МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ
ЖИТОМИРСЬКИЙ ДЕРЖАВНИЙ УНІВЕРСИТЕТ
ІМЕНІ ІВАНА ФРАНКА

КУЗНЄЦОВА Г. В.

ENGLISH FOR MASTER STUDENTS

**Практикум з англійської мови
для студентів фізико-математичного факультету
(ОКР – «Магістр»)**

Житомир
Вид-во ЖДУ імені Івана Франка
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Практикум містить матеріал, необхідний для проведення аудиторних практичних занять з англійської мови студентів-магістрантів фізико-математичного факультету. Тексти, вправи, тести та рекомендації методичного характеру подані у послідовності, окресленої Програмою (затвердженою у 2013 році), для виконання чотирьох основних змістовних модулів. Матеріал розрахований на поглиблення фахових спеціальних та загальних комунікативних навичок студентів у процесі професійно спрямованого вивчення англійської мови.

Для денної та заочної форм навчання.

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Вступ

Практикум містить матеріал для проведення аудиторних практичних занять з професійно спрямованої англійської мови для студентів ОКР «Магістр», спеціальності «Математика» і «Фізика», у руслі завдань, поставлених у Стратегіях вивчення іноземних мов у Житомирському державному університеті, які були прийняті в листопаді 2012 року. Практикум може використовуватися як для денної, так і для заочної форми навчання.

Практикум передбачає можливість вибору викладачем навчального матеріалу профільно-наукового змісту. Він містить також методичні поради та рекомендації щодо використання підручників та алгоритм реферування фахових текстів. Пропоновані завдання лексичного типу сприяють розширенню та закріпленню загального й фахового словника студентів.

Окремий модуль виділено для підготовки студентів до захисту дипломних робіт англійською мовою, що відповідає міжнародним вимогам і стандартам до навчання в магістратурі. Крім того, у спеціальному модулі приділяється увага мовній підготовці студентів до участі в наукових і науково-практичних конференцій у зарубіжних країнах, що також сприяє підвищенню загального та професійного мовно-мовленнєвого рівня студентів ОКР «Магістр».

Практикум пройшов пілотування при навчанні англійської мови студентів-магістрантів фізико-математичного факультету ЖДУ імені І. Франка в 2014–2015 навчальному році.

З М І С Т

MODULE 1: Universities in Ukraine and Abroad (Great Britain and the USA)

Unit 1. Ukrainian Universities

Before Reading

1. *Answer the questions:*
   1) Which establishments of higher education in Ukraine do you know?
   2) Which degrees do they give to their successful graduates?
   3) How many universities are there in Ukraine?
   4) Which establishments of higher education are there in Zhytomyr?
   5) Which university do you study in?

2. *Before reading the text study, the following useful vocabulary:*
   Similar to – подібний до
   To set up – засновувати, встановлювати
   Veterinary – ветеринарний
   Higher Mining School – Вища школа гірничої справи
   To own – мати у власності
   Term – семестр
   To inherit – успадковувати
   Certificate – свідоцтво, сертифікат, атестат
   Determination – визначення, встановлення
   Hence – звідси (у логічному, а не в просторовому значенні)
   Educational-proficiency level – освітньо-професійний рівень
   Sufficient – достатній

To discharge functions – виконувати функції
To stipulate – зумовлювати, ставити умову
Normative – нормативний
To obtain – отримувати
To cope with – упоратися з чимось, виконувати успішно
To attain – досягати, здобувати
Innovative character – інноваційний характер
To summarize – узагальнювати, підводити підсумок
To synthesize – синтезувати

Working with Text

3. *Read the following text, make a list of useful professional terms.*

Higher education in Ukraine

Higher education in Ukraine has a long and rich history. Its students, graduates and academics have long been known and appreciated worldwide. The pioneering research of scholars working in the country's higher education institutions and academies, such as Dmytro Mendeleyev, Mykola Zhukovsky, and Yeugeny Paton, are part of the universal history of scientific progress.

Brief historical survey

The first higher education institutions (HEIs) emerged in Ukraine during the late 16th and early 17th centuries. The first Ukrainian higher education institution was the Ostrozka School, or Ostrozkiy Greek-Slavic-Latin Collegium, similar to Western European higher education

institutions of the time. Established in 1576 in the town of Ostrog, the Collegium was the first higher education institution in the Eastern Slavic territories. The oldest university was the Kyiv Mohyla Academy, first established in 1632 and in 1694 officially recognized by the government of Imperial Russia as a higher education institution. Among the oldest is also the Lviv University, founded in 1661. More higher education institutions were set up in the 19th century, beginning with universities in Kharkiv (1805), Kiev (1834), Odessa (1865), and Chernivtsi (1875) and a number of professional higher education institutions, e.g.: Nizhyn Historical and Philological Institute (originally established as the Gymnasium of Higher Sciences in 1805), a Veterinary Institute (1873) and a Technological Institute (1885) in Kharkiv, a Polytechnic Institute in Kiev (1898) and a Higher Mining School (1899) in Katerynoslav. Rapid growth followed in the Soviet period. By 1988 a number of higher education institutions increased to 146 with over 850,000 students.[1] Most HEIs established after 1990 are those owned by private organizations.

Terms

The academic year in higher educational establishments in Ukraine starts on the 1st of September. It is divided into two terms, the first term is from September to the end of January and the second begins in February and ends in June. Each term lasts 17-18 weeks, followed by a 3 week examination period.

Higher education qualifications

Higher education qualifications combine both academic and professional qualifications. This is a very important feature of Ukrainian higher education inherited from its Soviet past. The State Diploma serves as both an educational certificate and a professional license. Employment is determined by a match between the state determination of the knowledge and skills required for different occupation levels and the state determination of levels of educational qualification. Hence is the correspondence between classification of educational qualification and that of the occupational structure, leading to the introduction of the term 'educational-proficiency' level.

The *Law on Higher Education* (2002) establishes the three-level structure of higher education: incomplete, basic, and complete educational levels with corresponding educational-proficiency levels of Junior Specialist, Bachelor, Specialist and Master.

Junior Specialist

Junior Specialist is an educational-proficiency level of higher education of a person who on the basis of complete secondary education has attained incomplete higher education, special skills and knowledge sufficient for discharging productive functions at a certain level of professional activity, stipulated for initial positions in a certain type of economic activity. The normative period of training makes 2.5–3 years.

Persons with basic secondary education may study in the educational and professional programs of junior specialist's training, obtaining at the same time complete secondary education.

Bachelor

Bachelor is an educational-proficiency level of higher education of a person who on the basis of complete secondary education has attained basic higher education, fundamental and special skills and knowledge, sufficient to cope with tasks and duties (work) at a certain level of professional activity (in economy, science, engineering, culture, arts, etc.). The normative period of training makes 4 years.

Training specialists of the educational-proficiency level of Bachelor may be carried out according to the shortened programme of studies on the basis of the educational- proficiency level of Junior Specialist.

Specialist

Specialist is an educational-proficiency level of higher education of a person who on the basis of the educational-proficiency level of Bachelor has attained complete higher education, special skills and knowledge, sufficient to cope with tasks and duties (work) at a certain level of professional activity (in economy, science, engineering, culture, arts, etc.). The normative period of training makes 1 year.

Master

Master is an educational-proficiency level of higher education of a person who has attained complete higher education, special skills and knowledge, sufficient to cope with professional

tasks and duties (work) of innovative character at a certain level of professional activity (in engineering, business administration, pedagogics, arts, etc.).

Training specialists of the educational-proficiency level of Master may also be carried out on the basis of the educational-proficiency level of Specialist. The period of training makes typically 1–1.5 year.

During his/her studies at the Master's or Specialist's level, students are required to write his/her final work on a selected subject and make its presentation, to be able to collect, analyse and summarize, synthesize and to communicate study and practical material; often knowledge of a foreign language is required.

4. *Make up sentences using the terms from your list.*

5. *Answer the following questions:*
   1) Which figures show that higher education in Ukraine has a long and developed history?
   2) Which was the historically first higher educational institution ever founded in Ukraine?
   3) What is the function of the State Diploma?
   4) What is the period of training of a junior specialist?
   5) What are the specific features of Master training in Ukraine?

6. *Find additional information about the history and work of famous Ukrainian universities. Prepare a short report on the information obtained (10-15 sentences).*

Unit 2. Our University

Before Reading

1. *Answer the following questions:*
   1) When was the Zhytomyr Ivan Franko State University founded?
   2) What was it called then?
   3) Where was the University situated?
   4) Which interesting facts about the history of our university do you know?

Working with Text

2. *Read the text about the Zhytomyr State Ivan Franko University. Find some facts that you did not know before.*

Our University

Zhytomyr State Ivan Franko University is one of the oldest higher educational establishments in Polissia. The university (initially, the Institute) was founded in 1919. In 1926 it was named after Ivan Franko. In 1999 the Institute was granted the status of a University.

At present the University includes three Institutes (the Institute of Foreign Philology, the Institute of Philology and Journalism, the Institute of Pedagogical Sciences) and five departments (the Department of Physics and Mathematics, the Department of Natural

Sciences, the Department of Social Psychology, the Historical Department, the Department of Physical Training and Sports).

Over the recent years the number of students has greatly increased and now it comprises more than 8200 people, and more than 4700 of them are full-time students. The rest study in the correspondence form of education.

Besides there is a Preparatory Department, post-graduate studies in about a dozen of specialities and the Institute of Post-Diploma Education at the University.

The teaching staff of the University and its academic facilities provide opportunities for training bachelors, specialists and masters.

The scientific and research level of the teaching staff is constantly increasing: among 926 teachers working at 36 departments there are: the Academician of the Higher School Academy of Sciences; 20 Doctors of Science, Professors; 247 Candidates of Science, Assistant Professors.

Members of the University teaching staff consistently work at improving their practical, academic and theoretical level. The result of their work is the foundation and development of several scientific schools (e.g. “Dialectological School of Prof. M.V. Nykonchuk’; “Drama History and Theory”, headed by Prof. O.S. Chyrkov; “Problems of Semantics in Structural-Functional Theory of Communication”, founded by Prof. D.I. Kveselevych).

Our University occupies five buildings. They are not far from the centre of the town and are

set close to one another. There are five halls of residence at the University which accommodate about 2000 students.

At the university there is a library, several reading-rooms, a publishing centre, an agrobiological station, an observatory, two museums, a modern sports complex, a computer centre, a canteen and three refreshment rooms.

The students get everything a modern specialist should acquire; profound knowledge in speciality, computer and language skills. They can also learn one of several working professions (a driver, a secretary, a hairdresser etc.).

Students are involved to carry out scientific research work in many fields. They often continue their studies as post-graduates and after defending their thesis become Candidates and Doctors of Science.

Active students' life provides the development of managing skills, creative abilities, cultural and aesthetic tastes. Students of the University are journalists of a university newspaper "Universum" and of a radio-studio. They are participants of amateur art groups (the drama group "Kalyna", the vocal group "Elegia", the university folk orchestra, the dance group "Yunist" and others), a career centre, a student community centre, a counselling centre for first-year students, the Judicial Clinic.

The University maintains scientific and educational cooperation with institutes of higher education, other educational establishments, famous scientific schools and scholars from Russia, Belarus, Great Britain, the USA,

Germany, Poland and other countries. The departments of the University take part in international educational projects.

During the 90 years of its existence the University has prepared thousands of specialists in different fields. Many of them have become famous researchers, honoured teachers and cultural figures.

Among the graduates of the University there are such outstanding personalities as M.V. Homychevskyi (Borys Ten) – a famous poet and translator of Old Greek and European literature (including such monumental works as "Iliad" and "Odyssey" by Homer) into Ukrainian; V.G. Bondarchuk, an Academician of the National Academy of Sciences of Ukraine; O.K. Kasymenko, Doctor of History, Head of the Institute of History in the National Academy of Sciences of Ukraine and many others. Many graduates now teach in Zhytomyr State Ivan Franko University.

Their enthusiasm, industry and creativity guarantee that the tasks facing the teaching staff will be successfully fulfilled.

3. *Answer the questions:*
   1) On the basis of the text how would you define the place of our university among other higher educational institutions in Ukraine?
   2) What is the place of our university among educational institutions of Zhytomyr Region?
   3) Which department of our university is the biggest?

4) Which department of the university do you find the most interesting? Why?
5) Which department (speciality) in our university is the most promising as to job-hunting? Why?
6) Which research scientific schools do you know at your department?
7) Have your ever taken part in any amateur art groups of our University? What do you think about such activity?

4. *On the basis of the text write an essay about the department you are studying at.*

Unit 3. Higher Education in Great Britain

Before Reading

1. *Answer the questions:*
   1) In which institutions can people get higher education in Great Britain?
   2) Which British universities do you know?
   3) What do you know about the level of education given in British universities?
   4) How many universities are there in the UK?

2. *Before reading the text, study the following useful vocabulary:*
   to be founded – бути заснованим
   award degree – призначення ступеню
   Privy Council – таємна рада
   fee – оплата, гонорар
   minor – необов'язковий, незначний
   league tables – рейтингові таблиці університетів

redbrick university – університет з червоної цегли
to admit – приймати
subject-specific rankings – рейтинги по предметах
to critique – критикувати
compulsory courses – обвєякові курси
electives – виборні

Working with text

3. *Read the text about the organization of higher education in the UK.*

Universities in Great Britain
General Information

Just like the American university system, the British one is not completely homogeneous. The following will provide some general information on some of its most important concepts in the field of education in Great Britain, and some basic information about the Republic of Ireland. It must be noted, that certain aspects are handled differently at the so called ancient universities, particularly at the University of Oxford and the University of Cambridge.

British Universities

In Great Britain, new universities are *founded* by Act of Parliament or Royal Charter. In addition, for an institution to be allowed to *award degrees*, it must be recognized by the **Privy Council**, an advisory body to the British Head of State (i.e. the monarch).

One of the main differences between the British and the American University system is that all of Britain's universities except for the **University of Buckingham**, are financed by the State. In America on the other hand there are just about as many **public** as **private** institutions of higher education. The British is therefore much more similar to the German university system than the American. Yet the important fact to consider about British academic institutions is that even though they are financed by the British government, no university is actually owned by the State and in spite of the state's sponsoring of universities, *fees* at British university are considerably higher than they are going to be at German institutions. As opposed to the American and German system, students in the United Kingdom generally study only one subject instead of a combination of *minor* and master.

One particularity of universities in UK is that most students choose to attend institutions far away from their hometowns. Consequently most universities provide accommodation for their students or at least help them find a place to live.

Four Main Types

There are four main types of British Universities.

1. Ancient Universities

Ancient universities in the United Kingdom and Ireland were *founded* during the Middle Ages and the Renaissance. Since no universities were *founded* in the United Kingdom and Ireland between the 16th and 19th century, the term "ancient university" generally refers to

institutions of higher education that were *established* before the 19th century.
The ancient universities (in order of formation) are:

- **University of Oxford** – *founded* before 1167 (England)
- **University of Cambridge** – *founded* 1209 (England)
- **University of St Andrews** – *founded* 1413 (Scotland)
- **University of Glasgow** – *founded* 1451 (Scotland)
- **University of Aberdeen** – *founded* 1495 (Scotland)
- **University of Edinburgh** – *founded* 1583 (Scotland)
- **University of Dublin** – *founded* 1592 (Ireland; only ancient university outside the UK)

Due to their sheer age and continuous academic and scientific output, all of the ancient universities are very reputable. The two top universities in UK, which are continuously found in first and second place of the British **league tables**, are Oxford and Cambridge. Together they are known as **Oxbridge** and share a century old rivalry, which dates back to when Cambridge was *founded* by dissident Oxford scholars.

