the 19th century, thanks to the efforts of Augustin Louis Cauchy, Bernhard Riemann, Karl Weierstrass, and others, who based their work on the definition of a limit and on a precise understanding of real numbers. Their work discredited the use of infinitesimals to justify calculus. Yet, infinitesimals survived in science and engineering, and even in rigorous mathematics, via the fundamental computational device known as the differential. Beginning in 1960, Abraham Robinson worked out a rigorous foundation for Leibniz's infinitesimals, using model theory. The resulting nonstandard analysis can be seen as a belated vindication of Leibniz's mathematical reasoning.

Posthumous reputation

When Leibniz died, his reputation was in decline. He was remembered for only one book, the Théodicée, whose supposed central argument Voltaire lampooned in his Candide. Voltaire's depiction of Leibniz's ideas was so influential that many believed it to be an accurate description (this misapprehension may still be the case among certain lay people). Thus Voltaire and his Candide bear some of the blame for the lingering failure to appreciate and understand Leibniz's ideas.

Much of Europe came to doubt that Leibniz had discovered the calculus independently of Newton, and hence his whole work in mathematics and physics was neglected. Leibniz's long march to his present glory began with the 1765 publication of the Nouveaux Essais, which Kant read closely. In 1768, Dutens edited the first multi-volume edition of Leibniz's writings, followed in the 19th century by a number of editions.

In 1900, Bertrand Russell published a critical study of Leibniz's metaphysics. Shortly thereafter, Louis Couturat published an important study of Leibniz, and edited a volume of Leibniz's heretofore unpublished writings, mainly on logic. Nicholas Jolley has surmised that Leibniz's reputation as a philosopher is now perhaps higher than at any time since he was alive. Analytic and contemporary philosophy continue to invoke his notions of identity, individuation, and possible worlds, while the doctrinaire contempt for metaphysics, characteristic of analytic and linguistic philosophy, has faded. Leibniz's thought is now seen as a major prolongation of the mighty endeavor begun by Plato and Aristotle: the universe and man's place in it are amenable to human reason. In 1985, the German government created the Leibniz Prize, offering an annual award of 1.55 million euros for experimental results and 770,000 euros for theoretical ones. It is the world's largest prize for scientific achievement. (From Wikipedia, the free encyclopedia)

Text 4.

Carl Friedrich Gauss

Johann Carl Friedrich Gauss (30 April 1777 – 23 February 1855) was a German mathematician and scientist who contributed significantly to many fields, including number theory, statistics, analysis, differential geometry, geodesy, electrostatics, astronomy and optics. Sometimes known as the «greatest mathematician since antiquity», Gauss had a remarkable influence in many fields of mathematics and science and is ranked as one of history's most influential mathematicians. He referred to mathematics as «the queen of sciences.»

Gauss was a child prodigy. There are many anecdotes pertaining to his precocity while a toddler, and he made his first ground-breaking mathematical discoveries while still a teenager. He completed Disquisitiones Arithmeticae, his magnum opus, in 1798 at the age of 21, though it would not be published until 1801. This work was fundamental in consolidating number theory as a discipline and has shaped the field to the present day.

A new proof of the theorem that every integral rational algebraic function of one variable can be resolved into real factors of the first or second degree, Gauss proved the fundamental theorem of algebra which states that every non-constant single-variable polynomial over the complex numbers has at least one root. Mathematicians including Jean le Rond d'Alembert had produced false proofs before him, and Gauss's dissertation contains a critique of d'Alembert's work. Ironically, by today's standard, Gauss's own attempt is not acceptable, owing to implicit use of the Jordan curve theorem. However, he subsequently produced three other proofs, the last one in 1849 being generally rigorous. His attempts clarified the concept of complex numbers considerably along the way.

Gauss also made important contributions to number theory with his 1801 book Disquisitiones Arithmeticae (Latin, Arithmetical Investigations), which contained a clean presentation of modular arithmetic and the first proof of the law of quadratic reciprocity.

In that same year, Italian astronomer Giuseppe Piazzi discovered the dwarf planet Ceres, but could only watch it for a few days. Gauss predicted correctly the position at which it could be found again, and it was rediscovered by Franz Xaver von Zach on 31 December 1801 in Gotha, and one day later by Heinrich Olbers in Bremen. Zach noted that «without the intelligent work and calculations of Doctor Gauss we might not have found Ceres again.» Though Gauss had been up to that point supported by the stipend from the Duke, he doubted the security of this arrangement, and also did not believe pure mathematics to be important enough to deserve support. Thus he sought a position in astronomy, and in 1807 was appointed Professor of Astronomy and Director of the astronomical observatory in Göttingen, a post he held for the remainder of his life.

The discovery of Ceres by Piazzi on 1 January 1801 led Gauss to his work on a theory of the motion of planetoids disturbed by large planets, eventually published in 1809 under the name Theoria motus corporum coelestium in sectionibus conicis solem ambientum (theory of motion of the celestial bodies moving in conic sections around the sun). Piazzi had only been able to track Ceres for a couple of months, following it for three degrees across the night sky. Then it disappeared temporarily behind the glare of the Sun. Several months later, when Ceres should have reappeared, Piazzi could not locate it: the mathematical tools of the time were not able to extrapolate a position from such a scant amount of data three degrees represent less than 1% of the total orbit.

Gauss, who was 23 at the time, heard about the problem and tackled it. After three months of intense work, he predicted a position for Ceres in December 1801 just about a year after its first sighting and this turned out to be accurate within a half-degree. In the process, he so streamlined the cumbersome mathematics of 18th century orbital prediction that his work published a few years later as Theory of Celestial Movement remains a cornerstone of astronomical computation. It introduced the Gaussian gravitational constant, and contained an influential treatment of the method of least squares, a procedure used in all sciences to this day to minimize the impact of measurement error. Gauss was able to prove the method in 1809 under the assumption of normally distributed errors (see Gauss–Markov theorem; see also Gaussian). The method had been described earlier by Adrien-Marie Legendre in 1805, but Gauss claimed that he had been using it since 1795.

Gauss was a prodigious mental calculator. Reputedly, when asked how he had been able to predict the trajectory of Ceres with such accuracy he replied, «I used logarithms.» The questioner then wanted to know how he had been able to look up so many numbers from the tables so quickly. «Look them up?» Gauss responded. «Who needs to look them up? I just calculate them in my head!»[citation needed]

In 1818 Gauss, putting his calculation skills to practical use, carried out a geodesic survey of the state of Hanover, linking up with previous Danish surveys. To aid in the survey, Gauss invented the heliotrope, an instrument that uses a mirror to reflect sunlight over great distances, to measure positions.

Gauss also claimed to have discovered the possibility of non-Euclidean geometries but never published it. This discovery was a major paradigm shift in mathematics, as it freed mathematicians from the mistaken belief that Euclid's axioms were the only way to make geometry consistent and non-contradictory. Research on these geometries led to, among other things, Einstein's theory of general relativity, which describes the universe as non-Euclidean. His friend Farkas Wolfgang Bolyai with whom Gauss had sworn «brotherhood and the banner of truth» as a student had tried in vain for many years to prove the parallel postulate from Euclid's other axioms of geometry. Bolyai's son, János Bolyai, discovered non-Euclidean geometry in 1829; his work was published in 1832. After seeing it, Gauss wrote to Farkas Bolyai: «To praise it would amount to praising myself. For the entire content of the work... coincides almost exactly with my own meditations which have occupied my mind for the past thirty or thirty-five years.»