Oxbridge is often compared to the American **Ivy League** universities, but it is important to note that all Ivy League institutions are private universities, while Oxford and Cambridge are state-owned.

Both universities are divided into more than thirty colleges. Since each college at Oxford only

offers a certain range of subjects, the choice of college often depends on the field of study. At Cambridge, on the other hand, all colleges give students to opportunity to study any subject offered by the university as a whole.

Yet in spite of the differences and rivalries, there is also much cooperation between Britain's two oldest academic institutions. Most Oxford colleges have a sister college in Cambridge. Some colleges even share a common name, but are not necessarily sister colleges. There is for instance a **Trinity College at Oxford** (sister college: **Churchill College, Cambridge**) as well as a **Trinity College at Cambridge** (sister college: **Christ Church, Oxford**).

2. Red Brick Universities

Red Brick Universities – named after the buildings they were housed in which were usually built with red brick – were *founded* in the industrial parts of the cities during the Victorian era (1837-1901) and before the Second World War.

The main difference between Red Brick and ancient universities is that Red Bricks were so called **non-collegiate** institutions (i.e. were not situated within one campus) and *admitted* men without regarding their religion or social background. Furthermore they concentrated on teaching predominantly "practical subjects" often linked to engineering. There are 6 Red Brick universities? Among them are the University of Birmingham, the University of Liverpool and others.

3. New Universities

Two types of universities are subsumed under the term "New Universities". First of all the academic institutions founded in the 1960s after the Robins Report. Besides recommending immediate expansion of universities, the Report also suggested elevating Colleges of Advanced Technology to university status.

Due to their modern architecture and the predominant use of large stretches of plate glass in steel or concrete frames, the institutions founded in the 1960s are often called "Plate Glass Universities". Some Plate glass universities such as York and Warwick have by now out-performed some Red Brick universities, especially on the field of research, which has improved their reputation considerably. There are all in all 16 Plate Glass Universities in the UK Ireland, many of which are called after counties or localities, like the University of Sussex, the New University of Ulster etc.

- The second group (36 institutions) are the so called Post-1992 Universities. The term refers to former polytechnics that were given university status by **John Major's** government in 1992. They have the poorest reputation among British universities, and many of them regularly appear in bottom Tenth of **league tables**. Some of the universities of this group are: **Manchester Metropolitan University**, **Northumbria University**, **Glasgow Caledonian University**, **University of Greenwich**.

4. Open University

Founded in 1986, the **Open University** is Britain's single distance-learning institution. In 2005 a total of 180,000 students, most of them based in the UK, were enrolled, which made it the largest institution of higher education in the UK by student numbers.

The Open University was rated top university in England and Wales for student satisfaction in 2005 and the **Quality Assurance Agency for Higher Education** rated teaching at the Open University as excellent that same year. Just as any other academic institution, the Open University, too, actively engages in research and awards both undergraduate and postgraduate degrees.

Its administration is based at Walton Hall, Milton Keynes in Buckinghamshire, but there are additional offices in 13 regions around the UK.

University Rankings

Over the past several years, the perception of universities by the general public has become ever more heavily influenced by the so called **league tables**, surveys ranking universities by research and teaching.

The most important university ranking is **TimesLeagueTable**,with **Oxford** and **Cambridge** regularly placing first and second. It is important to note that the **Times League Table** provides a general overall ranking of universities across subject lines as well as a subject-specific ranking. Students generally tend to be more

interested in comparisons between individual subjects rather than entire universities.

The most famous subject-specific ranking result in the United Kingdom occurred in 2004, when the history department of the former polytechnic **Oxford Brookes** received a higher research rating than Oxford University's history department in the **Guardian university ranking** of **2004**.

Also it an often quoted fact that neither **Oxford**, nor **Cambridge** are represented in the top 20s of the ratings of engineering subjects. However, this statement is quite misleading, since Oxford and Cambridge do not offer specific courses in engineering subjects, but merely general engineering course. In that field again, Oxbridge ranked 1st and 2nd in 2005!
Like in the United States, university rankings in the UK, too, are subject to **critique** from various sides.

4. *Respond to the following statements, agree or disagree with them. Give motivation.*
   1) In the UK you can get a higher education only in universities.
   2) Some British universities are world famous.
   3) Students study many subjects to get a degree.
   4) Most British students prefer to study close to their home places.
   5) All British universities are old and similar to each other.
   6) Only education elite go to Oxford and Cambridge.

7) There are no entrance exams in British universities.
8) There are about 80 universities and colleges of higher education in GB.
9) Many overseas students study in the UK.

5. *Fill in the blanks with the following words:* ***programs, international, years****,* ***from, students, much, to apply, higher, one, education****. Read the complete text for more information about the studies in the UK.*

The UK has a vast variety of … education opportunities to offer students with over 100 universities offering various degree programs for students from the UK and around the world. In the UK about 1/3 of all students go on to some form of higher … and this number is well over 50% for students from Scotland. This makes competition for places very fierce and so it is advised … early for courses.

In the UK most undergraduate degree programs take three … to finish; however, the 'sandwich course' is increasing in popularity, which is four years and involves … year in the work place (normally in your third year). In Scotland the courses are four years in length for undergraduate programs.

For graduate or masters … they are generally shorter in length and undertaken after graduation of your undergraduate program. Some professional degrees like medicine, veterinary, law etc. have longer programs that can be as … as five years.

From 2007, universities in the UK are allowed to charge students … the UK up to &3,070 per year (depending on the school and location). For students from the EU, you will also only have to pay the same fees as students from the UK, but international … from the rest of the world will have to pay the full school fees which will vary depending on the school. These fees for … students can range anywhere from &4,000 per year up to &18,000 per year or more.

6. *Compose 5-7 questions for your group-mates about university studies in the UK. Be ready to answer your friends' questions.*

7. *Insert prepositions if necessary in the following text. Study the information you receive. Speak about 5 facts in the organization of studies at British universities which you like/dislike.*

Organization of Studies

At most British Universities the academic year is divided ….. three terms. Students study a main subject throughout their degree course, which is usually a mix ….. compulsory courses and electives. Teaching methods vary between universities. Most ….. students have lectures and seminars and there are practicals ….. those doing a science subject. At some universities students have individual tutorials or supervisions.

In Britain a professor is the person in charge ….. a department or a senior member of staff. Other teaching and research staff are called lecturers. Junior academic staff may be called ….. research associates. …… the US most people

who teach at colleges or universities and have a doctorate are addressed as *professor*. Full professors are senior ….. associate professors, assistant professors and instructors. Graduate students working towards a higher degree may teach ….. undergraduate courses ….. larger universities. These grad students are called TAs (teaching assistants). In return, TAs do not have to pay ….. their own tuition and get a small amount of money to live ….. .

8. *Choose the correct variant to check your knowledge of English:*
   1) It's your … that we're late for school again.
      a) care b) fault c) mistake
   2) When Mr. Brett was at school, he won first … for good behaviour.
      a) price b) prize c) reward
   3) They had lunch together in the school ….
      a) bar b) canteen c) café
   4) We all make mistakes; no-one is ….. .
      a) fallible b) infallible c) unmistakable
   5) I think you should … that matter with your teacher.
      a) complain b) demand c) discuss
   6) Since Oscar had no proper reason for missing school, his absence should be treated as … .
      a) desertion b) neglect c) truancy
   7) If pupils are to understand the notice, the instructions must be … clearer.
      a) done b) got c) made.

8) You are late again – please try to be … in future.
   a) accurate b) punctual c) efficient
9) Those pupils never … any notice of what their teacher says.
   a) give b) make c) take
10) Patrick … the whole morning looking for his essay, but still couldn't find it.
   a) brought b) had c) spent
11) The classes were closed because of … of interest.
   a) absence b) emptiness c) lack
12) This school has the highest … standards in our town.
   a) academic b) intelligence c) learning
13) We need … information before we can decide which courses to choose.
   a) farther b) further c) nearer
14) Someone from the Ministry of Education is coming to … our classes.
   a) control b) inspect c) look on
15) Please … clearly which courses you want to take.
   a) ask b) indicate c) instruct

9. *Put each of the following words or phrases into its correct place in the text below:*
amount, calendar, class hours, course, credits, curriculum, electives, graduation, major, number, opportunity, outlines, prospectus, specified, subjects, requirements, technical, three, weekselecting, college

Selecting Courses

The courses given by a … or university are called curriculum. The … of the institution … the complete ….. . It gives the … for entry to each course, as well as the credits given for the ….. .

Each course is designed as giving a … number of credits. These are usually equal to the number of … devoted each week to the course. For example, a course that meets three times a … usually gives … credits towards graduation. Schools using the semester … required about 120 credits for ….. . Between 30 and 40 of the required … must be in the student's … subject.

Schools vary considerably in the … of freedom given to students in … their course. Almost all schools have certain … of required ….. . Students can also usually choose nonrequired courses called ….. . Liberal-arts colleges usually give students more … to choose than do … schools.

10. Choose the correct variant:

1) Are you going to attend Prof. Wise's … on Medieval History next week?
   a) conference b) discussion c) lecture
2) The lecture was so … that almost everyone fell asleep.
   a) bored b) dull c) exhausted
3) Prof. Rush was speaking so quickly I couldn't … what he said.
   a) accept b) catch c) listen
4) Use your imagination and try to … the scene in your mind.
   a) draw b) model c) picture

5) Miss Not-Very-Bright said she could not … all the information given in the lecture.
   a) absorb b) accumulate c) listen
6) I can agree with you to a certain …, Professor, but not entirely.
   a) extent b) level c) way
7) The lecture was very … and I slept for most of it.
   a) annoying b) boring c) sleepy
8) You ought to pay … to what the lecturer is saying; it's quite interesting.
   a) attention b) comment c) praise
9) I absolutely… with everything that has been said.
   a) accept b) approve c) agree
10) The lecture will begin at 10.00 ….. .
   a) in time b) on time c) sharp
11) Prof. Orator spoke clearly and … so we could understand every word he said.
   a) distinct b) distinctly c) legibly
12) That's precisely what I mean. You've hit the … on the head.
   a) idea b) nail c) pin
13) The students were interested in what the teacher was saying and listened … .
   a) attentively b) guardedly c) prudently
14) A few jokes always … up a lecture.
   a) inspire b) liven c) loosen
15) The example you have just referred to has no … on the matter under discussion.
   a) connection b) dependence c) bearing.

11. *Read the jokes and try to explain the fun.*
    1) *Professor*: "Now, John, what are you doing – learning something?"
       Student: "No, sir; I am listening to you".
    2) The professor rapped on his desk and shouted: "Gentlemen – order!"
       The entire class yelled: "Beer!"

12. *Find in the Internet short information about some British university where one can specialize in Mathematics or Physics. Present this information to your groupmates.*

Unit 4. Universities in the USA

Before You Read

1. *Answer the following questions:*
    a) What do you know about American universities in general?
    b) Do you think that American universities are very similar to British ones? Why?
    c) Do you think that American universities are organized in the way similar to Ukrainian ones? Why?
    d) Which US universities have you heard about? What did you hear about them?

Working with the Text

2. *Study the vocabulary suggested. Pay special attention to educational terms. Use the given vocabulary units in 7-10 sentences of your own.*

to boast – хвалитися (чимось)
to be affiliated – належати до чогось як частина; бути складовою частиною (філіалом) чогось
elitism – елітизм, аристократична пиха
to be associated with – бути пов'язаним з чимось
to fail – не досягти успіху, не змогти зробити щось
pretentious – претензійний
to transfer – переходити
graduate school – тип вищого навчального закладу у США, де навчаються після отримання ступеня бакалавра (відповідає поняттю "аспірантура" в Україні; в деяких університетах включає також магістратуру)
graduate student – студент, що навчається для отримання ступеня магістра чи доктора
medical school – медичний факультет університету
standardized test – стандартний екзамен, який складають випускники середніх шкіл, бажаючі вступити до коледжу вищої освіти або університету
to take into account – брати до уваги
community college – (у США) громадський коледж (= середній навчальний заклад)
application form – бланк-заявка
letter of reference – рекомендаційний лист
high school – (у США) середня школа (як правило, для учнів 12-18 років; відповідає старшим класам середньої школи в Україні)
tuition – плата за навчання
undergraduate – студент, що навчається для отримання ступеня бакалавра

3. *Read the text about US universities. Make up 5-7 questions to your group mates on the text.*

American Universities

The United States is a great center of higher education, boasting more than 1500 universities, colleges, and other institutions of higher learning. There is no national public university system in the United States. Each state has his own public university system. There are also many privately run colleges, universities and trade schools, some of them are religiously affiliated.

The most famous universities are the eight Ivy League Universities, which include Harvard and Yale, the Massachusetts Institute of Technology and the University of California. The Ivy League Universities are named after the ivy plants traditionally covering their older buildings. The term "Ivy League" has connotations of academic excellence as well as a certain amount of elitism, though if an internet searcher would try and find the number of Nobel laureates associated with these universities he would most certainly fail.

No matter whether a student studies in a university or a college he would talk about 'going to college'. To Americans the phrase 'going to university' sounds pretentious. Most colleges offer classes only for undergraduate students studying for a bachelor's degree. Community colleges offer two-year courses leading to an associate degree, and afterwards students transfer to a different college or university to continue their studies. Universities are larger than colleges and also offer courses for graduate

students who study in graduate school. Many universities also have separate professional schools, e.g. a medical school or a law school.

American high school students who want to study at a college or university have to take a standardized test. Students from countries outside the US who are not native speakers of English must also take the TOEFL. Each college or university decides on the minimum score it will accept, though test scores are never the only factor taken into account. Students apply direct to between three and six colleges in their last year of high school. Each college has its own application form and most include a question for which the student must write an essay. The student also has to send a transcript (= an official list of all the subjects studied and the grades received) and letters of reference.

All universities charge tuition, and students pay extra for room and board. Many students choose public universities or colleges because the costs there are lower than in private ones. Prices range from a few hundred dollars a year to well over $25000 at some private colleges. Students whose families cannot afford to pay the full amount apply for financial aid.

Large universities often put most emphasis on research. Smaller colleges tend to concentrate on teaching undergraduates, and many students prefer these colleges because they offer smaller classes and more personal attention from teachers.

4. *Agree or disagree with the following statements. Suggest your motivation:*
   a) All American universities are alike.
   b) There is no elitism in US universities.
   c) American university applicants do not have to take any entrance examinations.
   d) Academic level of high school graduates is always taken into account when they apply to universities.
   e) In the USA one can receive higher education only in a university.
   f) All US colleges give higher education and degrees to their successful graduates.
   g) Some departments of universities in the US are called 'schools'.
   h) All US universities are private.
   i) In some universities students don't have to pay tuition.
   j) Because students pay for room and board they receive three meals a day in university canteens.

5. *Complete the sentences using the vocabulary of the text:*
   1) After finishing a university a student is granted … .
   2) At the end of high school studies a student must pass an exam called … .
   3) High school is … .
   4) An undergraduate is a student who … .
   5) If a student wants to continue his/her studies after receiving a bachelor's degree it is necessary to apply to … .
   6) A master's degree can be obtained … .

7) All universities and colleges charge … .
8) Community college is … .
9) In a graduate school one can … .
10) To apply to a university a school graduate must submit his/her …

6. *Fill in the gaps in the text with the words suggested:* ***choose, progress****,* ***lowest, weeks, include, year, their, each, take****. Study the information you receive.*

Organization of studies in the US

The US academic … may be divided into two semesters of about 15 weeks or three quarters of about 10 ….. each. Students take courses in a variety of subjects, regardless of their main subject, because the aim of the liberal arts curriculum is to produce well-rounded people with good critical skills At the end of their sophomore (=second) year students ….. a major (=main subject) and sometimes a minor (=additional subject) which they study for the next two years. Students … four or five courses from the course catalogue. Courses may consist mainly of lectures or may ….. discussion sections or lab sections.