This unproved statement put a strain on his relationship with János Bolyai (who thought that Gauss was «stealing» his idea), but it is now generally taken at face value. Letters by Gauss years before 1829 reveal him obscurely discussing the problem of parallel lines. Waldo Dunnington, a life-long student of Gauss, successfully proves in Gauss, Titan of Science that Gauss was in fact in full possession of non-Euclidian geometry long before it was published by János, but that he refused to publish any of it because of his fear of controversy.

The survey of Hanover fueled Gauss's interest in differential geometry, a field of mathematics dealing with curves and surfaces. This led in 1828 to an important theorem, the Theorema Egregium (remarkable theorem in Latin), establishing an important property of the notion of curvature. Informally, the theorem says that the curvature of a surface can be determined entirely by measuring angles and distances on the surface. That is, curvature does not depend on how the surface might be embedded in 3-dimensional space.

In 1831 Gauss developed a fruitful collaboration with the physics professor Wilhelm Weber, leading to new knowledge in magnetism (including finding a representation for the unit of magnetism in terms of mass, length and time) and the discovery of Kirchhoff's circuit laws in electricity. They constructed the first electromagnetic telegraph in 1833, which connected the observatory with the institute for physics in Göttingen. Gauss ordered a magnetic observatory to be built in the garden of the observatory, and with Weber founded the magnetischer Verein (magnetic club in German), which supported measurements of earth's magnetic field in many regions of the world. He developed a method of measuring the horizontal intensity of the magnetic field which has been in use well into the second half of the 20th century and worked out the mathematical theory for separating the inner (core and crust) and outer (magnetospheric) sources of Earth's magnetic field.

Gauss died in Göttingen, Hannover (now part of Lower Saxony, Germany) in 1855 and is interred in the cemetery Albanifriedhof there. Two individuals gave eulogies at his funeral, Gauss's son-in-law Heinrich Ewald and Wolfgang Sartorius von Waltershausen, who was Gauss's close friend and biographer. His brain was preserved and was studied by Rudolf Wagner who found its weight to be 1,492 grams and the cerebral area equal to 219,588 square millimeters (340.362 square inches). Highly developed convolutions were also found, which in the early 20th century was suggested as the explanation of his genius.

Gauss was an ardent perfectionist and a hard worker. According to Isaac Asimov, Gauss was once interrupted in the middle of a problem and told that his wife was dying. He is purported to have said, «Tell her to wait a moment till I'm done.» This anecdote is briefly discussed in Waldo Dunnington's Gauss, Titan of Science where it is suggested that it is an apocryphal story.

He was never a prolific writer, refusing to publish works which he did not consider complete and above criticism. This was in keeping with his personal motto pauca sed matura («few, but ripe»). His personal diaries indicate that he had made several important mathematical discoveries years or decades before his contemporaries published them. Mathematical historian Eric Temple Bell estimated that had Gauss timely published all of his discoveries, Gauss would have advanced mathematics by fifty years.

Though he did take in a few students, Gauss was known to dislike teaching. It is said that he attended only a single scientific conference, which was in Berlin in 1828. However, several of his students became influential mathematicians, among them Richard Dedekind, Bernhard Riemann, and Friedrich Bessel. Before she died, Sophie Germain was recommended by Gauss to receive her honorary degree.

Gauss usually declined to present the intuition behind his often very elegant proofs—he preferred them to appear «out of thin air» and erased all traces of how he discovered them. This is justified, if unsatisfactorily, by Gauss in his «Disquisitiones Arithmeticae», where he states that all analysis (i.e. the paths one travelled to reach the solution of a problem) must be suppressed for sake of brevity.

Gauss supported monarchy and opposed Napoleon, whom he saw as an outgrowth of revolution. (From Wikipedia, the free encyclopedia)

Text 5.

Évariste Galois

Évariste Galois (French pronunciation:October 25, 1811 – May 31, 1832) was a French mathematician born in Bourg-la-Reine. While still in his teens, he was able to determine a necessary and sufficient condition for a polynomial to be solvable by radicals, thereby solving a long-standing problem. His work laid the foundations for Galois theory, a major branch of abstract algebra, and the subfield of Galois connections. He was the first to use the word «group» (French: groupe) as a technical term in mathematics to represent a group of permutations. A radical Republican during the monarchy of Louis Philippe in France, he died from wounds suffered in a duel under shadowy circumstances at the age of twenty.

Life

Galois was born on October 25, 1811, to Nicolas-Gabriel Galois and Adélaïde-Marie (born Demante). His father was a Republican and was head of Bourg-la-Reine's liberal party, and became mayor of the village after Louis XVIII returned to the throne in 1814. His mother, the daughter of a jurist, was a fluent reader of Latin and classical literature and she was for the first twelve years of her son's life responsible for his education. At the age of 10, Galois was offered a place at the college of Reims, but his mother preferred to keep him at home. In October 1823, he entered the Lycée Louis-le-Grand, and despite some turmoil in the school at the beginning of the term (where about a hundred students were expelled), Galois managed to perform well for the first two years, obtaining the first prize in Latin. He soon became bored with his studies, and it was at this time, at the age of 14, that he began to take a serious interest in mathematics. He found a copy of Adrien Marie Legendre's Éléments de Géométrie, which it is said that he read «like a novel» and mastered at the first reading. At the age of 15, he was reading the original papers of Joseph Louis Lagrange and Niels Henrik Abel, work intended for professional mathematicians, and yet his classwork remained uninspired, and his teachers accused him of affecting ambition and originality in a negative way.[2]

Budding mathematician

In 1828, he attempted the entrance exam to École Polytechnique, without the usual preparation in mathematics, and failed for lack of explanations on the oral examination. In that same year, he entered the École préparatoire, a far inferior institution for mathematical studies at that time, where he found some professors sympathetic to him. In the following year, Galois' first paper, on continued fractions[3] was published, and while it was competent it held no suggestion of genius. Nevertheless, it was at around the same time that he began making fundamental discoveries in the theory of polynomial equations, and he submitted two papers on this topic to the Academy of Sciences. Augustin Louis Cauchy refereed these papers, but refused to accept them for publication for reasons that still remain unclear. In spite of many claims to the contrary, it appears that Cauchy had recognized the importance of Galois' work, and that he merely suggested combining the two papers into one in order to enter it in the competition for the Academy's Grand Prize in Mathematics. Cauchy, a highly eminent mathematician of the time considered Galois' work to be a likely winner (see below).[4] On July 28, 1829, Galois' father committed suicide after a bitter political dispute with the village priest. A couple of days later, Galois took his second, and final attempt at entering Polytechnique, and failed yet again. It is undisputed that Galois was more than qualified; however, accounts differ on why he failed. The legend holds that he thought the exercise proposed to him by the examiner to be of no interest, and, in exasperation, he threw the rag used to clean up chalk marks on the blackboard at the examiner's head.[5] [6] More plausible accounts state that Galois made too many logical leaps and baffled the incompetent examiner, evoking irascible rage in Galois. The recent death of his father may have also influenced his behavior.[2]

Having been denied admission to Polytechnique, Galois took the Baccalaureate examinations in order to enter the Ecole Normale. He passed, receiving his degree on December 29, 1829. His examiner in mathematics reported: «This pupil is sometimes obscure in expressing his ideas, but he is intelligent and shows a remarkable spirit of research.»

His memoir on equation theory would be submitted several times but was never published in his lifetime, due to various events. As previously mentioned, his first attempt was refused by Cauchy, but he tried again in February 1830 after following Cauchy's suggestions and submitted it to the Academy's secretary Fourier, to be considered for the Grand Prix of the Academy. Unfortunately, Fourier died soon after, and the memoir was lost. The prize would be awarded that year to Abel posthumously and also to Jacobi. Despite the lost memoir, Galois published three papers that year, two of which laid the foundations for Galois theory,[7] [8] and the third, an important one on number theory, where the concept of a finite field is first articulated.[9]

Galois lived during a time of political turmoil in France. Charles X had succeeded Louis XVIII in 1824, but in 1827 his party suffered a major electoral setback and by 1830 the opposition liberal party became the majority. Charles, faced with abdication, staged a coup d'état, and issued his notorious July Ordinances, touching off the July Revolution which ended with Louis-Philippe becoming king. While their counterparts at Polytechnique were making history in the streets during the les Trois Glorieuses, Galois and all the other students at the École Normale were locked in by the school's director. Galois was incensed and he wrote a blistering letter criticizing the director which he submitted to the Gazette des Écoles, signing the letter with his full name. Despite the fact that the Gazette's editor redacted the signature for publication, Galois was, predictably, expelled for it.[6]

Even before his expulsion from Normale was to take effect on January 4, 1831, Galois joined the staunchly Republican artillery unit of the National Guard. These and other political affiliations continually distracted him from mathematical work. Due to controversy surrounding the unit, soon after Galois became a member, on December 31, 1830, the artillery of the National Guard was disbanded out of fear that they might destabilize the government. At around the same time, nineteen officers of Galois' former unit were arrested and charged with conspiracy to overthrow the government.

In April, all nineteen officers were acquitted of all charges, and on May 9, 1831, a banquet was celebrated in their honor, with many illustrious personalities, such as Alexandre Dumas present. The proceedings became more riotous, and Galois proposed a toast to King Louis-Philippe with a dagger above his cup, which was interpreted as a threat against the king's life. He was arrested the following day, but was later acquitted on June 15.[10] [6]

On the following Bastille Day, Galois was at the head of a protest, wearing the uniform of the disbanded artillery, and came heavily armed with several pistols, a rifle, and a dagger. For this, he was again arrested, this time sentenced to six months in prison for illegally wearing a uniform.

[5] He was released on April 29, 1832. During his imprisonment, he continued developing his mathematical ideas.

Galois returned to mathematics after his expulsion from Normale, although he was constantly distracted in this by his political activities. After his expulsion from Normale was official in January 1831, he attempted to start a private class in advanced algebra which did manage to attract a fair bit of interest, but this waned as it seemed that his political activism had priority.[2][4] Simeon Poisson asked him to submit his work on the theory of equations, which he submitted on January 17. Around July 4, Poisson declared Galois' work «incomprehensible», declaring that «[Galois'] argument is neither sufficiently clear nor sufficiently developed to allow us to judge its rigor»; however, the rejection report ends on an encouraging note: «We would then suggest that the author should publish the whole of his work in order to form a definitive opinion.»[11] While Poisson's rejection report was made before Galois' Bastille Day arrest, it took some time for it to reach Galois, which it finally did in October that year, while he was imprisoned. It is unsurprising, in the light of his character and situation at the time, that Galois reacted violently to the rejection letter, and he decided to forget about having the Academy publish his work, and instead publish his papers privately through his friend Auguste Chevalier. Apparently, however, Galois did not ignore Poisson's advice and began collecting all his mathematical manuscripts while he was still in prison, and continued polishing his ideas until he was finally released on April 29, 1832.[6]

A month after his release, on May 30, was Galois' fatal duel. The true motives behind this duel that ended his life will most likely remain forever obscure. There has been a lot of speculation, much of it spurious, as to the reasons behind it. What is known is that five days before his death he wrote a letter to Chevalier which clearly alludes to a broken love affair.[4]

Some archival investigation on the original letters reveals that the woman he was in love with was apparently a certain Mademoiselle Stéphanie-Felicie Poterin du Motel, the daughter of the physician at the hostel where Galois remained during the final months of his life. Fragments of letters from her copied by Galois himself (with many portions either obliterated, such as her name, or deliberately omitted) are available.[12] The letters give some intimation that Mlle. du Motel had confided some of her troubles with Galois, and this might have prompted him to provoke the duel himself on her behalf. This conjecture is also supported by some of the other letters Galois later wrote to his friends the night before he died. Much more detailed speculation based on these scant historical details has been interpolated by many of Galois' biographers (most notably by Eric Temple Bell in Men of Mathematics), such as the oft-repeated conjecture that the entire incident was stage-managed by the police and royalist factions to eliminate a political enemy.[5]

As to his opponent in the duel, Alexandre Dumas names Pescheux d'Herbinville, one of the nineteen artillery officers on whose acquittal the banquet that occasioned Galois' first arrest was celebrated[10] and Du Motel's fiancee.[citation needed] However, Dumas is alone in this assertion, and extant newspaper clippings from only a few days after the duel give a description of his opponent which is inconsistent with d'Herbinville, and more accurately describes one of Galois' Republican friends, most probably Ernest Duchatelet, who was also imprisoned with Galois on the same charges. Given the conflicting information available, the true identity of his killer may well be equally lost to history.

Whatever the reasons behind the duel, Galois was so convinced of his impending death that he stayed up all night writing letters to his Republican friends and composing what would become his mathematical testament, the famous letter to Auguste Chevalier outlining his ideas.[13] Hermann Weyl, one of the greatest mathematicians of the 20th century, said of this testament, «This letter, if judged by the novelty and profundity of ideas it contains, is perhaps the most substantial piece of writing in the whole literature of mankind.» However, the legend of Galois pouring his mathematical thoughts onto paper the night before he died seems to have been exaggerated. In these final papers he outlined the rough edges of some work he had been doing in analysis and annotated a copy of the manuscript submitted to the academy and other papers. On 30 May 1832, early in the morning, he was shot in the abdomen and died the following day at ten in the Cochin hospital (probably of peritonitis) after refusing the offices of a priest. He was 20 years old. His last words to his brother Alfred were:

Ne pleure pas, Alfred ! J'ai besoin de tout mon courage pour mourir à vingt ans ! (Don't cry, Alfred! I need all my courage to die at twenty.)

Much of the drama surrounding the legend of his death has been attributed to one source, Eric Temple Bell's Men of Mathematics.

Galois' mathematical contributions were published in full in 1843 when Liouville reviewed his manuscript and declared it sound. It was finally published in the October–November 1846 issue of the Journal des mathématiques pures et appliquées.[14] The most famous contribution of this manuscript was a novel proof that there is no quintic formula, that is, that fifth and higher degree equations are not solvable by radicals. Although Abel had already proved the impossibility of a «quintic formula» by radicals in 1824 and Ruffini had published a solution in 1799 that turned out to be flawed, Galois' methods led to deeper research in what is now called Galois Theory. For example, one can use it to determine, for any polynomial equation, whether or not it has a solution by radicals.

Contributions to Mathematics

Tu prieras publiquement Jacobi ou Gauss de donner leur avis, non sur la vérité, mais sur l'importance des théorèmes.
Après cela, il y aura, j'espere, des gens qui trouveront leur profit à déchiffrer tout ce gâchis. (Ask Jacobi or Gauss publicly to give their opinion, not as to the truth, but as to the importance of these theorems. Later there will be, I hope, some people who will find it to their advantage to decipher all this mess.) Évariste Galois, Lettre de Galois à M. Auguste Chevalier.

Unsurprisingly, Galois' collected works amount to only some 60 pages, however within them are many important ideas that have had far-reaching consequences for nearly all branches of mathematics.[15] It was indeed, much to the advantage of later mathematicians to decipher the mess that was Galois' work. His work has been compared to that of Niels Henrik Abel, yet another mathematician who died tragically at a very young age, and much of their work has had significant overlap.