Students are given grades at the end of ….. course. The highest grade is A; the ….. is F, which means that the student has failed the course and will not get credit for taking it. To check a student's overall ….. , the university calculates a grade point average (GPA). Students who finish their degree with a high GPA may be awarded Latin honours, of which the highest is *summa cum laude*.

7. *Compose 5-7 questions to your group mates about the organization of university education in the USA.*

8. *Name 5 facts about the US university education which you like and 5 facts which you don't like.*

9. *Discuss the pluses and minuses of US higher education in a dialogue. You may begin like this:*
   A.: You do think that education of American students is better than the one we receive here in Ukraine?
   B.: Well, …..

10. *To train your topical vocabulary, choose the correct variant in the following sentences:*
    1) Tom did not like his first … at the college at all.
       a) period b) presence c) term
    2) An I.Q. test is supposed to measure the … of your intelligence.
       a) degree b) level c) size
    3) Rita is not … of doing this work – she should change her class.
       a) capable b) fit c) possible
    4) There is no … in going to college if you are not willing to learn.
       a) aim b) point c) purpose
    5) Before joining a course of study you must fill in a long … form.
       a) enrolment b) personal c) inscription
    6) The Examination Board have recently changed the … for the Diploma in Physics.

a) brochure b) programme c) syllabus

7) During their first teacher-training year, the students often visit local schools to … lessons.
   a) examine b) investigate c) observe
8) The students paid … attention to their distinguished professor.
   a) respectable b) respected c)respectful
9) I absolutely … with everything that has been said.
   a) accept b) agree c) admit
10) The lecturer spoke so fast that I found it hard to take … what he was saying.
   a) away b) in c) over

MODULE 2. Profile Science

Unit 1. Algebra

Before Reading

1. *Answer the questions:*
   1) Which branches of mathematics do you know? Which of them are taught at school?
   2) Which branch of mathematics do you like most? Why?
   3) What is the greatest problem in studying algebra?

2. *Study the following vocabulary. Memorize the vocabulary units suggested. Make up 5-7 sentences of your own with them.*
   reunion of broken parts – поєднання (воз-з'єднання) розірваних частин

number theory – теорія чисел
to manipulate symbols – управляти символами
study of abstractions – вивчення узагальнень
elementary algebra – елементарна алгебра
abstract algebra – абстрактна алгебра
the law of inverses – закон протилежностей
to express formulas – виражати формулами (за допомогою формул)
computations – підрахунки
proof of properties – доказ властивостей
polynomial – многочлен
infinitesimal calculus – розрахунок нескінченно малих
field theory – теорія поля
commutative algebra – комунікативна алгебра
associative ring – асоціативне кільце.

Working with the Text

3. Read the text. Compose 7-10 questions to it.

Algebra

Algebra (from Arabic *al-jebr* meaning "reunion of broken parts") is one of the broad parts of mathematics, together with number theory, geometry and analysis. In its most general form algebra is the study of symbols and the rules for manipulating symbols and is a unifying thread of almost all of mathematics. As such, it includes everything from elementary equation solving to the study of abstractions such as groups, rings, and fields. The more basic parts of algebra are called elementary algebra, the more abstract

parts are called abstract algebra or modern algebra. Elementary algebra is essential for any study of mathematics, science, or engineering, as well as such applications as medicine and economics. Abstract algebra is a major area in advanced mathematics, studied primarily by professional mathematicians. Much early work in algebra, as the Arabic origin of its name suggests, was done in the Near East, by such mathematician as Omar Khayyam (1048-1131).

Elementary algebra differs from arithmetic in the use of abstractions, such as using letters to stand for numbers that are either unknown or allowed to take on many values. For example, in $x + 2 = 5$ the letter x is unknown, but the law of inverses can be used to discover its value: $x = 3$. In $E = mc^2$, the letters E and m are variables, and the letter c is a constant. Algebra gives methods for solving equations and expressing formulas that are much easier (for those who know how to use them) than the older method of writing everything out in words.

The word *algebra* is also used in certain specialized ways. A special kind of mathematical object in abstract algebra is called an "algebra", and the word is used, for example, in the phrases linear algebra and algebraic topology.

A mathematician who does research in algebra is called an **algebraist**.

Algebra as a branch of mathematics

Algebra began with computations similar to those of arithmetic, with letters standing for numbers. This allowed proofs of properties that

are true no matter which numbers are involved. For example, in the quadratic equation

$$ax^2 + bx + c = 0,$$

a, b, c can be any numbers whatsoever (except that ***a*** cannot be ***0***), and the quadratic formula can be used to quickly and easily find the value of the unknown quantity ***x***.

As it developed, algebra was extended to other non-numerical objects, such as vectors, matrices, and polynomials. Then the structural properties of these non-numerical objects were abstracted to define algebraic structures such as groups, rings, and fields.

Before the 16th century, mathematics was divided into only two subfields, arithmetic and geometry. Even though some methods, which had been developed much earlier, may be considered nowadays as algebra, the emergence of algebra and, soon thereafter, of infinitesimal calculus as subfields of mathematics only dates from 16th or 17th century. From the second half of 19th century on, many new fields of mathematics appeared, most of which made use of both arithmetic and geometry, and almost all of which used algebra.

Today, algebra has grown until it includes many branches of mathematics: -General algebraic systems, -Field theory and polynomials, -Commutative algebra, -Linear and multilinear algebra; matrix theory, -Associative rings and algebras, -Nonassociative rings and algebras, -Category theory; homological algebra, -K-theory and -Group theory. Algebra is also used extensively in Number theory and Algebraic geometry.

After Reading

4. *Complete the sentences:*
   1) In its most general form …
   2) Algebra includes everything …
   3) Elementary algebra is essential …
   4) Abstract algebra is a major area …
   5) Much early work in algebra was done …
   6) Algebra differs from …
   7) It gives methods for …
   8) The usage of letters standing for numbers allowed …
   9) Before the 16th century mathematics was divided into …
   10) From the second half of the 19th century new fields of mathematics made use …

5. *Comment on true/false statements.*
   1) In its most general form algebra is the study of numbers and the rules for manipulating numbers.
   2) It includes everything from elementary equation solving to the study of abstractions such as groups, rings, and fields.
   3) Elementary algebra is nearly the same as arithmetic.
   4) Abstract algebra is an additional field in advanced mathematics.
   5) Basic algebra differs from arithmetic in the use of complex theorems.
   6) Algebra gives methods for solving equations and expressing formulas that are much easier than the older method of writing everything out in words.

7) As a science algebra began with computations different from those of arithmetic.
8) In the process of development, algebra was extended to such non-numerical objects, as vectors, matrices, and polynomials.
9) Before the 16th century, mathematics was divided into only two subfields, algebra and geometry.
10) From the second half of 17th century on, many new fields of mathematics appeared, most of which made use of both arithmetic and geometry, and almost all of which used algebra.

6. *Answer the questions.*
1) What does algebra study?
2) What are basic and abstract parts of algebra?
3) How does elementary algebra differ from arithmetic?
4) In what way did algebra begin as a science?
5) What is the link between algebra and geometry?
6) Which subfields of mathematics appeared in the 16^{th}-17^{th} centuries?
7) What was special about the new fields of mathematics of the second half of the 19^{th} century?

7. *Explain such mathematical structures as:*
Elementary algebra, monomial, polynomial, abstract algebra and its fundamental concepts, groups, rings and fields, algebra over a field, algebra over a ring.

8. *Insert the necessary word or word combination:* ***the general geometric solution, developed, indeterminate, to do calculations, geometric methods, solution, Greek mathematician, advanced, linear, ancient, Egyptians, geometric objects, formulas, algebraic equations, a drastic change, number theory, foundations,***

Early history of algebra

The roots of algebra can be traced to the … Babylonians, who developed an … arithmetical system with which they were able … in an algorithmic fashion. The Babylonians developed … to calculate solutions for problems typically solved today by using … equations, quadratic equations, and … linear equations. By contrast, most … of this era, as well as Greek and Chinese mathematics in the 1st millennium BC, usually solved such equations by …, such as those described in the *Rhind Mathematical Papyrus*, Euclid's *Elements*, and *The Nine Chapters on the Mathematical Art*. The geometric work of the Greeks, typified in the *Elements*, provided the framework for generalizing formulae beyond the … of particular problems into more general systems of stating and solving equations, although this would not be realized until mathematics … in medieval Islam.

By the time of Plato, Greek mathematics had undergone … . The Greeks created a geometric algebra where terms were represented by sides of …, usually lines, that had letters associated with them. Diophantus (3rd century AD) was an

Alexandrian … and the author of a series of books called *Arithmetica*. These texts deal with solving …, and have led, in … to the modern notion of Diophantine equation.

The Persian mathematician Omar Khayyam is credited with identifying the … of algebraic geometry. He found … of the cubic equation.

9. Open the brackets, use Passive voice.

1) Letters in algebra (to use) to express briefly in a written form that the product of two numbers remains unaltered when the position of the multiplicand and multiplier (to interchange).
2) Algebra is a branch of mathematics that may (to define) as the generalization and the extension of arithmetic.
3) An algebraic expression of one term (to call) a monomial.
4) Coefficients are numerical, literal or mixed, and they (to compose) of letters, figures or both figures and letters.
5) An Ancient Greek text *Arithmetica* (to create) by the mathematician Diophantus in the 3rd century AD.
6) Diophantus also appears to know that every number can (to write) as the sum of four squares.
7) *Arithmetica* originally (to write) in thirteen books, but the Greek manuscripts that survived to the present contain no more than six books.
8) In 1968, four previously unknown books of *Arithmetica* (to find) at the shrine of Imam

Rezā in the holy Islamic city of Mashhad in northeastern Iran.

9) The four books (to think) to have been translated from Greek to Arabic by Costa ben Luca, a Melkite physician, scientist and translator (820–912).

10. *Find in the text sentences which express its* ***purpose***, ***subject*** *and* ***object****. Are they expressed directly? Try and formulate each of these notions within one sentence each. Begin like this:* The purpose of the text about algebra is … The subject of this text is …

11. *Make up an outline of the text. On its basis prepare the rendering of the text using the Algorithm.*

Algorithm of Text Rendering
Алгоритм реферування тексту

I. State the title and the author of the text (article).
II. State the main topic of the text (article).
III. Define the purpose, the subject and the object.
IV. Make an outline of the text (it is often useful to express each paragraph in one sentence).
V. Join the sentences of the outline together using time and space indicators (фрази, що слугують індикаторами часу та місця) like: *at the beginning, at first, then, in the second / third / following / next part of the article /text, later, finally etc.*
VI. Make a conclusion of the text: say what the author proves and express your own opinion of the text (article) you've read. If you like /dislike the text, give your motivation.

Unit 2. Geometry

Before Reading

1. *Answer the questions:*
   1) Do you like geometry? Is it more difficult for you than algebra?
   2) Which outstanding figures in geometry do you know?
   3) In which activities (industries) is geometry especially important?

2. *Study the suggested vocabulary. Make up 5-7 sentences of your own with these vocabulary units:*
   to depend upon – залежати від
   to turn away from – відхилятися від
   twice the size of – удвічі більший
   half a complete turn – половина повного оберту
   angles are said to be –кажуть, що кути є
   right angle – прямий кут
   straight angle – розгорнутий кут
   acute angle – гострий кут
   obtuse angle – тупий кут
   supplementary angles – доповнюючі кути (до 180°)
   vertex – вершина
   complementary angle – доповнюючий кут (до 90)

Working with the Text

3. *Read the text about the notions of geometry. Compose 7-10 questions to the text.*

Geometry

The origin of geometry

Geometry is the branch of mathematics which investigates the relations, properties and measurements of solids, surfaces, lines and angles. In other words, it is the study of lines and closed figures. People of different professions, engineers, architects and geodesists being only some of them, use lines and figures in their daily work, so, they use their knowledge of geometry.

Geometry is a very old science. It is thought to have begun in Babilonia and Egypt. Men needed practical ways for measuring their land, for building pyramids, and for defining volumes. The Egyptians were mostly concerned with applying geometry to their everyday needs. As the knowledge of Egyptians spread to Greece, the Greeks found their ideas very intriguing. In 300 BC all the known facts about Greek geometry were put into a logical sequence by Euclid. His book, called Elements, is one of the most famous books on mathematics.

Points and lines

The most fundamental idea in the study of geometry is the idea of a point.

A point has no dimensions – length, width or thickness. It merely indicates position. To represent a point in geometry we mark a dot and label it with a capital letter. For example, A would be called 'point A'.

A line has no width or thickness. Likewise, it has length and direction. An infinite number of straight lines can be drawn through one point. Since a line extends indefinitely in either direction, we usually deal with line segments, or

portions of lines. The segment is represented by two capital letters, one placed at each end.

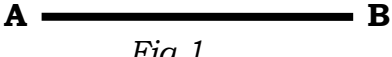


Fig.1

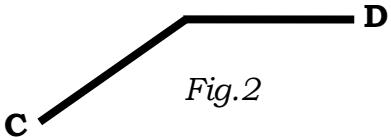


Fig.2

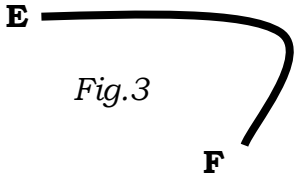


Fig.3

The line segment AB or BA is shown in Fig. l. It can also be represented by small letters, so we can say: a line segment *a.*

A line joins two points. Only one straight line can be drawn between two points. There are three kinds o f lines: straight, curved and broken. In Fig. 1 AB is a straight line, CD is a broken line, EF is a curved line. Notice that the lines are labeled by capital letters placed at the end o f the line.

Angles

An angle is formed when two straight lines meet at a point. The lines are called the sides of an angle. The point at which the sides meet is called the vertex of the angle. The angle shown in Fig. 3 is read as angle BAC or CAB. The size of an angle depends upon the amount one side has turned away from the other. The length of the sides of an angle does not determine its size.

The unit of measure used in measuring an angle is the degree. A degree is a unit that equals 1/90* of a right angle and 1/360* of a circle. A right angle, therefore, contains 90 degrees (90°) and a circle contains 360 degrees (360°). The size of an angle is the number of degrees through

which one side of the angle has turned away from the other side.

Kinds of angles

If one side of an angle turns a quarter of a complete circle away from the other side, the angle that is formed is called a right angle (Fig. 4). When two angles are put together and they form a right angle, that is, their sum is 90°, the angles are complementary. For example, an angle DBC is complementary of angle ABC since their sum (30° + 60°) equals 90° (Fig. 5).

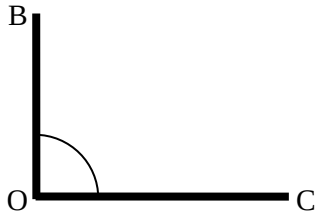


Fig. 4

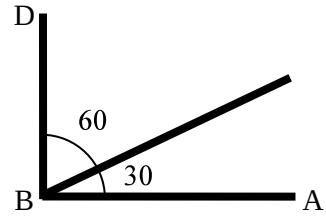


Fig. 5

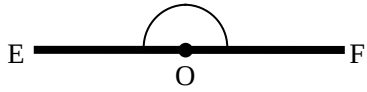


Fig. 6

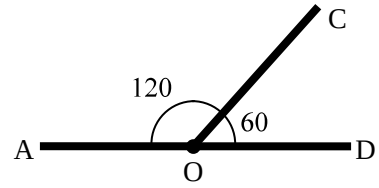


Fig. 7

If one side of an angle turns half a complete circle away from the other side, the angle that is formed is a straight angle (Fig. 6). The sides of a straight angle lie in the same straight line. Notice that a straight angle is twice the size of a right angle since in a straight line the side has made half a complete turn. The number of degrees in a straight angle is 180°. When the sum o f two angles is 180°, the angles are said to be supplementary. For example, angle AOC is the

supplementary angle o f angle COD since their sum (120° + 60°) is 180° (Fig. 7).