Algebra

While many mathematicians before Galois gave consideration to what are now known as groups, it was Galois who was the first to use the word 'group' (in French groupe) in the technical sense it is understood today, making him among the key founders of the branch of algebra known as group theory. He developed the concept that is today known as a normal subgroup. He called the decomposition of a group into its left and right cosets a 'proper decomposition', if the left and right cosets coincide, which is what today is known as a normal subgroup.[13] He also introduced the concept of a finite field (also known as a Galois field in his honor), in essentially the same form as it is understood today.[9]

Galois Theory

Main article: Galois theory
Galois' most significant contribution to mathematics by far is his development of Galois theory. He realized that the algebraic solution to a

polynomial equation is related to the structure of a group of permutations associated with the roots of the polynomial, the Galois group of the polynomial. He found that an equation could be solvable in radicals if one can find a series of normal subgroups of its Galois group which are abelian, or its Galois group is solvable. This proved to be a fertile approach, which later mathematicians adapted to many other fields of mathematics besides the theory of equations which Galois originally applied it to.[15] (From Wikipedia, the free encyclopedia)

Text 6.

Bernhard Riemann

Georg Friedrich Bernhard Riemann (September 17, 1826 – July 20, 1866) was a German mathematician who made important contributions to analysis and differential geometry, some of them paving the way for the later development of general relativity.

Riemann was born in Breselenz, a village near Dannenberg in the Kingdom of Hanover in what is today Germany. His father, Friedrich Bernhard Riemann, was a poor Lutheran pastor in Breselenz who fought in the Napoleonic Wars. His mother died before her children were grown. Riemann was the second of six children, shy, and suffered from numerous nervous breakdowns. Riemann exhibited exceptional mathematical skills, such as fantastic calculation abilities, from an early age, but suffered from timidity and a fear of speaking in public.

In high school, Riemann studied the Bible intensively, but his mind often drifted back to mathematics. To this end, he even tried to prove mathematically the correctness of the Book of Genesis. His teachers were amazed by his genius and his ability to solve extremely complicated mathematical operations. He often outstripped his instructor's knowledge. In 1840, Riemann went to Hanover to live with his grandmother and attend lyceum. After the death of his grandmother in 1842, he attended high school at the Johanneum Lüneburg. In 1846, at the age of 19, he started studying philology and theology in order to become a priest and help with his family's finances.

In 1847 his allowed him to stop studying theology and start studying mathematics. He was sent to the renowned University of Göttingen, where he first met Carl Friedrich Gauss, and attended his lectures on the method of least squares. In 1847, Riemann moved to Berlin, where

Jacobi, Dirichlet, and Steiner were teaching. He stayed in Berlin for two years and returned to Göttingen in 1849.

Bernhard Riemann held his first lectures in 1854, which not only founded the field of Riemannian geometry but set the stage for Einstein's general relativity. In 1857, there was an attempt to promote Riemann to extraordinary professor status at the University of Göttingen. Although this attempt failed, it did result in Riemann finally being granted a regular salary. In 1859, following Dirichlet's death, he was promoted to head the mathematics department at Göttingen. He was also the first to propose the theory of higher dimensions, which greatly simplified the laws of physics. In 1862 he married Elise Koch and had a daughter. He died of tuberculosis on his third journey to Italy in Selasca (now a hamlet of Verbania on Lake Maggiore) where he was buried in the cemetery in Biganzolo (Verbania).

He had had to flee Göttingen in a hurry when the armies of Hanover and Prussia clashed there. This haste for a sick man may have hastened his end. When she heard of his death, his housekeeper at Göttingen started to throw out the papers in his study thus possibly destroying a proof of the Riemann hypothesis. No one else has yet proved it and another paper suggests that he had at least the bones of a proof[1].

Riemann's published works opened up research areas combining analysis with geometry. These would subsequently become major parts of the theories of Riemannian geometry, algebraic geometry, and complex manifold theory. The theory of Riemann surfaces was elaborated by Felix Klein and particularly Adolf Hurwitz. This area of mathematics is part of the foundation of topology, and is still being applied in novel ways to mathematical physics. Riemann made major contributions to real analysis. He defined the Riemann integral by means of Riemann sums, developed a theory of trigonometric series that are not Fourier series a first step in generalized function theory and studied the Riemann-Liouville differintegral.

He made some famous contributions to modern analytic number theory. In a single short paper (the only one he published on the subject of number theory), he introduced the Riemann zeta function and established its importance for understanding the distribution of prime numbers. He made a series of conjectures about properties of the zeta function, one of which is the well-known Riemann hypothesis.

He applied the Dirichlet principle from variational calculus to great effect; this was later seen to be a powerful heuristic rather than a rigorous method. Its justification took at least a generation. His work on monodromy and the hypergeometric function in the complex domain made a great impression, and established a basic way of working with functions by consideration only of their singularities.

Euclidean geometry versus Riemannian geometry

Picture of a hypercube projected onto a 2-dimensional surface. In 1853, Gauss asked his student Riemann to prepare a Habilitationsschrift on the foundations of geometry. Over many months, Riemann developed his theory of higher dimensions. When he finally delivered his lecture at Göttingen in 1854, the mathematical public received it with enthusiasm, and it is one of the most important works in geometry. It was titled Über die Hypothesen welche der Geometrie zu Grunde liegen (loosely: «On the foundations of geometry»; more precisely, «On the hypotheses which underlie geometry»), and was published in 1868.

The subject founded by this work is Riemannian geometry. Riemann found the correct way to extend into n dimensions the differential geometry of surfaces, which Gauss himself proved in his theorema egregium. The fundamental object is called the Riemann curvature tensor. For the surface case, this can be reduced to a number (scalar), positive, negative or zero; the non-zero and constant cases being models of the known non-Euclidean geometries.

Higher dimensions

Riemann's idea was to introduce a collection of numbers at every point in space that would describe how much it was bent or curved. Riemann found that in four spatial dimensions, one needs a collection of ten numbers at each point to describe the properties of a manifold, no matter how distorted it is. This is the famous Riemann curvature tensor. (From Wikipedia, the free encyclopedia)

Text 7.

Sofia Kovalevskaya

Sofia Vasilyevna Kovalevskaya (Moscow, January 15, 1850 – Stockholm, Sweden, February 10, 1891, aged 41 from influenza), was the first major Russian female mathematician, and also the first woman who was appointed to a full professorship in Europe in 1889 (Sweden). Her first name is sometimes given as Sonya.

Life and career

Sofia Kovalevskaya was born in Russia of an artillery officer, a General with Tsar Nikolai I and a German scholar woman, being the second of three children. Her father nurtured her interest in mathematics and hired Strannoliubskii to tutor her in calculus. However, at the time she could not get a university degree except by going to Europe with the permission of her father or her husband. Thus, she entered a marriage of convenience with Vladimir O. Kovalevsky, then a young paleontology student, the brother of biologist Alexander Kowalevski, with whom she left Russia around 1867, in company also of her sister Anyuta, to avoid Anyuta's involvement with the novelist Fyodor Dostoyevsky.

Kovalevskaya was admitted in 1869 to the University of Heidelberg, Germany, which allowed her to study as long as the professors involved approved. Shortly after beginning her studies there, she visited London with her husband Vladimir, who visited his acquaintances Thomas Huxley and Charles Darwin, while Sonya was invited to one of George Eliot's Sunday salons. There, at age nineteen, she met Herbert Spencer and was led into a debate, at George Eliot's instigation, on «woman's capacity for abstract thought». This was well before she made her notable contribution of the «Kovalevski top» to the brief list of known examples of integrable rigid body motion. George Eliot was writing Middlemarch at the time, in which one finds the remarkable sentence: «In short, woman was a problem which, since Mr. Brooke's mind felt blank before it, could hardly be less complicated than the revolutions of an irregular solid.» (Middlemarch, Chapter IV).

After two years of mathematical studies at Heidelberg, knowing such teachers as Helmholtz, Kirchoff and Bunsen, she moved in 1869 to the University of Berlin, where she had to take private lessons from Karl Weierstrass since the university didn't admit women at all.

Kovalevskaya prepared three different doctoral dissertations before settling on a fourth one that, with the support of Weierstrass, earned her a doctorate summa cum laude from the University of Göttingen in 1874. This meant that her achievements were so impressive, that the University did not require her to attend any lectures or examinations in order to award her the degree. Her result, now known as the Cauchy-Kowalevski theorem, was published in (Kowalevski 1875). Thus, Sofia Kovalevskaya became the first woman in Europe to earn a doctorate in mathematics.

The return of the Kovalevskys to Russia was futile, as no university would hire them with their European degrees. Returning to Germany, they consummated their marriage leading to the birth of a daughter, Sofia "Fufa." When the girl turned one year old, Kovalevskaya resumed her work in mathematics. After Kovalevsky's suicide in 1883, when she was barely

33, Kovalevskaya, with the support of Gösta Mittag-Leffler, was offered a position as a private docent at the Stockholm University in Sweden.

The next year she was on tenure-track and began editing Acta Mathematica. In 1886 she won the French Prix Bordin in response to the challenge to «perfect in one important point the theory of the movement of a solid body round an immovable poin». This led to her celebrated discovery of what is now known as the Kovalevsky top, which was since shown to be the only other case of rigid body motion, beside the tops of Euler and Lagrange, which is «completely integrable». She also contributed work on the dynamics of Saturns rings.

In 1889, aged 39, she won a prize from the Royal Swedish Academy of Sciences, and the same year was appointed professor in Stockholm University, while she also achieved a chair in the Russian Academy of Sciences. Kovalevskaya also had a marginal activity in fiction writing, including Reminiscences of childhood, plays (in collaboration with Anne-Charlotte Leffler) and a partly autobiographic novel: Nihilist Girl (1890).

She was never offered a professorship in Russia, but received other honors from her homeland when she died of pneumonia in 1891 at forty-one, after a visit to her late husband's relatives in Paris, her daughter Sofia Vladimirovna becoming thus a full orphan aged only about 13. (From Wikipedia, the free encyclopedia)

Text 8.

Norbert Wiener

Norbert Wiener (November 26, 1894, Columbia, Missouri – March 18, 1964, Stockholm, Sweden) was an American theoretical and applied mathematician. Wiener was a pioneer in the study of stochastic and noise processes, contributing work relevant to electronic engineering, electronic communication, and control systems.

Wiener also founded cybernetics, a field that formalizes the notion of feedback and has implications for engineering, systems control, computer science, biology, philosophy, and the organization of society.

Biography

Youth

Wiener was the first child of Leo Wiener, a Polish-Jewish immigrant, and Bertha Kahn, of German-Jewish descent. Employing teaching methods of his own invention, Leo educated Norbert at home until 1903, except for a brief interlude when Norbert was 7 years of age. Thanks to his father's tutelage and his own abilities, Wiener became a child prodigy. Earning his living teaching German and Slavic languages, Leo read widely and accumulated a personal library from which the young Norbert benefited greatly. Leo also had ample ability in mathematics, and tutored his son in the subject until he left home.

After graduating from Ayer High School in 1906 at 11 years of age, Wiener entered Tufts College. He was awarded a BA in mathematics in 1909 at the age of 14, whereupon he began graduate studies in zoology at Harvard. In 1910 he transferred to Cornell to study philosophy.

Harvard

The next year he returned to Harvard, while still continuing his philosophical studies. Back at Harvard, Wiener came under the influence of Edward Vermilye Huntington, whose mathematical interests ranged from axiomatic foundations to problems posed by engineering. Harvard awarded Wiener a Ph.D. in 1912, when he was a mere 18, for a dissertation on mathematical logic, supervised by Karl Schmidt, whose essential results were published as Wiener (1914). In that dissertation, he was the first to see that the ordered pair can be defined in terms of elementary set theory. Hence relations can be wholly grounded in set theory, so that the theory of relations does not require any axioms or primitive notions distinct from those of set theory. In 1921, Kuratowski proposed a simplification of Wiener's definition of the ordered pair, and that simplification has been in common use ever since.

In 1914, Wiener traveled to Europe, to study under Bertrand Russell and G. H. Hardy at Cambridge University, and under David Hilbert and Edmund Landau at the University of Göttingen. In 1915-16, he taught philosophy at Harvard, then worked for General Electric and wrote for the Encyclopedia Americana. When World War I broke out, Oswald Veblen invited him to work on ballistics at the Aberdeen Proving Ground in Maryland. Thus Wiener, an eventual pacifist, wore a uniform 1917-18. Living and working with other mathematicians strengthened and deepened his interest in mathematics.

After the war

After the war, Wiener was unable to secure a position at Harvard because he was Jewish (despite his father's being the first tenured Jew at Harvard) and was rejected for a position at the University of Melbourne. At W. F. Osgood's invitation, Wiener became an instructor in mathematics at MIT, where he spent the remainder of his career, rising to Professor.

In 1926, Wiener returned to Europe as a Guggenheim scholar. He spent most of his time at Göttingen and with Hardy at Cambridge, working on Brownian motion, the Fourier integral, Dirichlet's problem, harmonic analysis, and the Tauberian theorems. In 1926, Wiener's parents arranged his marriage to a German immigrant, Margaret Engemann, who was not Jewish; they had two daughters.

During and after World War II

During World War II, his work on the automatic aiming and firing of anti-aircraft guns led Wiener to communication theory and eventually to formulate cybernetics. After the war, his prominence helped MIT to recruit a research team in cognitive science, made up of researchers in neuropsychology and the mathematics and biophysics of the nervous system, including Warren Sturgis McCulloch and Walter Pitts. These men went on to make pioneering contributions to computer science and artificial intelligence. Shortly after the group was formed, Wiener broke off all contact with its members. Speculation still flourishes as to why this split occurred.

Wiener went on to break new ground in cybernetics, robotics, computer control, and automation. He shared his theories and findings with other researchers, and credited the contributions of others. These included Soviet researchers and their findings. Wiener's connections with them placed him under suspicion during the Cold War. He was a strong advocate of automation to improve the standard of living, and to overcome economic underdevelopment. His ideas became influential in India, whose government he advised during the 1950s.

Wiener declined an invitation to join the Manhattan Project. After the war, he became increasingly concerned with what he saw as political interference in scientific research, and the militarization of science. His article «A Scientist Rebels» in the January 1947 issue of The Atlantic Monthly urged scientists to consider the ethical implications of their work. After the war, he refused to accept any government funding or to work on military projects. The way Wiener's stance towards nuclear weapons and the Cold War contrasted with that of John von Neumann is the central theme of Heims (1980).

Awards and honors

- Wiener won the Bôcher Prize in 1933 and the National Medal of Science in 1963 (Presented by President Johnson at a White House Ceremony in January 1964.), shortly before his death.
- The Norbert Wiener Prize in Applied Mathematics was endowed in 1967 in honor of Norbert Wiener by MIT's mathematics department

and is provided jointly by the American Mathematical Society and Society for Industrial and Applied Mathematics.

- The Norbert Wiener Award for Social and Professional Responsibility awarded annually by CPSR, was established in 1987 in honor of Wiener to recognize contributions by computer professionals to socially responsible use of computers. The crater Wiener on the far side of the Moon is named after him. The Wiener sausage (in mathematics) was named for him.