If one side of an angle turns less than a quarter of a circle away from the other side, the angle formed is an acute angle (Fig. 7, angle COD). An acute angle, therefore, is smaller than a right angle, or less than 90°. If one side of an angle turns more than a quarter of a circle but less than half a circle away from the other side, the angle thus formed is an obtuse angle (Fig. 7, angle AOC). Therefore, an obtuse angle is greater than a right angle but smaller than a straight line.

After Reading

4. *Complete the sentences:*
   a) The most fundamental idea in the study of geometry is ... .
   b) There exist three dimentions : ..... .
   c) Geometry is thought to have begun ..... .
   d) Euclid's book, called Elements, is one ..... .
   e) A line has no ..... .
   f) Since a line extends indefinitely in either direction, ...
   g) Only one straight line can be drawn ..... .
   h) The lines are labeled by capital letters placed ..... .
   i) An angle is formed when ..... .
   j) The size of an angle depends upon ..... .
   k) The size of an angle is the number of degrees ..... .

5. *Answer the following questions:*
   1) What were the Egiptians interested in as concerns geometry?

2) Who was the first to put down the knowledge of Greek geometry as a system?
3) What are the characteristics of a point?
4) Which dimensions does a line possess?
5) How many straight lines can be drawn through one point?
6) How many and which kinds of lines do you know?
7) What do we call straight lines which form an angle?
8) Which unit of measure is used in measuring an angle?
9) How many degrees are there in a right angle?
10) Which angles are called complementary?
11) Where do sides of a straight angle lie?

6. *Agree or disagree with the following statements*:
1) Geometry is the branch of mathematics which investigates the relations, properties and measurements of solids, surfaces, lines and angles.
2) People seldom use their knowledge of geometry in their professional activity.
3) Geometry is a very old science, which began in Greece.
4) People needed practical ways for measuring their land, for building big houses, for defining volumes.
5) The Greeks were mostly concerned with applying geometry to their everyday needs.
6) Euclid's book, called Elements, is one of the most famous books on mathematics.
7) A point has three dimensions.

8) If one side of an angle turns more than a quarter of a circle away from the other side, the angle formed is an acute angle.
9) An acute angle is smaller than a right angle, or less than 90°.
10) A line joins three points.

7. *Define the **object, subject** and **purpose** of the text you have read (in writing). Are they stated directly?*

8. *Make up an outline of the text. On its basis prepare the rendering of the text using the Algorithm given in **Unit 1**.*

Grammar Page

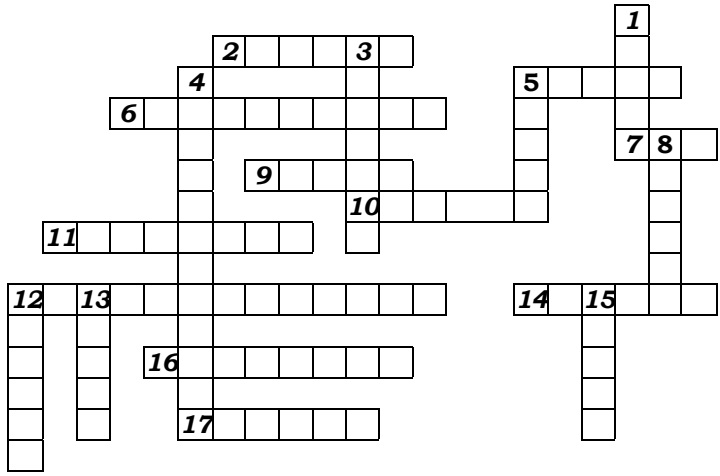
9. *Compare the use of ing-forms in the pairs of sentences and translate these sentences.*
   1. Geometry presented practical ways for obtaining information about the size and shape of various objects. On obtaining the necessary information they could draw the conclusions.
   2. Measuring the length of a line segment one must use a ruler. Measuring the length of a line segment is done with the help of a ruler.
   3. The Greeks were concerned with applying their knowledge of geometry for solving practical problems. The people solving practical problems of architecture must be competent in geometry.
   4. Seeing, moving or feeling a point is impossible since a point has no dimensions.

Seeing a straight line we began to think about it as a geometric figure.

5. Drawing a correct conclusion is not always easy. A protractor is used for drawing and measuring angles.
6. The arrow indicating the direction in which the line is extending is placed over the letters. Indicating the direction in which the line is extending is necessary.

10. *Make up sentences of your own using the following words and expressions:*
is said to be, is called, is formed, to depend upon, to turn away, in less than, is more than, to turn more than a quarter, a degree, a circle.

11. Do the crossword on lines and angels



Across

2. Lines can be straight, ... and broken

5. It is formed when two straight lines meet at a point
6. It is used to draw angles and to measure their size
7. A geometrical term, a synonym to “point”
9. A line … two points
10. A unit of measure used in measuring an angle
11. The study of lines and closed figures.
12. Two angles the sum of which is 180°
14. The point at which the sides meet
16. The angle having 180°
17. An angle which is greater than a straight line

Down

1. Lines are… by capital letters placed at the end of the line
3. A. line … indefinitely in either direction
4. Two angles put together have in sum 90°
5. An angle which is smaller than a right angle, or less than 90°
8. An angle which is greater than a right angle but smaller than a straight line
12. A part of a line limited by two endpoints
13. It has no length, width or thickness
15. The angle containing 90°

Unit 3. Problems in Theoretical Physics

Before Reading

1. *Think of the title of the text and write down 5 problems or issues of theoretical physics from your point of view.*

2. *Study the active vocabulary. Use 5-7 of them in sentences of your own.*
resolve the problem – вирішити проблему
to make sense of smth. – розумітися у чомусь
unification – об'єднання
manifestation – вияв
fundamental entity – основне(єдине) ціле
general relativity – загальна відносність
dark matter – темна матерія
to overlap yield results – переривати наявні результати
curvature of spacetime – кривизна простору-часу
participatory – колективний
quantum wavefunction – квантова хвильова функція
decoherence – некогерентність
bizarre – дивний
vibrational modes – види коливань
unified field theory – уніфікована теорія полів
mathematical framework – математичне підґрунтя
to make predictions – передбачати
inherently – невід'ємно
anthropic principle – антропічний принцип.

Working with the Text

3. ***Read the text*** *"Five Great Problems in Theoretical Physics".*
By Andrew Zimmerman Jones
Physics Expert

In his controversial 2006 book *The Trouble with Physics: The Rise of String Theory, the Fall of a Science, and What Comes Next* , theoretical physicist Lee Smolin points out "five great problems in theoretical physics."

1. **The problem of quantum gravity**: Combine general relativity and quantum theory into a single theory that can claim to be the complete theory of nature.
2. **The foundational problems of quantum mechanics**: Resolve the problems in the foundations of quantum mechanics, either by making sense of the theory as it stands or by inventing a new theory that does make sense.
3. **The unification of particles and forces**: Determine whether or not the various particles and forces can be unified in a theory that explains them all as manifestations of a single, fundamental entity.
4. **The tuning problem**: Explain how the values of the free constants in the standard model of particle physics are chosen in nature.
5. **The problem of cosmological mysteries**: Explain dark matter and dark energy. Or, if they don't exist, determine how and why gravity is modified on large scales. More generally, explain why the constants of the standard model of cosmology, including the dark energy, have the values they do.

Problem 1: The Problem of Quantum Gravity

Quantum gravity is the effort in theoretical physics to create a theory that includes both general relativity and the standard model of particle physics. Currently, these two theories describe different scales of nature and attempts to explore the scale where they overlap yield results that don't quite make sense, like the force of gravity (or curvature of spacetime) becoming infinite. (After all, physicists never see real infinities in nature, nor do they want to!)

Problem 2: The Foundational Problems of Quantum Mechanics

One issue with understanding quantum physics is what the underlying physical mechanism involved is. There are many interpretations in quantum physics – the classic Copenhagen interpretation, Hugh Everette II's controversial Many Worlds Interpretation, and even more controversial ones such as the Participatory Anthropic Principle . The question that comes up in these interpretations revolves around what actually causes the collapse of the quantum wavefunction. (The puzzle of the curious aspect of human consciousness's role in resolving these questions is related in *Quantum Enigma* .)

Most modern physicists who work with quantum field theory no longer consider these questions of interpretation to be relevant. The principle of decoherence is, to many, the explanation – interaction with the environment causes the quantum collapse. Even more significantly, physicists are able to solve the

equations, perform experiments, and practice physics *without* resolving the questions of what exactly is happening at a fundamental level, and so most physicists don't want to get near these bizarre questions with a 20 foot pole.

Problem 3: The Unification of Particles and Forces

There are four fundamental forces of physics, and the standard model of particle physics includes only three of them (electromagnetism, strong nuclear force, and weak nuclear force). Gravity is left out of the standard model. Trying to create one theory which unifies these four forces into a unified field theory is a major goal of theoretical physics.

Since the standard model of particle physics is a quantum field theory, then any unification will have to include gravity as a quantum field theory, which means that solving problem 3 is connected with the solving of problem 1.

In addition, the standard model of particle physics shows a lot of different particles – 18 fundamental particles in all. Many physicists believe that a fundamental theory of nature should have some method of unifying these particles, so they are described in more fundamental terms. For example, string theory, the most well-defined of these approaches, predicts that all particles are different vibrational modes of fundamental filaments of energy, or strings.

Problem 4: The Tuning Problem

A theoretical physics model is a mathematical framework that, in order to make predictions, requires that certain parameters are set. In the

standard model of particle physics, the parameters are represented by the 18 particles predicted by the theory, meaning that the parameters are measured by observation.

Some physicists, however, believe that fundamental physical principles of the theory should determine these parameters, independent of measurement. This motivated much of the enthusiasm for a unified field theory in the past and sparked Einstein's famous question "Did God have any choice when he created the universe?" Do the properties of the universe inherently set the form of the universe, because these properties just won't work if the form is different?

The answer to this seems to be leaning strongly toward the idea that there is not only one universe that could be created, but that there are a wide range of fundamental theories (or different variants of the same theory, based on different physical parameters, original energy states, and so on) and our universe is just one of these possible universes.

In this case, the question becomes why our universe has properties that seem to be so finely tuned to allow for the existence of life. This question is called the *fine-tuning problem* and has promoted some physicists to turn to the anthropic principle for explanation, which dictates that our universe has the properties it does because if it had different properties, we wouldn't be here to ask the question. (A major thrust of Smolin's book is the criticism of this viewpoint as an explanation of the properties.)

Problem 5: The Problem of Cosmological Mysteries

The universe still has a number of mysteries, but the ones that most vex physicists are dark matter and dark energy . This type of matter and energy is detected by its gravitational influences, but can't be observed directly, so physicists are still trying to figure out what they are. Still, some physicists have proposed alternative explanations for these gravitational influences, which do not require new forms of matter and energy, but these alternatives are unpopular to most physicists.

After Reading

4. *Say whether these statements are true or false:*
   1) Andrew Zimmerman Jones is the author of the book "The Trouble with Physics: The Rise of String Theory, the Fall of a Science, and What Comes Next".
   2) Lee Smolin points out 5 important issues in practical physics.
   3) Quantum gravity is the effort in theoretical physics to create a theory that includes both general relativity and the standard model of particle physics.
   4) There are two interpretations in quantum physics: the classic Copenhagen interpretation and Hugh Everette II's controversial Many Worlds Interpretation.
   5) These interpretations revolve around the question what actually causes the collapse of the quantum wavefunction.

6) The standard model of particle physics includes electromagnetism, strong nuclear force, gravity and weak nuclear force.
7) Trying to create one theory which unifies four forces into a unified field theory is a major goal of theoretical physics.
8) String theory predicts that all particles are the same vibrational modes of fundamental filaments of energy, or strings.
9) Einstein's idea was that the universe can have various properties and various forms.
10) Physicists have already solved the question of dark matter and dark energy.

5. *Answer the following questions:*
1) What do general relativity and the standard model of particle physics describe?
2) Are there any real infinites in nature?
3) What is the principle of decoherence?
4) Which fundamental forces does the standard model of particle physics include?
5) What is a major goal of theoretical physics?
6) The standard model of particle physics shows a lot of different particles – 18 fundamental particles in all, doesn't it?
7) Which idea does string theory predicts?
8) What is Einstein's famous question and what is the answer to it?
9) What are the mostly known cosmological mysteries?

6. *Look at your notes and say which 5 problems of theoretical physics you wrote as the most important. Why did Lee Smolin point out the problems mentioned?*

7. *Choose the correct variant to complete the sentence:*

1) Galileo Galilei, Tuscan professor of mathematics, was a founder of modern physics and is famous for … the importance of observations as checks of statements about nature.
   a) speaking for; b) protecting; c) advocating.
2) Some animals emit sounds that … echoes in order … speeds to high precision.
   a) form; to survey; b) create; to measure; c) produce; study.
3) In their first years of life, children … a lot of time … objects around.
   a) waste; dropping; b) pass; cast; c) spend; throwing.
4) Developmental psychology … experimentally that from this very experience children … the concepts of time and space.
   a) showed; escape; b) has shown; extract; c) is showing; omit.
5) All animal brains have internal clocks. These brain clocks … their users … between present, recent and past data and observations.
   a) allow; to distinguish; b) let; to determine; c) agree; to understand.
6) When Galileo … motion in the seventeenth century, there were as yet no stopwatches. He thus had … one himself, in order to measure times in the range between a fraction and a few seconds.
   a) observed; to construct; b) described; to make; c) studied; to build.

7) A *clock* is a moving system whose position … .
   a) can be watched; b) can be read; c) can read.
8) When a dancer … in the air, how many times can he or she … around his or her vertical axis before … back on earth?
   a) arises; move; coming; b) jumps; rotate; arriving; c) hops; move; standing.

8. *Find in the text sentences which express its* ***purpose****,* ***subject*** *and* ***object****. Are they expressed directly? Try and formulate each of these notions within one sentence each. Begin like this:* The purpose of the text about algebra is … The subject of this text is …

9. *Make up an outline of the text. On its basis prepare the rendering of the text.*

Unit 4. Newton's Law of Gravity

Before Reading

1. *Answer the questions:*
   a) Who was Newton? Why do we remember him now?
   b) Why is gravity important?
   c) In which spheres is gravity studied and used directly?
2. *Study the following vocabulary. Compose 5-7 sentences of your own with the given vocabulary units:*
   attractive force – сила тяжіння
   profound insight – глибоке розуміння (проникнення)

issue – (тут) питання, проблема
to outline – окреслити, сформулювати
to govern – керувати
trial and error – спроба та помилка
to apply to – застосовувати (до чогось)
rigorous – суворий; точний
literally – буквально
particle of matter – частинка матерії
directly proportional – прямо пропорційний
inversely proportional – зворотно пропорційний
quantity – кількість
magnitude – величина
tool – знаряддя
density – густина
to accelerate – прискорювати, підвищувати швидкість
considerably – значно
identical – ідентичний
galaxy – галактика
vector quantity –
to interact – взаємодіяти
to cancel each other out – врівноважувати (нейтралізувати) одна одну
to concern – займатися чимось, мати відношення до чогось
net force – кінцева (сумарна) сила
rectangular plate – чотирикутна пластина
practical applications – практичне застосування
non-uniform – неоднорідний; непостійний
for the sake of precision – задля точності

Working with the Text

3. *Read the text about Newton's law of gravity. Make up 7-8 questions on it for you group-mates to answer.*

Newton's law of gravity defines the attractive force between all objects that possess mass. Understanding the law of gravity, one of the fundamental forces of physics, offers profound insights into the way our universe functions.