Work

Wiener was as a pioneer in the study of stochastic and noise processes, contributing work relevant to electronic engineering, electronic communication, and control systems.Wiener also founded cybernetics, a field that formalizes the notion of feedback and has implications for engineering, systems control, computer science, biology, philosophy, and the organization of society. He was influenced by William Ross Ashby. In the mathematical field of probability, the Wiener sausage is a neighborhood of the trace of a Brownian motion up to a time t, given by taking all points within a fixed distance of Brownian motion. It can be visualized as a sausage of fixed radius whose centerline is Brownian motion. (From Wikipedia, the free encyclopedia)

UNIT 11

MATHEMATICAL HUMOR

1. Questions and answers:

Q: How do we know that mathematics is a violent subject?
A: We often hear about mean values, cross products, and warring fractions.
Q: Was Newton sick very often?
A: Yes, so often that he called himself «I sick» Newton.
Q: What is your specialty? (the applied probabilist was asked)
A: «Sadistics and sarcastic processes.»
Q: Where is your half? a husband of a plump woman was asked
A: She is not my half but three thirds of me.

2. Definitions Mathematics is made of 50 percent formulas, 50 percent proofs, and 50 percent imagination. «A mathematician is a device for turning coffee into theorems» (P. Erdos). Addendum: American coffee is good for lemmas. An engineer thinks that his equations are an approximation to reality. A physicist thinks reality is an approximation to his equations. A mathematician doesn't care. Old mathematicians never die; they just lose some of their functions. Mathematicians are like Frenchmen: whatever you say to them, they translate it into their own language, and forthwith it means something entirely different. Goethe Mathematics is the art of giving the same name to different things. J. H. Poincare.

There is no logical foundation of mathematics, and Gödel has proved it! I do not think therefore I am not. A mathematician is a blind man in a dark room looking for a black cat which isn't there. (Charles R Darwin)

A statistician is someone who is good with numbers but lacks the personality to be an accountant. Classification of mathematical problems as linear and nonlinear is like classification of the Universe as bananas and non-bananas. A law of conservation of difficulties: there is no easy way to prove a deep result. A tragedy of mathematics is: a beautiful conjecture ruined by an ugly fact. Algebraic symbols are used when you do not know what you are talking about. Philosophy is a game with objectives and no rules. Mathematics is a game with rules and no objectives.

Math is like love; a simple idea, but it can get complicated. The difference between an introvert and extrovert mathematicians is: An introvert mathematician looks at his shoes while talking to you. An extrovert mathematician looks at your shoes.

A bit of theology.

Math is the language God used to write the universe.

Medicine makes people ill, mathematics makes them sad and theology makes them sinful. (Martin Luther)

The good Christian should beware of mathematicians and all those who make empty prophecies. The danger already exists that mathematicians have made a covenant with the devil to darken the spirit and confine man in the bonds of Hell. (St. Augustine)

He who can properly define and divide is to be considered a god. (Plato)

«God geometrizes» says Plato and here is the analytical continuation of this saying:

Biologists think they are biochemists, Biochemists think they are Physical Chemists, Physical Chemists think they are Physicists, Physicists think they are Gods, And God thinks he is a Mathematician.

Funny stories

A mathematician, a physicist, an engineer went to the races and laid their money down. Commiserating in the bar after the race, the engineer says, «I don't understand why I lost all my money. I measured all the horses and calculated their strength and mechanical advantage and figured out how fast they could run...» The physicist interrupted him: «...but you didn't take individual variations into account. I did a statistical analysis of their previous performances and bet on the horses with the highest probability of winning...» «...So if you're so hot why are you broke?» asked the engineer. But before the argument can grow, the mathematician takes out his pipe and they get a glimpse of his well-fattened wallet. Obviously here was a man who knows something about horses. They both demanded to know his secret. «Well,» he says, «first I assumed all the horses were identical and spherical...»

* * *

A mathematician and an engineer are on desert island. They find two palm trees with one coconut each. The engineer climbs up one tree, gets the coconut, eats. The mathematician climbs up the other tree, gets the coconut, climbs the other tree and puts it there. «Now we've reduced it to a problem we know how to solve.»

* * *

Several scientists were all posed the following question: «What is 2 times 2?» The engineer whips out his slide rule (so it's old) and shuffles it back and forth, and finally announces «3.99». The physicist consults his technical references, sets up the problem on his computer, and announces «it lies between 3.98 and 4.02». The mathematician cogitates for a while, then announces: «I don't know what the answer is, but I can tell you, an answer exists!» Philosopher smiles: «But what do you mean by 2 times 2?» Logician replies: «Please define 2 times 2 more precisely.» The sociologist: «I don't know, but it was nice talking about it». Medical Student: «4». All others looking astonished: «How did you know?» Medical Student: "I memorized it.»

* * *

A physicist, a mathematician, and a mystic were asked to name the greatest invention of all time. The physicist chose the fire, which gave humanity the power over matter. The mathematician chose the alphabet, which gave humanity power over symbols. The mystic chose the thermos bottle. «Why a thermos bottle?» the others asked. «Because the thermos keeps hot liquids hot in winter and cold liquids cold in summer.» «Yes so what?» «Think about it.» said the mystic reverently. That little bottle – how does it "know"?»

* * *

A mathematician, a physicist, and an engineer were travelling through Scotland when they saw a black sheep through the window of the train. «Aha,» says the engineer, «I see that Scottish sheep are black.» «Hmm,» says the physicist, «You mean that some Scottish sheep are black.» «No,» says the mathematician, «All we know is that there is at least one sheep in Scotland, and that at least one side of that one sheep is black!»

* * *

One day a farmer called up an engineer, a physicist, and a mathematician and asked them to fence of the largest possible area with the least amount of fence. The engineer made the fence in a circle and proclaimed that he had the most efficient design. The physicist made a long, straight line and proclaimed «We can assume the length is infinite...» and pointed out that fencing off half of the Earth was certainly a more efficient way to do it. The Mathematician just laughed at them. He built a tiny fence around himself and said «I declare myself to be on the outside.»

* * *

The physicist and the engineer are in a hot-air balloon. Soon, they find themselves lost in a canyon somewhere. They yell out for help: «Helllloooooo! Where are we?» 15 minutes later, they hear an echoing voice: «Hellllooooooo! You're in a hot-air balloon!!» The physicist says, «That must have been a mathematician.» The engineer asks, «Why do you say that?» The physicist replied: «The answer was absolutely correct, and it was utterly useless.»

* * *

Dean addresses the head of the Physics department. «Why do I always have to give you so much money, for laboratories and expensive equipment and stuff? Why couldn't you be like the Math.Department? All they need is money for pencils, paper and waste-paper baskets. Or even better, like the Philosophy department. All they need are pencils and paper.»

* * *

A mathematician organizes a lottery in which the prize is an infinite amount of money. When the winning ticket is drawn, and the jubilant winner comes to claim his prize, the mathematician explains the mode of payment: «1 dollar now, 1/2 dollar next week, 1/3 dollar the week after that...»

* * *

A mathematician believes nothing until it is proven;
A physicist believes everything until it is proven wrong;
A chemist doesn't care; Biologist doesn't understand the question.

UNIT 12

TESTS

PART I

<u>**Test 1**</u>

Translate these sentences using Infinitive in different functions
Variant I

1. Здавалось, що будь-яка можливість помилки була врахована. 2. Цей метод достатньо надійний, щоб використовуватись для обчислення дифференційних рівнянь. 3. Здається, що ці дані були неперевірені. 4. Він примусив їх поновити експеримент. 5. Повідомляється, що нові експерименти по телепортації провадяться у Лос-Аламосі. 6. Ця група вчених виявила, що руйнація ізотропії системи є найпростішою серед проблем такого типу. 7. Це питання достатньо складне, щоб його можна було вирішити без достатньої підготовки.8.Не дозволяйте їм використовувати ці пристрої без дозволу зав.лабораторією. 9. Це такі умови, які слід обговорити заздалегідь. 10. Здавалось, що на кінець 19 століття основні фундаментальні принципи, що керують поведінкою фізичного всесвіту були відомі. 11. Цікаво проаналізувати дані, які будуть отримані в результаті експерименту. 12. Для розв‘язання цього рівняння слід визначитися з усіма невідомими.

Translate these sentences using Infinitive in different functions.
Variant II

1. Допускається, що магнетизм виникає у результаті руху електронів. 2. Ми бажаємо, щоб ці дослідження були продовжені. 3. Ці формули недостатньо точні, щоб ми користувалися ними при проведенні експерименту. 4. Відомо, що напівпровідники мають кристалічну структуру. 5. Щоб встановити залежність між цими двома функціями, треба обчислити всі значення "x" у кожній з них. 6. Це стаття , яку буде зачитано на конференції. 7. Здається, що ви знаєте про всі деталі цієї роботи. 8. Не примушуйте мене вдаватися до дісциплінарних заходів. 9. Відомо, що всі труднощі можна подолати, якщо сильно цього бажаєш. 10. Цієї інформації недостатньо, щоб ми робили якісь висновки. 11. Ми очікуємо, що ці методи будуть особливо ефективними при вимірюванні кривих поверхнь. 12. Я знаю, що це рівняння розв’язано неправильно.

Translate these sentences using Infinitive in different functions. Variant III

1. Ці формули недостатньо точні, щоб ми користувалися ними при проведенні цих експериментів. 2. Проблеми, які будуть вирішені, мають велике практиичне значення. 3. Щоб поділити цей сегмент, ми повинні провести кілька паралельних ліній. 4. Вони хотіли, щоб усі дані цього експерименту були перевірені ще раз. 5Автор статті очікує, що отримані результати матимуть універсальне значення. 6. Ця гипотеза достатньо цікава, щоб привернути увагу багатьох вчених. 7. Такі вимоги примусили їх шукати інших підходів до вирішення цієї проблеми.8.Ми очікуємо, що ці дані будуть перевірені на практиці. 9. Виявилось, що математика та мистецтво тісно пов'язані між собою. 10. Відомо, що деякі категорії філософії дуже часто використовуються в інших науках. 11. Цей текст дуже важкий для мене, щоб я його перекладала. 12. Не дозоляйте їм відкладати цю роботу на невизначений термін.

PART II

Gerund, Participle and Infinitive Phrases
Test 1
Variant 1

Choose the phrase that is correct in form:

1. ………it is not surprising to find them everywhere in business.
A. Giving the power of computers
B. Being given the power of computers
C. Given the power of computers
D. Having given the power of computers

2. In October, 1776, Benjamin Franklin accepted an appointment as one of three commissioners to France, the others ……Silas Deane and Arthur Lee.
A. being
B. being with
C. were being
D. who were being

3. Streams cause more erosion than all other geological ……
A. agents combine
B. combining agents
C. agents combined
D. are combined agents

4. Of all the Western world's import cultivated foods, tomatoes are the newest, …. widely used only within the last hundred years.
A. they became
B. having become
C. they have become
D. have become
5. The GRG algorithm may be difficult for users with limited statistical training …
A. to be implemented. B. for implementation
C. to implement D. being implemented
6. The website manager ………… to notify the server that the retrieval of the data must be performed by an account holder.
A. must assume B. to be assumed
C. had assumed D. is assumed
7. The above mentioned technique……,the greatest general impact of a shear flow may be analyzed in dimensions 1, 2, 3.
A. being effective B. is effective
C. for being effective D. had effective

Check to see which of the underlined parts is not correct. Give the correct variant

1. The carve of the monumental heads of the presidents on Mount Rushmore in South Dacota took fourteen years.
2. It is possible determining that French explorers reached the juncture of the Kansas and Missouri rivers in the seventeenth century.
3. Sorghum leaves contain hydrocyanic acid and are poisonous enough killing livestock.
4. These televisions are all too expensive for we to buy at this time, but perhaps we will return later.
5. After to take the medication, the patient became drowsy and more manageable.
6. We insist on you leaving the meeting before any further outbursts take place.
7. Henry objects to us buying this house without the approval of our attorney.

Gerund, Participle and Infinitive Phrases
Test 1
Variant 2
Choose the phrase that is correct in form:

1. In the last six months of 1818, Sam Houston mastered a course in law usually …. Eighteen months.
A. it required
B. was requiring
C. requiring
D. that required
2. In biology, a cell is defined as the smallest unit of life …. all the components required for independent existence.
A. contains
B. is contained
C. it contains
D. containing
3. …..to many people, the famous cowgirl Calamity Jane wrote a series of touching letters to her daughter.
A. Unknowing B. Unknown. C. Unknowingly D Having unknown
4. With the aid of new technology, people can now travel faster than …. possible even 25 years ago.
believe
believes
believed
believing
5. In Los Alamos physicists measured the thickness of a human hair … that was never actually shone on the hair.
A. to use laser light B. using laser light
C. on using laser light D. laser light to be used
6. The proposed model is believed ……. the manager so that the order size can be precisely determined.
A. can assist B. assisting
C. to assist D. to have assist
7. This method ….. several times, it can be applied for the solution of such problems.
A. having been tested B. to be tested
C. being tested D. was tested

Check to see which of the underlined parts is not correct. Give the correct variant

1. Rita enjoyed to be able to meet several Congress members during her vacation.
2. After being indicted for his part in a bank robbery, the reputed mobster

decided find another attorney.
3. Harry's advisor persuaded his taking several courses which did not involve much knowledge of mathematics
4. The students were interested in take a field trip to the National History Museum, but they were not able to raise enough money.
5. Use a stethoscope enables a physician to hear sounds produced in the body, especially heart and lung sounds
6. It is difficult for them applying these new techniques for the solution of this problem.
7. And don't try to make them to do this immediately.

Test 2
Variant 1
I. Translate the following sentences from English into Ukrainian.
1. The GRG algorithm may be difficult for users with limited statistical training to implement.
2. Verification of the data accuracy is required by the site manager to ensure quality control within a factory
3. The manager can be assisted by the proposed model to precisely determine the order size.
4. Uncontrollable factors turned out to have increased the temperature by several degrees.
5. A more detailed description of the three design types is to be provided in Kackar and Phadke.
6. In Los Alamos the scientists measured the thickness of a human hair using laser light that was never actually shone on the hair.

II. Translate the following sentences from Ukrainian into English.
1. Присутність подібного відношення пояснюється тим, що квантові частинки водночас проявляють хвильові властивості, причому довжина хвилі пов'язана із швидкістю частинок.
2. Вважають, що зміна температури на 2 градуси вплине на подальшу динаміку хімічної реакції.
3. Він не знав, що всі ці аспекти будуть тісно поєднані з головною проблемою, яку потрібно було вирішити.
4. Часто передбачається, що моделе-формуюча система є однорідною та ізотропною.
5. Відомо, що порушення симетрії призводить до дісбалансу усієї системи.

6. Вважається, що всі значення змінної x будуть вірними при y=1.
7. В цій статті аналізуються основні характеристики доповнення, причому основний акцент робиться на тих його рисах, що представляють інтерес для подальшого вивчення.
8. Ми бажаємо, щоб наші вимоги було виконано якомога скоріше.
9. Вважається, що порушення ізотронної системи є найпростішою серед проблем такого типу.
10. З'ясувалось, що такий підхід є цілком неадекватним по відношенню до цього типу рівнянь.
11. Передбачалося, що ці моделі будуть відповідати всім вимогам вищеозначеної функції.
12. Оскільки число застосувань мікропроцесорів збільшується з кожним днем, вимоги до них зростають.