The Proverbial Apple

The famous story that Isaac Newton came up with the idea for the law of gravity by having an apple fall on his head is not true, although he did begin thinking about the issue on his mother's farm when he saw an apple fall from a tree. He wondered if the same force at work on the apple was also at work on the moon. If so, why did the apple fall to the Earth and not the moon?

Along with his Three Laws of Motion, Newton also outlined his law of gravity in the 1687 book *Philosophiae naturalis principia mathematica (Mathematical Principles of Natural Philosophy)*, which is generally referred to as the *Principia*.

Johannes Kepler (German physicist, 1571-1630) had developed three laws governing the motion of the five then-known planets. He did not have a theoretical model for the principles governing this movement, but rather achieved them through trial and error over the course of his studies. Newton's work, nearly a century later, was to take the laws of motion he had developed and apply them to planetary motion to

develop a rigorous mathematical framework for this planetary motion.

Gravitational Forces

Newton eventually came to the conclusion that, in fact, the apple and the moon were influenced by the same force. He named that force gravitation (or gravity) after the Latin word *gravitas* which literally translates into "heaviness" or "weight."

In the *Principia*, Newton defined the force of gravity in the following way (translated from the Latin):

Every particle of matter in the universe attracts every other particle with a force that is directly proportional to the product of the masses of the particles and inversely proportional to the square of the distance between them.

Mathematically, this translates into the force equation shown to the right. In this equation, the quantities are defined as:

- F_g = The force of gravity (typically in newtons)
- G = The *gravitational constant*, which adds the proper level of proportionality to the equation. The value of G is 6.67259×10^{-11} N * m^2 / kg^2, although the value will change if other units are being used.
- m_1 & m_1 = The masses of the two particles (typically in kilograms)
- r = The straight-line distance between the two particles (typically in meters)

Interpreting the Equation

This equation gives us the magnitude of the force, which is an attractive force and therefore always directed *toward* the other particle. As per

Newton's Third Law of Motion, this force is always equal and opposite. Click on the picture to see an illustration of two particles interacting through gravitational force.

In this picture, you will see that, despite their different mass and sizes, they pull on each other with equivalent force. Newton's Three Laws of Motion give us the tools to interpret the motion caused by the force and we see that the particle with less mass (which may or may not be the smaller particle, depending upon their densities) will accelerate more than the other particle. This is why light objects fall to the Earth considerably faster than the Earth falls toward them. Still, the force acting on the light object and the Earth is of identical magnitude, even though it doesn't look that way.

It is also significant to note that the force is inversely proportional to the square of the distance between the objects. As objects get further apart, the force of gravity drops very quickly. At most distances, only objects with very high masses such as planets, stars, galaxies, and black holes have any significant gravity effects.

Centre of Gravity

In an object composed of many particles, every particle interacts with every particle of the other object. Since we know that forces (including gravity) are vector quantities, we can view these forces as having components in the parallel and perpendicular directions of the two objects. In some objects, such as spheres of uniform density, the perpendicular components of force will cancel each other out, so we can treat the objects as if

they were point particles, concerning ourselves with only the net force between them.

The center of gravity of an object (which is generally identical to its center of mass) is useful in these situations. We view gravity, and perform calculations, as if the entire mass of the object were focused at the center of gravity. In simple shapes – spheres, circular disks, rectangular plates, cubes, etc. – this point is at the geometric center of the object.

This idealized model of gravitational interaction can be applied in most practical applications, although in some more esoteric situations such as a non-uniform gravitational field, further care may be necessary for the sake of precision.

After Reading

4. *Agree or disagree with the following statements:*
   a) Newton's law of gravity concerns not all the objects which possess the mass.
   b) The law of gravity is one of the fundamental forces of physics.
   c) The law of gravity does not explain the way our universe functions.
   d) The famous story about Isaac Newton and the apple which fell upon his head is just a legend.
   e) Newton was wondering why the apple fell to the Earth and not the moon.
   f) The German physicist J. Kepler lived at the same time as I. Newton.

g) Johannes Kepler had developed three laws governing the motion of the five then-known planets.
h) J. Kepler worked out the principles governing the movement of planets.
i) Newton took Kepler's laws of motion, developed and applied them to planetary motion.
j) Newton eventually came to the conclusion that the apple and the moon were influenced by the same force.

5. *Answer the questions:*
1) Who was the first to outline the laws of motion?
2) What does the word 'gravity' mean?
3) In what way was Newton's first law formulated?
4) How can Newton's first law be translated mathematically?
5) Is the attractive force between the two particles always equal and opposite?
6) Why does the particle with less mass will accelerate more than the other particle?
7) What causes the force of gravity drop quickly?
8) Which objects have significant gravity effects in reality?
9) What is important about the forces acting among the particles within an object?
10) Where is the center of gravity in simple shapes?
11) Where does the model of gravitational interaction find practical applications?

6. *Choose the correct variant to complete the sentence:*
   1) Understanding the law of gravity ….. profound insights into the way our universe functions.
      a) gives b) offers c) translates
   2) The law of gravity is one of the fundamental ….. of physics.
      a) rule b) rules c) forces
   3) Newton wondered if the same force ….. on the apple was also ….. on the moon.
      a) at work b) which acts c) effecting
   4) Newton's book *Philosophiae naturalis principia mathematica (Mathematical Principles of Natural Philosophy)* is generally ….. as the *Principia*.
      a) entitled b) referred to c) cited as
   5) Kepler did not have a theoretical model for the principles ….. the movement of planets.
      a) understanding b) which governs c) governing
   6) Kepler achieved his inventions ….. trial and error ….. the course of his studies.
      a) with; on b) through; over c) over; on
   7) Newton's equation gives us the magnitude of the force, which is an attractive force and ….. always directed ….. the other particle.
      a) as such; for b) because; into c) therefore; toward
   8) Newton's Three Laws of Motion give us the tools to interpret the motion caused by the force.
      a) to interpret b) to investigate c) to suggest

9) We see that the particle with less mass (which may or may not be the smaller particle, ….. upon their densities) will ….. more than the other particle.
a) judging; move b) depending; accelerate c) looking; fall
10) Newton eventually ….. to the conclusion that, in fact, the apple and the moon were influenced by the ….. force.
a) thought; identical b) made; greater c) came; same.

7. *Find in the text sentences which express its* ***purpose****,* ***subject*** *and* ***object****. Are they expressed directly? Try and formulate each of these notions within one sentence each. Begin like this: The purpose of the text about the laws of gravity is … The subject of this text is …*

8. *Make up an outline of the text. On its basis prepare the rendering of the text.*

Unit 5. Outstanding Mathematicians

Before Reading

1. *Answer the following questions:*
a) Which outstanding mathematicians do you remember? Which countries do the represent?
b) Do you think that great discoveries in mathematics are important for the development of humankind? Prove your point.
c) Are great discoveries in mathematics possible in modern times?

2. *You are going to read the text about C. F. Gauss. Before that study the vocabulary suggested and compose 7-8 sentences of your own with the given vocabulary items.*

precocity – незвичайно ранній розвиток
incredible – надзвичайний
pay-roll – платіжна відомість
under smb's charge – під чиїмось патронатом, керівництвом
computation – обчислювання, обчислення
to reckon – думати, мати точку зору
prodigious power – вражаюча (незвичайна) сила
with suspicion – з підозрою
to matriculate – закінчувати (навчальний заклад)
immortal – безсмертний
to come into play – проявлятися, вступати в дію
to cost an effort – коштувати зусиль
the law of quadratic reciprocity – закон взаємності квадратичних лишків
repeating decimal – періодичний дріб
treasure – скарб
merely – тільки
to be in two minds – вагатися у виборі
errors of observations – похибки в спостереженнях
double periodicity – подвійна періодичність
prolific – плідний, продуктивний
masterpiece – шедевр
to broaden one's activity – розширяти свою діяльність
terrestrial magnetism –

to earn – заробляти, заслуговувати
undisputable title – незаперечний титул
to predict – передрікати, передбачати
ramification – галуження
chief concern – основне питання
classics of antiquity – античні класики

Working with the Text

3. *Read the text and make up 5-7 questions on it for your group-mates.*

C. F. GAUSS

Carl Friederich Gauss is considered to be the third greatest mathematician in the world, after Archimedes and Newton. He was born in Germany, in 1777. In all the history o f mathematics there is nobody approaching the precocity o f Gauss as a child. Although it seems incredible, Gauss showed his exceptional mathematics qualities before he was three years old. One Saturday his father was making outthe weekly pay-roll for the workers under his charge. At the end of his computation his little son said: «Father, the reckoning is wrong. It should be …». A check of the account showed that the figure named by the little boy was correct. In later years he liked to joke that he had known how to count before he could talk.

A prodigious power for involved mental calculations remained with him all his life. At the age o f 12 he was looking with suspicion at the foundations of Euclidean geometry; by the age o f 16 he had caught his first glimpse of a geometry other than Euclid's.

In 1792 he matriculated at the Caroline College in Brunswick. While still at the college Gauss started those researches in the higher arithmetic which were to make him immortal. His prodigious power of calculation now came into play. Going directly to the numbers themselves he experimented with them, discovering by induction general theorems whose proofs were to cost even him an effort. In this way he discovered «the gem of arithmetic», which is known as the law of quadratic reciprocity, and which he was the first to prove.

The whole investigation originated in a simple question which many beginners in arithmetic ask themselves: How many digits are there in the period of a repeating decimal? To get some light on the problem, Gauss calculated the decimal representations of all the fractions 1/n for n = 1 to 1000. He did not find the treasure he was seeking, but something infinitely greater – the law of quadratic reciprocity. The mere discovery o f such a law was a notable achievement. That a boy of nineteen was the first to prove it will suggest to anyone who tries to prove it that Gauss was more than merely competent in mathematics.

At the age of 18 he entered the University of Gottingen still being in two minds whether to follow mathematics or philology as his life work. He had already invented the method of the «least squares». This work was the beginning of Gauss' interest in the theory of errors of observations. At the age of 20 he discovered the double periodicity of certain elliptic functions, and some time later

he recognized the double periodicity in the general case.

The three years at the University of Gottingen were the most prolific in Gauss' life. Since 1795 he had been meditating on a great work on the theory of numbers, and by 1789 his work on Arithmetic Research was practically completed. This work was the first Gauss' masterpiece, and it is considered by some people to be the greatest. After its publication in 1801 (Gauss was then 24) he broadened his activity to include astronomy, geodesy and electromagnetism in their both mathematical and practical aspects.

It would take a long list to describe all the outstanding contributions of Gauss to mathematics, both pure and applied. Here is the summary of the principal fields of Gauss' interests after 1800: astronomy, geodesy, mathematical physics, particularly electromagnetism – (in 1833 Gauss, together with Weber, invented the electric telegraph), terrestrial magnetism, and the theory of attraction according to Newton's law, the geometry associated with functions of complex variables.

To conclude this long but far from being complete list of great things that earned Gauss the undisputable title of the Prince of Mathematics, we must mention the subject which he predicted to become one of the chief concerns of mathematics – the «geometry o f position», or topology. Today this problem has far reaching ramifications in both geometry and analysis.

His last years were full of honour, but he was not as happy as he had earned the right to be. He

died on February 23, 1855 at the age of 78. Unlike Newton in his last years, Gauss was never attracted by the rewards of public office. He found complete satisfaction in his science and his simple recreations. Wide reading in the European literature and the classics of antiquity, a critical interest in world politics and the mastery of foreign languages and new sciences, including botany and mineralogy, were his hobbies.

After Reading

4. Match the words or phrases in two columns to form the word combinations from the text. Use them in the situations from text

1. Exceptional	a) two minds
2. It would take	b) arithmetic
3. A prodigious power	c) the theory o f errors of observations
4. There is nobody approaching	d) certain elliptic functions
5. Caught his	e) list o f great things
6. A geometry	f) ramifications
7. Matriculated at	g) the rewards of public office
8. To be in	h) mathematics qualities
9. The method of	i) a long list to describe
10. Interest in	j) for involved mental calculations
11. The double periodicity of	k) the precocity of Gauss as a child
12. Far from being complete	l) the mastery of foreign languages

13. Far reaching	m) other than Euclid's
14. To be attracted by	n) the Caroline College
15. A critical interest in	o) first glimpse
16. The gem of	p) the least squares

5. *Match the word combinations in group A with their Ukrainian equivalents in group B*

   A: exceptional mathematical qualities; to catch one's glimpse at (smth); to matriculate at a college; method of least squares; to mention a subject; chief concern; public office; mastery of foreign languages; theory of errors of observations.

   B: метод найменших квадратів; головна турбота; теорія похибки спостережень; оволодіння іноземними мовами; державна установа; складні математичні розрахунки; звернути увагу (зупинити погляд на чомусь); бути прийнятим до коледжу; згадати предмет; виняткові здібності до математики.

6. *Fill in the blanks with the prepositions from the table below (many of them can be used several times), suggest the title for this extract and convey its main idea in 2-3 sentences*

with in to of at from within without on for

The facility ... which he mastered languages ... his youth stayed ... Gauss all his life. Languages were ... him more than a hobby. To test the plasticity ... his mind as he grew older he would deliberately acquire a new language. The

exercise, he believed, helped him to keep his mind young. ... the age ... 62 he began an extensive study ... Russian ... assistance ... anybody two years he was reading Russian prose and poetical works fluently, and carrying... his correspondence ... scientific friends ... St. Petersburg wholly ... Russian. ... the opinion ... Russians who visited him ... Gottingen he also spoke the language perfectly. He put Russian literature ... a par ... English ... the pleasure it gave him. He also tried Sanskrit but disliked it.

7. *Say whether these statements are true or false. Supply the answers with the phrases:* ***that's quite true, according to the text, as far as the text goes, to my mind..., just on the contrary..., to be more exact..., it is generally known..., more than that..., that's (quite) wrong...,*** *etc.*
   1. In his childhood Gauss was rather slow in mental development.
   2. Gauss is a French mathematician.
   3. Gauss developed a prodigious power for mental calculations at the University.
   4. He decided to study mathematics at the University o f Gottingen.
   5. C. F. Gauss thought of pure mathematics more highly than of its application.
   6. Besides Mathematics, Gauss was interested in astronomy.
   7. In his old age Gauss, like Newton, was attracted by the rewards o f public office.
   8. His hobby was reading the classics of antiquity.

9. Carl Friederich Gauss is considered to be the third greatest mathematician in the world, after Archimedes and Euler.

8. *Discuss with your group mates Gauss' prodigy as a mathematician.*

9. *Find in the text sentences which express its* ***purpose****,* ***subject*** *and* ***object****. Are they expressed directly? Try and formulate each of these notions within one sentence each. Begin like this:* The purpose of the text about the life and activity of C.F. Gauss is … The subject of this text is …

10. *Make up an outline of the text. On its basis prepare the rendering of the text.*

Unit 6. 10 Inventions That Changed the World

Before Reading

1. *Answer the following questions:*
   a) If you are asked to remember three important inventions what would you say? Which of them is the most important one?
   b) Which sphere is the best to make extremely important inventions? Why?
   c) Which nation was/is most capable of world-important inventions?

2. *Before reading the text about world-important inventions, study the suggested vocabulary. Use 7-9 vocabulary items in sentences of your own.*

axle mechanism – осьовий механізм
beep – гудок
broadcaster – радіожурналіст
to carve a furrow – зробити борозну
to concoct – змішувати
crank – кривошип
cog – зубець
combustion engine – двигун внутрішнього згорання
diffusion of knowledge – розповсюдження знань
drastically – ретельно, круто
easy access – легкий доступ
feat – досягнення, подвиг
filament – нить накалювання
gear – механізм
incandescent – накалений
jet engine – реактивний двигун
landmark – віха
to lump – звалювати в купу
power plant – електростанція
pulley – шків, блок
screw press – винтовий прес
to spell out – вимовляти, писати по буквах
surplus – надлишок

Working with the Text

3. *Read the text "10 Inventions That Changed the World". Point out 5 most important/ interesting facts in it. Tell your groupmates about them.*

10 Inventions That Changed the World

When you imagine inventors, you probably picture a lone genius in a laboratory concocting brilliant devices, experimenting and redesigning

until some concept or contraption works perfectly. At that point, the new invention is unveiled to the world, a stunning piece of new technology that instantly changes everything.

Well, you've got part of it right. There's certainly a lot of redesigning and experimenting when it comes to inventions, but it takes a lot longer than you think. It also takes far more people than that lone genius.

As you'll see when you read about these 10 world-changing inventions, no invention is created in a vacuum. Every single one was built on previous inventions created by other inventors years, decades or even centuries before. Every invention has problems, and it might not be until some other inventor comes along that they get solved. To confuse things further, it usually isn't the original inventor who gets all the credit, but rather the inventor who made the one crucial improvement that makes us all want one.

The Plow

Compared to some of the gleaming, electronic inventions that fill our lives today, the plow doesn't seem very exciting. It's a simple cutting tool used to carve a furrow into the soil, churning it up to expose nutrients and prepare it for planting. Yet the plow is probably the one invention that made all others possible.

No one knows who invented the plow, or exactly when it came to be. It probably developed independently in a number of regions, and there is evidence of its use in prehistoric eras. Growing food added some stability to life, but doing it by hand was labor intensive and took a long time.

Plows made the work easier and faster. Improvements in the plow's design made farming so efficient that people could harvest far more food than they needed to survive. They could trade the surplus for goods or services. And if you could get food by trading, then you could devote your day-to-day existence to something other than growing food, such as producing the goods and services that were suddenly in demand.

The ability to trade and store materials drove the invention of written language, number systems, fortifications and militaries. As populations gathered to engage in these activities, cities grew. It's not a stretch to say that the plow is responsible for the creation of human civilization.

Wheel

The wheel is another invention so ancient that we have no way of knowing who first developed it. The oldest wheel and axle mechanism we've found was near Ljubljana, Slovenia, and dates to roughly 3100 B.C.

The wheel made the transportation of goods much faster and more efficient, especially when affixed to horse-drawn chariots and carts. However, if it had been used only for transportation, the wheel wouldn't have been as much of a world-changer as it was. In fact, a lack of quality roads limited its usefulness in this regard for thousands of years.

Tens of thousands of other inventions require wheels to function, from water wheels that power mills to gears and cogs that allowed even ancient cultures to create complex machines. Cranks and

pulleys need wheels to work. A huge amount of modern technology still depends on the wheel, like centrifuges used in chemistry and medical research, electric motors and combustion engines, jet engines, power plants and countless others.

Printing Press

Like many of the inventions on this list, the man we believe invented the printing press (Johann Gutenberg in the 1430s) actually improved on pre-existing technologies and made them useful and efficient enough to become popular. The world already had paper and block printing – the Chinese had them as early as the 11th century – but the complexity of their language limited popularity. Marco Polo brought the idea to Europe in 1295.

Gutenberg combined the idea of block printing with a screw press (used for olive oil and wine production). He also developed metal printing blocks that were far more durable and easier to make than the hand-carved wooden letters in use previously. Finally, his advances in ink and paper production helped revolutionize the whole process of mass printing.

The printing press allowed enormous quantities of information to be recorded and spread throughout the world. Books had previously been items only the extremely rich could afford, but mass production brought the price down tremendously. The printing press is probably responsible for many other inventions, but in a more subtle way than the wheel. The diffusion of knowledge it created gave billions of

humans the education they needed to create their own inventions in the centuries since.

Refrigeration

Refrigerators cool things down by taking advantage of the way substances absorb and unload heat as their pressure points and phases of matter change (usually from gas to liquid and back). In the early 20th century, harvested natural ice was still common, but large industries such as breweries were beginning to use ice-making machines. Harvested ice for industrial use was rare by World War I. In the 1920s home refrigerators became the norm.

The ability to keep food cold for prolonged periods (and even during shipping, once refrigerated trucks were developed) drastically changed the food production industry and the eating habits of people around the world. Now, we have easy access to fresh meats and dairy products even in the hottest summer months, and we're no longer tied to the expense of harvesting and shipping natural ice.

Communications

Maybe it's cheating to lump the telegraph, telephone, radio and television into one 'invention', but the development of communication technology has been a continuum of increased utility and flexibility since Samuel Morse invented the electric telegraph in 1836 (building on the prior work of others, of course). The telephone simply refined the idea by allowing actual voice communications to be sent over copper wires, instead of just beeps that spelled out the plain text in Morse code. These communication

methods required an extensive infrastructure of wires to function.

Transmitting signals wirelessly using electromagnetic waves was a concept worked on by many inventors around the world, but Guglielmo Marconi and Nikola Tesla popularized it in the early 20th century. Eventually, sound could be transmitted wirelessly, while engineers gradually perfected the transmission of images. Radio and television were new landmarks in communications because they allowed a single broadcaster to send messages to thousands or even millions of recipients as long as they were equipped with receivers.

These developments in communications technology effectively shrank the world. In the span of about 120 years, we went from a world where it might take weeks to hear news from across the country to one where we can watch events occurring on the other side of the globe as they happen. The advent of mass communications put more information within our grasp and altered how we interact with each other.

Steam Engine

The concept of using steam to power machines had been around for thousands of years, but Thomas Newcomen's creation in 1712 was the first to harness that power for useful work (pumping water out of mines, for the most part). In 1769, James Watt modified a Newcomen engine by adding a separate condenser, which vastly increased the steam engine's power and made it a far more practical way to do work. He also developed a way for the engine to produce

rotary motion, which may be just as important as the efficiency gains. Thus, Watt is often considered the inventor of the steam engine.

Newcomen's and Watt's engines were bulky. It was the high-pressure steam engine developed by Richard Trevithick and others that allowed for steam engines small enough to power a train. Not only did steam engines power factories that made the rapid production of goods possible, they powered the trains and steamships that carried those goods across the globe.

Most power plants in the world actually generate electricity using steam turbines, whether the steam is heated by burning coal, natural gas or a nuclear reactor.

Automobile

If the steam engine mobilized industry, the automobile mobilized people. Karl Benz's 1885 Motorwagen, powered by an internal combustion engine of his own design, is widely considered the first automobile. Henry Ford's improvements in the production process – and effective marketing – brought the price and the desire for owning an auto into the reach of most Americans. Europe soon followed.

The automobile's effect on commerce, society and culture is hard to overestimate. Most of us can jump in our car and go wherever we want whenever we want, effectively expanding the size of any community to the distance we're willing to drive to shop or visit friends. Our cities are largely designed and built around automobile access, with paved roads and parking lots taking up huge amounts of space and a big chunk of

our governments' budgets. The auto industry has fueled enormous economic growth worldwide, but it's also generated a lot of pollution.

Lightbulb

Every invention is built by incrementally improving earlier designs, and the person usually associated with an invention is the first person to make it commercially viable. Such is the case with the light bulb. We immediately think of Thomas Edison as the electric light bulb's inventor, but dozens of people were working on similar ideas in the 1870s, when Edison developed his incandescent bulb. Joseph Swan did similar work in Britain at the time, and eventually the two merged their ideas into a single company, Ediswan.

The bulb itself works by transmitting electricity through a wire with high resistance known as a filament. The waste energy created by the resistance is expelled as heat and light. The glass bulb encases the filament in a vacuum or in inert gas, preventing combustion.

Computer

A computer is a machine that takes information in, is able to manipulate it in some way, and outputs new information. There is no single inventor of the modern computer, although the ideas of British mathematician Alan Turing are considered eminently influential in the field of computing. Mechanical computing devices were in existence in the 1800s (there were even rare devices that could be considered computers in ancient eras), but electronic computers were invented in the 20th century.

Computers are able to make complicated mathematical calculations at an incredible rate of speed. When they operate under the instructions of skilled programmers, computers can accomplish amazing feats. Some high-performance military aircraft wouldn't be able to fly without constant computerized adjustments to flight control surfaces. Computers performed the sequencing of the human genome, let us put spacecraft into orbit, control medical testing equipment, and create the complex visual imagery used in films and video games.

Computers let us store vast amounts of information and retrieve a given piece of it almost instantly. Many of the things we take for granted in the world wouldn't function without computers, from cars to power plants to phones.

Internet

The Internet, a network of computers covering the entire planet, allows people to access almost any information located anywhere in the world at any time. Its effects on business, communication, economy, entertainment and even politics are profound. The Internet may not have changed the world as much as the plow, but it's probably on par with the steam engine or automobile.

DARPA (Defense Advanced Research Projects Agency), the research and development arm of the U.S. military, created ARPANET in the late 1960s. This network of computer-to-computer connections was intended for military and academic research. Other computer networks began to cross the globe in the next few years, and by the late 1970s computer scientists had

created a single protocol, TCP/IP, that would allow computers on any network to communicate with computers on other networks. This was, essentially, the birth of the Internet, but it took 10 or so years for various other networks in the world to adopt the new protocol, making the Internet truly global.

The Internet is such a powerful invention that we've probably only begun to see the effects it will have on the world. The ability to diffuse and recombine information with such efficiency could accelerate the rate at which further world-changing inventions are created. At the same time, some fear that our ability to communicate, work, play and do business via the Internet breaks down our ties to local communities and causes us to become socially isolated. Like any invention, the good or ill it accomplishes will come from how we choose to use it.

After Reading

4. *Complete the sentences:*
   1) Every single invention was built …
   2) It usually isn't the original inventor who gets all the credit, but …
   3) Plows made the work … . The plow made farming so efficient …
   4) Tens of thousands of other inventions require wheels …
   5) The printing press allowed …
   6) Now due to the refrigerators we have easy access …
   7) Transmitting signals wirelessly using electromagnetic waves …

8) James Watt modified a Newcomen engine …
9) Henry Ford's improvements in the automobile production process …
10) The bulb itself works by transmitting electricity …

5. *Agree or disagree with the statements. Motivate your answers.*
   1) The plow is a simple cutting tool used to carve a furrow into the soil, churning it up to expose nutrients and prepare it for planting.
   2) With the plow people spent more time on food growing.
   3) The wheel appered firstly in Egypt.
   4) Due to the wheel people of the ancient times could travel much.
   5) Johann Gutenberg combined the idea of block printing with a screw press.
   6) Mass production of books brought the price on them up tremendously.
   7) Till the early 20th century harvested ice was used to cool products.
   8) The automobile's effect on commerce, society and culture was not essencial.
   9) Transmitting signals wirelessly using electromagnetic waves was a concept worked on by many inventors around the world.
   10) Many of the things we take for granted in the world wouldn't function without computers, from cars to power plants to phones.

6. *Develop the idea (in 2-5 sentences):*
   1) The plough is probably the one invention that made all others possible.
   2) If the wheel had been used only for transportation, the wheel wouldn't have been as much of a world-changer as it was.
   3) Johann Gutenberg improved the existed printing press.
   4) The ability to keep food cold for prolonged periods drastically changed the food production industry and the eating habits of people around the world.
   5) The steam engine is widely used in the modern industries.
   6) The automobile's effect on commerce, society and culture is hard to overestimate.
   7) The possibility to communicate nearly from anywhere stopped to seem fantastic due to the Internet.

7. *Compose 5-7 questions on the text for your groupmates.*

8. *Which of these inventions are the most interesting, crucial and important for civilization from your point of view? Motivate your answers.*

9. *Say what other inventions you would add to the list of those changing the world. Prepare a short report about one of them.*

10. *Make up an outline of the text. On its basis prepare the rendering of the text.*

Unit 7. The Golden Ratio

Before Reading

1. *Answer the following questions:*
   a) What do you think about the notion of symmetry in our world?
   b) When did you hear about the golden ratio for the first time? In which context did you hear it?
   c) Who was the first to discover the law of the golden ratio?

2. *Study the following vocabulary to the text about the golden ratio. Use 7-8 vocabulary items in the sentences of your own.*
   extreme ratio – крайнє відношення
   mean ratio – середнє відношення
   regular pentagon – правильниий п'ятикутник
   icosahedron – ікосаедр (двадцятигранник)
   dodecahedron – додекаедр (дванадцятигранник)
   isosceles triangle – вписаний трикутник
   to bisect – ділити навпіл
   similarly – так само, аналогічно
   to attribute (to) – відносити (до чогось, до когось), приписувати (комусь)
   proposition – судження; висловлення
   concerning – стосовно
   inconsistent – непослідовний, суперечливий
   fair amount of evidence – значна кількість свідчень
   polyhedra – багатогранник
   property –приналежність, власність

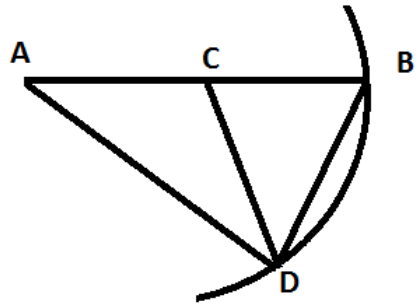
approximate value – приблизне значення
circumscribed circle – описане коло
to be aware of (smth) – добре розуміти (щось)
to indicate – вказувати
divine – божественний, священний
proof or a reference – доказ або посилання
to restate –наново сформулювати
to befit – відповідати (чомусь), підходити
regular solid – тіло правильної форми
adjacent term – супутній термін
division in extreme and mean ratio – поділ відповідно до золотого відношення
continuous proportion – безперервна пропорція

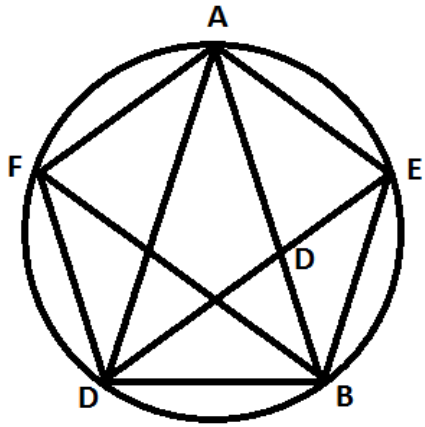
Working with the text

3. *Read the text and compose 8-10 questions on it for your group mates to answer.*

THE GOLDEN RATIO

Euclid, in *The Elements,* says that the line *AB* is divided in extreme and mean ratio by *C* if *AB:AC = AC:CB.* Although Euclid does not use the term, we shall call this the **golden ratio.** The definition appears in Book VI but there is a construction given in Book II, Theorem 11, concerning areas which are solved by dividing a line in the golden ratio. As well as constructions to divide a line in the golden ratio, Euclid gives applications such as the construction of a regular pentagon, an icosahedron and a dodecahedron. Here is how the golden ratio comes into the construction of a pentagon.





First construct an isosceles triangle whose base angles are double the vertex angle. This is done by taking a line *AB* and marking *C* on the line in the golden ratio. Then draw a circle with centre *A* and radius *AB*. Mark *D* on the circle so that *AC* = *CD* = *BD*. The triangle *ABD* has the property that its base angles are double its vertex angle.

Now starting with such a triangle *ABD* draw a circle through *A*, *B* and *D*.

Then bisect the angle *A D B* with the line *DE* meeting the circle at *E*. Note that the line passes

through C, the point dividing *AB* in the golden ratio. Similarly construct *F* and draw the pentagon *AEBDF* .