Test 2

Variant 2

I. Translate the following sentences from English into Ukrainian.

1. The experimental results proved the temperature to be increasing because of uncontrollable factors
2. These rays being unexplained, Roentgen called them x-rays.
3. By the end of the nineteenth century the basic fundamental principles governing the behavior of the Universe seemed to be known.
4. Trying to awaken a sense of urgency about the situation, ecologists sometimes do not hesitate to predict the end of the world.
5. The number of possible applications of this method is rather significant, given how specialized the field is.
6. An intelligent camera, mounted high over a public swimming pool, could serve as the lifeguard's second pair of eyes by recognizing dangerous behavior.

II. Translate the following sentences from Ukrainian into English.

1. Але вцілому фізики залишилися спокійними, очікуючи, що ці дивні речі врешті – решт будуть пояснені існуючею теорією.
2. Це такий підхід, що гарантує високу точність при вирішенні подібних рівнянь.
3. Дуже легко перевірити ці дані різними експериментальними групами.
4. Оскільки всі інші підходи вже визначені, ми можемо більш детально проаналізувати нашу методику.
5. Очікується, що через 5–10 років комп'ютерна графіка буде

відігравати важливу роль у спрощенні спілкування між комп'ютерами та користувачами.
6. Ефект Хольцмана може бути поверненим до свого первинного стану як при преривванні енергетичної підтримки, так і при перезарядці поля.
7. Виявилось, що транзістори є більш ефективними, ніж електроннні лампи.
8. Оскільки електричне поле замкнуте, то по ньому проходить струм.
9. Розвиток понять системи та порядку у межах нової логіки демонструє, шо обмеження є невиправданим.
10. Виявилось, що Декарт був першим у кого з'явилась ідея загальної універсальної мови, щось на кшталт арифметики.
11. Але ця стратегія має серйозні недоліки, оскільки вона навряд чи продукує щось, що дійсно схоже на людський інтелект.
12. Відомо, що мова математики була створена найкращими розумами усіх часів і народів.

SUPPLEMENT

MATHEMATICAL SYMBOLS AND SIGNS

Part A

Table 1. ***Mathematical symbols***

Symbol	Name	Date of earliest use	First author to use
+	plus and minus signs	ca. 1360 (abbreviation for Latin *et* resembling the plus sign)	Nicole Oresme
−		1489 (first appearance of plus and minus signs in print)	Johannes Widmann
√	radical symbol (for square root)	1525 (without the vinculum above the radicand)	Christoff Rudolff
(…)	parentheses (for precedence grouping)	1544 (in handwritten notes)	Michael Stifel
		1556	Nicolo Tartaglia
=	equals sign	1557	Robert Recorde
×	multiplication sign	1618	William Oughtred
±	plus-minus sign	1628	
::	proportion sign		
$^n\sqrt{}$	radical symbol (for *n*th root)	1629	Albert Girard
< >	strict inequality signs (*less-than sign* and *greater-than sign*)	1631	Thomas Harriot
x^y	superscript notation (for exponentiation)	1636 (using Roman numerals as superscripts)	James Hume
		1637 (in the modern form)	René Descartes
$\sqrt{\ }$	radical symbol (for square root)	1637 (with the vinculum above the radicand)	René Descartes

Table 1 Continued

Symbol	Name	Date of earliest use	First author to use
%	percent sign	ca. 1650	Unknown
$\div$	*division sign* (a.k.a. obelus)	1659	Johann Rahn
∞	infinity sign	1655	John Wallis
$\leq$	unstrict inequality signs (*less-than or equals to sign* and *greater-than or equals to sign*)	1670 (with the horizontal bar over the inequality sign, rather than below it)	
$\geq$		1734 (with double horizontal bar below the inequality sign)	Pierre Bouguer
D	differential sign	1675	Gottfried Leibniz
$\int$	integral sign		
:	colon (for division)	1684 (deriving from use of colon to denote fractions, dating back to 1633)	
$\cdot$	middle dot (for multiplication)	1698 (perhaps deriving from a much earlier use of middle dot to separate juxtaposed numbers)	
/	division slash (a.k.a. *solidus*)	1718 (deriving from horizontal fraction bar, invented by Arabs in 12th century)	Thomas Twining
$\neq$	inequality sign (*not equal to*)	Unknown	Leonhard Euler
Σ	summation symbol	1755	
∂	partial differential sign (a.k.a *curly d* or *Jacobi's delta*)	1770	Marquis de Condorcet
x'	prime symbol (for derivative)		Joseph Louis Lagrange
$\equiv$	identity sign (for congruence relation)	1801 (first appearance in print; used previously in personal writings of Gauss)	Carl Friedrich Gauss
$[x]$	*integral part* (a.k.a. floor)	1808	
Π	product symbol	1812	

Table 1 Continued

Symbol	Name	Date of earliest use	First author to use
→	arrow (for function notation)	1936 (to denote images of specific elements)	Øystein Ore
		1940 (in the present form of f: X → Y)	Witold Hurewicz
⌊*x*⌋	*integral part* (a.k.a. floor)	1962	Kenneth E. Iverson

Part B

Table 2. ***Basic mathematical symbols***

Symbols	Meaning	Symbols	Meaning
√	square root	/	fraction bar
<	less than	∟	right angle sign
>	greater than	%	percent sign
≠	not equal	±	plus or minus sign
=	equal	GCF	greatest common factor
≡	equivalent	LCM	least common multiple
≈	approximately	|	divides
≤	smaller or equal	a : b	ratio
≥	bigger or equal	a^n	a to the nth power
÷	division	||	parallel lines
×	multiplication	| |	sign for absolute value
+	addition	()	parentheses for grouping
–	subtraction	b	base length
∠	angle	h	height
°	degree	p or P	perimeter

Table 2 Continued

Symbols	Meaning	Symbols	Meaning
π	pi (3.14)	l	Length or slant height
A	area	w	width
m	slope of a line	C	circumference
S.A.	surface area	-a	opposite of a
L.A	lateral area	d	diameter or distance
B	area of base	b_1, b_2	base lengths of a trapezoid
V	volume	r	rate or radius
□	perpendicular	∠ABC	angle ABC
□ABC	triangle ABC	m∠ABC	refers to the measure of angle ABC

REFERENCES

- Asimov I. I. Robot. A collection of short stories
- Clarke A. The nine billion names of God. – Pan books, G.B. – 412 p.
- Crichton M. Time line –Arrow., USA. – 456 p.
- Pyle, M.A. and Munoz, M.E. Test of English as a foreign language. – USA, 1986 – 250 p.
- Scientific American papers. N.Y. 2001–2011
- Wikipedia, the free encyclopedia
- Ветрова Е.И. Scientific English. K. – 1992
- Власенко Е.Л. Twenty texts for discussion. – М. – 1992
- Гейзенберг Вернер. Физика и философия. – М. – 1987
- Горенко О., Косаревская Т. Non-finite forms of the verb. – K. – 2005 – 100 c.
- Горенко О.П. Англійська мова для математиків: підручник для студентів-математиків. Київ, 2009 – 116 с.
- Дорожкина В.П. Английский язык для студентов-математиков и экономистов. – М.– 2004 – 347 с.
- Дорожкина В.П. Английский язык для студентов-математиков. – М. – 1986 – 341с.
- Ратушная В. Речевой этикет – LBS – 1992.

Notes

Notes

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Навчальне видання

Олена Горенко

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навчальний посібник

видання третє, доповнене

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