Of course nobody believes that Euclid's *Elements* represents original work so there is the question of who studied the golden ratio before Euclid. Now some historians believe that Book II of *The Elements* covers material originally studied by Theodorus of Cyrene while others attribute the material to Pythagoras, or at least to the Pythagoreans. Proclus, writing in the fifth century AD, claims: – *Eudoxus ... multiplied the number of propositions concerning the section which had their origin in Plato, employing the method of analysis for their solution.* Many believe that by «section» Proclus means «golden ratio». Eudoxus certainly attended lectures by Plato so it is entirely reasonable that he might work on topics suggested during these lectures.

Heath writes in his edition of Euclid's *Elements: – This idea that* Plato *began the study of [the golden ratio*] *as a subject in itself is not in the least inconsistent with the supposition that the problem of Euclid* II, 11 *was solved by the Pythagoreans.*

Heath claims later in the same work that the construction of a pentagon using the isosceles triangle method referred to above was known to the Pythagoreans so there is a fair amount of evidence to suggest that this is where the study o f the golden ratio began.

Hypsicles, around 150 BC, wrote on regular polyhedra. He is the author of what has been called Book XIV of Euclid's *Elements,* a work

which deals with inscribing regular solids in a sphere. The golden ratio enters into the constructions.

Up to this time the golden ratio seems to have been considered as a geometrical property and there is no obvious sign that any attempt was made to associate a number with the ratio. Of course if *AB* has length 1 and *AC* = *x* where C divides *AB* in the golden ratio, then we can use simple algebra to find x.

$1/x = x/(1 - x)$ gives $x^2 + x - 1 = 0$ so $x = (\sqrt{5} - 1)/2$.

Then the golden ratio is $1/x = (\sqrt{5} + 1)/2 = 1.6180339887498948482...$

Heron certainly begins to compute approximate ratios, and in his work he gives approximate values for the ratio of the area of the pentagon to the area of the square of one side. With Ptolemy trigonometric tables, at least in terms of chords of circles, begin to be computed. He calculates the side of a regular pentagon in terms of the radius of the circumscribed circle.

With the development of algebra by the Arabs one might expect to find the quadratic equation (or a related one) to that which we have given above. Al-Khwarizmi does indeed give several problems on dividing a line of length 10 into two parts and one of these does find a quadratic equation for the length of the smaller part of the line of length 10 divided in the golden ratio. There is no mention of the golden ratio, however, and it is unclear whether al-Khwarizmi is thinking of this particular problem.

Abu Kamil gives similar equations which arise from dividing a line of length 10 in various ways. Two of these ways are related to the golden ratio but again it is unclear whether Abu Kamil is aware of this. However, when Fibonacci produced *Liber Abaci* he used many Arabic sources and one of them was the problems of Abu Kamil. Fibonacci clearly indicates that he is aware of the connection between Abu Kamil's two problems and the golden ratio. In *Liber Abaci* he gives the lengths of the segments of a line of length 10 divided in the golden ratio as $\sqrt{125} - 5$ and $15 - \sqrt{125}$.

Pacioli wrote *Divina proportione (Divine proportion)* which is his name for the golden ratio. The book contains little new on the topic, collecting results from Euclid and other sources on the golden ratio. He states (without any attempt at a proof or a reference) that the golden ratio cannot be rational. He also states the result given in *Liber Abaci* on the lengths of the segments of a line of length 10 divided in the golden ratio. There is little new in Pacioli's book which merely restates (usually without proof) results which had been published by other authors. Of course the title is interesting and Pacioli writes:

... it seems to me that the proper title for this treatise must be Divine Proportion. This is because there are very many similar attributes which I find in our proportion – all befitting God himself – which is the subject of our very useful discourse.

He gives five such attributes, perhaps the most interesting being:

... just like God cannot be properly defined, nor can be understood through words, likewise this proportion of ours cannot ever be designated through intelligible numbers, nor can it be expressed through any rational quantity, but always remains occult an d secret, and is called irrational by the mathematicians.

Cardan, Bombelli and others included problems in their texts on finding the golden ratio using quadratic equations. A surprising piece of information is contained in a copy of the 1509 edition of Pacioli's *Euclid's Elements.* Someone has written a note which clearly shows that they knew that the ratio of adjacent terms in the Fibonacci sequence tend to the golden number. Handwriting experts date the note as early 16th century so there is the intriguing question as to who wrote it.

The first known calculation of the golden ratio as a decimal was given in a letter written in 1597 by Michael Maestlin, at the University of Tubingen, to his former student Kepler. He gives «about 0.6180340» for the length of the longer segment of a line of length 1 divided in the golden ratio. The correct value is 0.61803398874989484821... The mystical feeling for the golden ratio was of course attractive to Kepler, as was its relation to the regular solids. His writings on the topic are a mixture of good mathematics and magic. He, like the annotator of Pacioli's *Euclid*, knows that the ratio of adjacent terms of the Fibonacci sequence tends to the golden ratio and he states this explicitly in a letter he wrote in 1609.

The result that the quotients of adjacent terms of the Fibonacci sequence tend to the golden ratio is usually attributed to Simson who gave the result in 1753. We have just seen that he was not the first to give the result and indeed Albert Girard also discovered it independently of Kepler. It appears in a publication of 1634 which appeared two years after Albert Girard's death.

In this article we have used the term golden ratio but this term was never used by any of the mathematicians who we have noted above contributed to its development. We commented that «section» was possibly used by Proclus although some historians dispute that his reference to section means the golden ratio. The common term used by early writers was simply «division in extreme and mean ratio». Pacioli certainly introduced the term «divine proportion» and some later writers such as Ramus and Clavius adopted this term. Clavius also used the term «proportionally divided» and similar expressions appear in the works of other mathematicians. The term «continuous proportion» was also used.

The names now used are *golden ratio, golden number* or *golden section.* These terms are modern in the sense that they were introduced later than any of the work which we have discussed above. The first known use of the term appears in a footnote in *Die reine Elementar-Matematik* by Martin Ohm (the brother of Georg Simon Ohm):

One is also in the habit of calling this division of an arbitrary line in two such parts the golden

section; one sometimes also says in this case: the line r is divided in continuous proportion.

The first edition of Martin Ohm's book appeared in 1826. The footnote just quoted does not appear and the text uses the term «continuous proportion». Clearly sometime between 1826 and 1835 the term «golden section» began to be used but its origin is a puzzle. It is fairly clear from Ohm's footnote that the term «golden section» is not due to him. Fowler examines the evidence and reaches the conclusion that 1835 marks the first appearance of the term.

The golden ratio has been famed throughout history for its aesthetic properties and it is claimed that the architecture of Ancient Greece was strongly influenced by its use.

After Reading

4. *Agree or disagree with the statements. Correct the wrong ones.*
   a) Euclid's *Elements* represents original work.
   b) It is still unknown who was the first to work on the golden ratio.
   c) The first description of the golden ratio was connected with the construction of a dodecahedron.
   d) Up to this time the golden ratio is considered as a geometrical property.
   e) In his work Heron gives the exact value of the golden ratio.
   f) With the development of algebra by the Arabs the study of the golden ratio continued.

g) Abu Kamil gives equations which arise from dividing a line of length 10 in various ways.
h) Fibonacci clearly indicates that he is not aware of the connection between Abu Kamil's two problems and the golden ratio
i) Pacioli's book contains a new profound study on the topic, collecting results from Euclid and other sources on the golden ratio.
j) Pacioli introduced the term «divine proportion» and some later writers such as Ramus and Clavius adopted this term.

5. *Choose the proper item to complete the sentences*
   1. Golden ratio was considered by the mathematicians of antiquity as a _____ property.
      a) algebraic
      b) mathematical
      c) geometrical
   2. Hypsicles around 150 BC wrote on _____ polyhedra.
      a) simple
      b) regular
      c) common
   3. Fibonacci in Liber Abaci used many sources on mathematics.
      a) Indian
      b) Italian
      c) Arabic
   4. Another term used by ancient mathematicians to denote golden ratio is _____ .

a) golden relation
b) golden rule
c) divine proportion

5. Paciolli made contribution to understanding golden ratio.
   a) considerable
   b) insignificant
   c) no
6. One of the terms used to denote golden ratio now is _____ .
   a) miracle
   b) golden section
   c) Fibonacci sequence

6. *Give the Ukrainian equivalents of these word combinations*

extreme and mean ratio; a regular pentagon; to draw a circle; to bisect an angle; vertex angle; to attend lectures; entirely reasonable; the idea … is not in the least unconsistent with the supposition; isosceles triangle method mentioned above.

7. *Answer the questions on the text*
   1. What is the numerical value of golden ratio?
   2. Where, when and whom was this definition formulated by?
   3. In the construction of what kind of polygons is the golden rule used?
   4. What property of the isosceles triangle was used for constructing the pentagon? 5. Who studied the golden rule before and after Euclid?

6. What problems did Al-Kwarizmi give?
7. Why does, in Paciolli's view, golden ratio remain occult and secret and why is it called irrational by mathematicians?

writers?

9. What are the other terms used to denote golden ratio now?
10. In what fields is the golden ratio used by specialists?

8. *Problem solution: demonstrate the construction of a regular polygon using the golden ratio.*

9. *Write a short summary of the history of golden ratio development.*

10. *Make up an outline of the text. On its basis prepare the rendering of the text.*

MODULE 3. Students' Research Work

Unit 1. My Research Interests

1. *Study the scheme of compiling the topic "My Research Interests". Use it to write about your own research.*

My name is ….. . I am a master student of Zhytomyr State Ivan Franko University, as I want to improve my professional qualification. I study at the Department of History, the Academic Chair of … .

The direction of my research is …, as I became interested in it when I was an

undergraduate. I work under the tutorship of Docent (Professor) … . My topic can be phrased as "….. ". I believe my topic is of great importance for the studying of ….. .

I hope to complete the work at my diploma paper ….. .

I plan to continue the work at my topic as a post graduate student of ….. .

I'd like to add that I have taken part in the work of … research conference which was held in ….. .

I have published one (two, three) article(s) based on my scientific research.

Unit 2. At the Research Conference

1. *Answer the following questions:*
   1) Have you ever been present at a students' research conference? Have you participated in its work?
   2) Where was the conference held? Were there many people present?
   3) Which report produced the greatest impression on you? Why?
   4) How did you feel after you have made your own report? Was it received with interest?
   5) Did you make any friends or interesting acquaintances at the conference?
   6) What was your general impression of the work of the conference?

2. *Read the text and write out 15 basic phrases to speak about the work of a research conference in your field of science.*

Young Scholars' Research Conference in Poltava

I will never forget the day I arrived at Poltava to participate in the work of the research conference for young scholars. I had a good opportunity to meet with a lot of master and post graduate students and have talks on some important problems.

The topic of the conference was "Modern Look on Problems in Higher Education". The topic being of great importance, scholars from 9 countries arrived to take part in it. Being an international conference, 110 registered participants arrived from countries outside Ukraine. It was the European Center for Higher Education of UNESCO that mainly sponsored it.

The papers presented at the conference covered problems of higher education in European countries, so the president of the Conference was Professor O. Schwarz of the University of Munich, Germany and the vice president was the President of the Academy of Pedagogical Sciences of Ukraine. Many outstanding contemporary educationalists came to speak at the conference and they addressed young learners like their colleagues.

The conference started its work on May 2, and lasted till May 4. The first session was the plenary meeting at which the greatest scholars present made their speeches. All speakers in their reports pointed out that the requirements of contemporary social and technical development in European countries brought about new challenges in educational advancement and

higher education. Their reports were so interesting that the time for discussion of the reports appeared too short.

After the discussion and the coffee-break the work of the sections began. Most sections were devoted to particular higher school aspects or particular directions or specializations in higher education. Being interested in the organization of distant studies, I took part in the work of the section “Modern Tendencies in Organization of Higher Education”. Some papers presented at the section dealt with several national experiences in the development of distant form of higher education. It is evident that this type of education meets the requirements of the time, though much was said about its minuses as well as about its pluses. My paper was devoted to computer-assisted instruction in distant higher education, and it received positive commentaries form the colleagues present.

During the round-table talks the issues of future developments in the field of organization and information structure of higher education were discussed by groups of experienced and young scholars. Ukrainian participants took active part in those discussions.

At the final session the speakers expressed their satisfaction with the work of the conference as to a certain extent it stimulated practical interest in the direction of application of some schemes in contemporary higher education in European universities.

Pay attention to the correct translation of the following sentences:

Being an international conference, 110 registered participants arrived from countries outside Ukraine. Оскільки конференція була міжнародною, з-за меж України для участі в ній прибуло 110 зареєстрованих учасників.
Being interested in the organization of distant studies, I took part in the work of the section "Modern Tendencies in Organization of Higher Education". Мене цікавить організація дистантного навчання, тому я взяв участь у роботі секції "Сучасні тенденції в організації вищої освіти".

3. *Make one sentence of the suggested two, as in the model:*
   Model: The topic of the conference was of great importance. Scholars from 15 countries took part in it. – The topic of the conference being of great importance, scholars from 15 countries took part in it.
   1) The papers covered the problems of higher education. The European Centre for Higher Education of UNESCO sponsored it.
   2) The topic of the conference was very interesting. A lot of scientists presented noteworthy papers on it.
   3) The computer is capable of performing tasks of great variety and capacity. It is widely used to solve complex problems, to

record, classify and reproduce information of practically unlimited quantity.

4) The conference has stimulated interest in educational technology and the directions of its application. The speakers expressed their satisfaction with the work of the conference.
5) The technological revolution has brought about significant progress in industrial advancement. New scientific and technological facilities emerged.

4. *Complete the following sentences:*
   1) Naturally, the papers presented at the conference ….. .
   2) The topic of the report being of great importance, ….. .
   3) Really, this was the first conference ….. .
   4) No doubt, the requirements of contemporary life created ….. .
   5) Naturally, higher education can't stand aside from ….. .
   6) It is common knowledge that the computer today is capable of ….. .
   7) It is evident that new approaches to higher education organization ….. .
   8) At the final session speakers expressed their satisfaction with ….. .

5. *Ask questions about the underlined words as in the model.*

   Model: The delegates came from different countries of the world. – Where did the delegates come from?

1) The opening ceremony was followed by a heated discussion.
2. The papers presented at the conference were on some problems of theoretical physics.
3. Most noteworthy papers were presented by a lot of scholars.
4. The conference was attended by a delegation from Ukraine.
5. At the final session speakers expressed their satisfaction with the work of the conference.
6. Educational technology is aimed at greater teaching efficiency.
7. The computer today is capable of numerous important complicated operations.
8. In the paper I touched upon our experience in working with a certain type of equations.

6. *Paraphrase the sentences using the expression* ***to be interested in*** *as in the model:*
Model: Does mathematics interest you? – Are you interested in mathematics?
1) I take great interest in modern literature.
2) Natural sciences do not interest me.
3) Do you take any interest in cybernetics?
4) My future plans as to my career always interest my parents.
5) These problems are of no interest to us.
6) Do these experiments interest you?
7) What educational problems interest you most of all?

7. *Insert prepositions where necessary:*
   a) ….. ….. the development ….. the computer, revolutionary changes have come ….. communication techniques.
   b) The number ….. those attending ….. the conference ….. the problems ….. nuclear reactions was about 320.
   c) Higher education can't be indifferent ….. the opportunity ….. utilizing the new tools and techniques ….. teaching and research.
   d) The president ….. the Conference was Professor O. Schwarz ….. the University ….. Munich, Germany.
   e) All speakers pointed ….. that the technological revolution brought ….. significant progress ….. industrial advancement.
   f) The papers presented ….. the conference attracted attention ….. all those interested ….. the problems ….. higher education .
   g) The majority ….. foreign participants could hear speeches and lectures ….. their native languages or ….. English as it is an international language.

8. *Complete one of the conversations:*
   A. – As far as I know, Mathematical Congresses are national scientific gathering and are held in the USA every three years.
   – You seem to be wrong. Mathematical Congresses are annual meetings. They are held at different countries as they are international, and the delegates come different parts of the world.

B. – What are your impressions of the conference?
– The conference was a great success. The hosts made good arrangements for the business part of it.
– And how about the cultural programme?
– Oh, they offered well-considered programmes for each participant.

9. *Using the text, write 5-7 questions for your friends about their participation in a research conference.*

10. *Prepare a story about your participation (or plans of participation) in a students' research conference.*

Unit 3. Students' Research Conference.

1. *Study the programme of the students' research conference which was held at Zhytomyr Ivan Franko State University (see Appendix 1, p. 139).*

2. *Prepare a review of the conference, be sure to cover the following points:*
   - time and place of the conference;
   - educational institutions which were the organizers of the conference;
   - schedule of the conference;
   - programme of the plenary meeting;
   - number and character of particular sections;
   - number of participants in a section/ the whole conference;

- section of your interest, the most interesting reports;
- general conclusion.

3. *Study an article submitted to the Students' Research Conference in Zhytomyr State Ivan Franko University. Define the* ***topicality****, the* ***purpose*** *and* ***the subject*** *of the article. Do you find it noteworthy? Why? Use the article as an example to write your own one.*

Alyona Polishchuk,
Master student, speciality 'Mathematics'
Scientific supervisor – **Tetyana Viktorivna Didkivska**,
Associate Professor, Chair of Algebra and Geometry
Language tutor: Kuznyetsova A. V.,
Candidate of Philology, Associate Professor

METHODS OF SOLVING SOME SYSTEMS OF EQUATIONS

The topicality of the paper is that solving systems of equations has always been interesting for scholars. Besides, not every system of equations can be reduced to a standard system after changing or a successful substitute of variables for which there exists a certain solving algorithm. In such cases it is useful to apply other methods of solving described in this paper.

To reveal the content of both, the basic and artificial methods of solving systems of equations is the **purpose** of the paper.

Let's study the cyclical systems of equations and one of the methods of their solving.

Consider the system of equations in general:

$$\begin{cases} F(x_1, x_2, \ldots, x_{n-1}, x_n) = 0, \\ F(x_2, x_3, \ldots, x_n, x_1) = 0, \\ \ldots\ldots\ldots\ldots\ldots\ldots \\ F(x_{n-1}, x_n, \ldots, x_{n-3}, x_{n-2}) = 0, \\ F(x_n, x_1, \ldots, x_{n-2}, x_{n-1}) = 0, \end{cases} \quad (1)$$

where function F depends on n variables $x_1, x_2, \ldots, x_n \in X \subset R$. After the cyclical substitute of $x_1 \to x_2 \to \ldots \to x_n \to x_1$ we obtain the system

$$\begin{cases} F(x_2, x_3, \ldots, x_n, x_1) = 0, \\ F(x_3, x_4, \ldots, x_1, x_2) = 0, \\ \ldots\ldots\ldots\ldots\ldots\ldots \\ F(x_n, x_1, \ldots, x_{n-2}, x_{n-1}) = 0, \\ F(x_1, x_2, \ldots, x_{n-1}, x_n) = 0, \end{cases} \quad (2)$$

which has the same equations but they are placed in a different order. A conclusion can be made that system (2) coincides with system (1). Such systems (1) are named **cyclical systems.**

All known methods of solving systems can be adequately applied for cyclical systems, but there is one more method which fits only cyclical systems. It helps to change our system into one equation. Let's analyze it on the example [3]:

Method of reduction to a confluent equation

Exercise 1. $\begin{cases} x - y = \sin x, \\ y - x = \sin y. \end{cases}$

Solution. Let $x = y = t$ and write down a confluent equation of our system $\sin t = 0$.

Numbers such as πm, where $n \in Z$ is the solution of this equation. That's why $(\pi m, \pi m)$, $n \in Z$ – solutions of this system.

Now let's prove that the system has no other solutions. Let $x = a, y = b$ – solution of the system, where $a \neq b$. When we insert it into the equation of the system and subtract from the first congruence the corresponding parts of the second one, we have the following result:

$$2(a-b) = \sin a - \sin b \Leftrightarrow a - b = \sin\frac{a-b}{2}\cos\frac{a+b}{2}.$$

Since $\left|\sin\frac{a-b}{2}\right| \leq \frac{|a-b|}{2}$ і $\left|\cos\frac{a+b}{2}\right| \leq 1$,

we obtain a contradictory inequation from the last congruence: $|a-b| \leq \frac{|a-b|}{2}$.

That's why the system has no other solutions.

Answer: $(\pi n, \pi n), n \in Z$.

Resume. The article deals with one of the most interesting methods of solving systems of equations named **'Method of reduction to a confluent equation'** and shows how it works. The perspective of the further work is studying other methods of solving systems of equations.

List of references

1. Gaishtut O. G., Litvinenko G. M. Solving algebraic questions. – K. : Rad. sch., 1991.
2. Voronyy O. M. Let's prepare for academic competition in mathematics. Second book. – Kh. : Osnova, 2008. – 141 p.

4. *Study the programme of the scientific research conference which was held in England (see Appendix 2, p. 147). Make a review of the conference, be sure to cover the following points:*
   - time, place and organizers of the conference;
   - the title of the conference;
   - main scientific directions;
   - countries represented at the conference;
   - schedule of the conference;
   - programme of the plenary meeting;
   - character of particular presentations;
   - number of participants in a section/ the whole conference;
   - section of your interest, the most interesting presentations;
   - differencies and similarities with the conference programme in Zhytomyr State Ivan Franko University Appendix 1 (p. 139).

5. *Analyse a sample from the book of abstracts for this conference. State the main points of the abstract: the scientific direction, the topicality, the purpose and the subject. Compose an abstract on your article.*

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Catherine Stenson, **Advisor:** Louis Billera
January 2014

Linear Inequalities for Flag f-Vectors of Polytopes

Abstract: Here we study the combinatorics of polytopes. A polytope *P* is the convex hull of a finite set of points in **R**^*d*, and its boundary is a collection of lower-dimensional polytopes known as the faces of *P*. The flag *f*-vector of *P* counts the faces of each dimension and their incidences with one another. We would like to know what linear inequalities the entries of the flag *f*-vector satisfy.

First we present some of the history of this problem, along with the necessary mathematical background. We discuss several special classes of polytopes, including simplicials, simples, cubicals and zonotopes, whose flag *f*-vectors satisfy inequalities not satisfied by all polytopes.

Then we define Stanley's toric *g*-vector, which can be used to generate many linear inequalities for flag *f*-vectors. We prove Meisinger's conjecture that some of these inequalities are implied by others. In addition, we consider the **cd**-index, another source of many inequalities. We show that not all of these are consequences of the non-negativity of the toric *g*-vector.

We then use linear inequalities satisfied by lower-dimensional polytopes to generate linear relations satisfied by simplicial, simple, *k*-simplicial and *k*-simple polytopes, and cubical zonotopes. We also examine a *g*-vector for cubical polytopes proposed by Adin and give evidence that supports the conjecture *g*_2 <= 0. In particular, we show this to hold for the class of almost simple cubical polytopes, where one might expect it is most likely to fail. Next we improve upon previously known linear inequalities satisfied by zonotopes. Finally, we construct examples of another special class of polytopes, the self-dual polytopes.

Module 4: My Diploma Thesis

Unit 1. Diploma Thesis Presentation

1. *Study the structure of the diploma thesis presentation.*

Structure of the diploma paper presentation

I. State the topic of your master-paper and do some introduction to your research.

II. State

- the objective
- the subject and the object of the research
- tasks
- the scientific novelty
- the topicality of the research
- experimental methods

III. Descibe the process of the experiment.

IV. Present conclusions/results of the diploma paper.

V. Perspectives of the research.

2. *Analyse sample 1 of the diploma thesis presentation. Pay attention to the structure of the diploma paper presentation. What questions would you ask the author of this presentation? What do you like/dislike about this presentation?*

The topic of my master paper is “Research of Spectral Dependence of Transmission Coefficient in a Liquid Crystal 5CV in case Nanoparticles available”.

With increasing frequency the term *liquid crystal* appears in the pages of scientific and science popular editions. In everyday life we use clocks, thermometers, TVsets and other facilities with liquid crystals. The question arises, what this stuff with the paradoxical title "liquid crystal" is and why it causes a scientific interest.

Nowadays, science has become a productive force and a scientific interest to a certain phenomenon means it is perspective for material production and further application. In this regard, the liquid crystal is not an exception. Interest in them is primarily caused by the possibilities of their effective usage in various spheres of industries. The introduction of liquid crystals contributes to economic **efficiency**, simplicity, convenience.

Liquid crystal is a **mesophase** between a solid substance and a liquid.

Researches in physics of liquid crystals and their applications are widely conducted in all most developed countries. Therefore, a detailed study of liquid crystals in terms of optics, and advanced informational technologies is of great importance to modern science.

The objective: to investigate experimentally the transmission coefficient in a liquid crystal 5CV in case nanoparticles available.

The subject is a nematic liquid crystal 5CV.

The object is spectral dependence of transmission coefficient in 5CV in case nanoparticles available.

The objective of the diploma paper presupposes the fulfillment of the following **tasks**:

1. To study properties of liquid crystals;
2. To research experimentally a nematic liquid crystal 5CV;
3. To review and analyze features of spectral dependence of liquid crystals;
4. To define the dependence of transmission coefficient in a liquid crystal 5CV in case nanoparticles available.

The scientific novelty: lies in the fact that spectral dependence of transmission coefficient in a liquid crystal 5CV in case nanoparticles available was studied.

The topicality of the diploma paper:

1. practical usage of nematic liquid crystals is based on their optical properties which make them a perspective environment for creation of optical devices;

2. rapid development of various devices with nematic liquid crystals.

The experimental methods: include the optical spectroscopy.

The studied samples: the cell of nematic liquid crystal 5CV with thickness of $2*10^{-5}$ m.

4-Cyano-4'-pentyl biphenyl is a widely used nematic liquid crystal with chemical formula: $C_{18}H_{19}N$. The common name 5CV is often used.

We have conducted experimental studies of spectral dependence of transmission coefficient in a liquid crystal 5CV in case nanoparticles available. ***The coplanar cell was made for the experiments over the nematic liquid crystal.*** All experiments were conducted on DFS-8 spectrograph.

The sample of the nematic liquid crystal 5CV

1 – light; 2 – input slit; 3 – swivel mirror; 4 – mirror lens; 5 – lattice; 6 – **focus** that projects scale onto the focal surface 11; 7 – lamp for backlight; 8 – lighting lens; 9 – the scale of wavelengths; 10 – swivel mirror; 11 – focal surface.

To carry out the experiment, installation and adjustment of the light source and lighting systems for DFS-8 spectrograph was held.

Alignment of the light source and lighting system is the proper placement of light source and lighting lens on the rail unit. For this, the first step is to place the lighting system so that the axis of collimator spectrograph was the

continuation of the lighting system axis. The second step is to place properly the lighting lens on the rail unit.

The scheme of the device that was used in the research

1) the quartz lamp- is a source of light;

2) the power supply DC V5-46 – is used to power the quartz lamp;

3) the BC-22 – High-current source designed to supply PV-79;

4) the photos electron multiplier -79 – is the vacuum diode, which consists of 79 pairs of anodes and cathodes designed for receiving light that missed nematic;

5) The gigaohm resistance box – it is resistance mounted on the divider is 10^9 ohms;

6) The voltage comparator R3003 – is used to voltage stabilization after the resistance box;

7) the recording potentiometer PCC-4 – is used to record the number of phonons light that pass through the sample.

The first stage of the research is to measure spectrum of the lamp. The second stage is to measure spectral dependence of transmission coefficient in a liquid crystal 5CV in case nanoparticles available.

After the study it was found out that:

1. spectrum of the quartz lamp

(Dependence of light current on wave length)

According to the research conducted, it was found out that the spectrum of quartz lamp has a maximum radiation in the 510-600 nm range that satisfies transmission of the investigated liquid crystal 5CV.

In the study of Spectral Dependence of Transmission Coefficient in a Liquid Crystal 5CV observed:

1) transmission coefficient is almost constant in the 700-600 nm;;

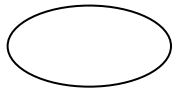
2) transmission coefficient is a sharp increase with temperatures T1 = 300 K, 310 K = T2, T3 = 320 K within 600-570 nm;

3) after 570 nm – transmission coefficient almost tends to infinity.

The results of this research will be used in my future work as a teacher of physics, particularly in sections of optics, in the extracurricular activities and in the scientific work with students participating in the activities of MAS of Ukraine.

Thank you for attention!

3. *Read sample 2 of the diploma paper presentation. Match its sections with the headings given below. Write 2-3 questions to the author of this presentation.*



1) The topic of my master paper is ***Stability of Ohmic Contacts toward Semiconductor Epitaxial Films n-InN under the Impact of Degradation Factors.*** The investigations were conducted at the Laboratory of Physical and technological problems of solid state microwave electronics in V.Ye. Lashkaryov Institute of Semiconductor Physics, NAS of Ukraine.

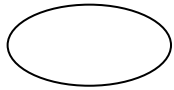
2) Among the new semiconductor materials, nitrides have a special place due to the number of physical parameters. They are GaN, AlN and InN. Indium nitride is a direct semiconductor of III-nitrides group which has band gap (~ 0.7 eV), low effective mass, high value of saturation velocity and high electron mobility, that makes this element a promising material for highspeed semiconductor devices, in particular for terahertz emitters, detectors and highly efficient solar cells.

Creating low resistance highly reliable, thermally stable ohmic contacts to the semiconductor is one of the major challenges to the development of semiconductor devices based on InN.

3) Ohmic contact is a metal-semiconductor contact, characterized by significantly lower resistance compared to semiconductor volume resistance and spreading resistance. Ohmic contact should not change the characteristics of the device, that's why it must have a symmetrical current-voltage characteristic and must not inject the minor carriers.

In case the electronic work function of a metal is less than the electronic work function of a n-type semiconductor and more than electronic work function of a p-type semiconductor, then the ohmic metalsemiconductor contact is formed.

In most cases, for the ohmic contact creation additional doping of near-contact area of semiconductor is used. Then the space charge area is thin and charge carriers can tunnel easily through it. In this figure we can see energy diagram of ohmic contact.



4) Electron transition through interface of metal-semiconductor can occur:

1. over the barrier (thermionic emission);
2. through the top of the barrier (thermionic field emission);
3. through the barrier at Fermi level (field emission).

F. A. Padovani and R. Stratton have introduced a criterion to determine the current transport mechanism. This criterion depends on effective mass of the semiconductor, dielectric constant, and on the doping level

of the semiconductor.

It can be mentioned that in the process of field emission, monotonic dependence of contact resistance on the temperature is observed. In the process of thermalfield emission, contact resistance decreases with increasing temperature, but much slower compared to thermionic emission.

5) The existing ohmic contacts to the nInN are studied, as well as their advantages and disadvantages and types of degradation factors that can optimize their manufacturing. It's defined that the multilayer contacts are optimal. Rapid thermal annealing is a factor that will generate the least amount of defects and can optimize these ohmic contacts.

6) In this diploma paper we investigated the structure of Au (100 nm)-Ti(50 nm)-Pd(30 nm)-n-InN(2,5 μm)/GaN(0,9 μm)/Al2 O3 with different concentration of donors $8.3 \cdot 10^{18} \sim 4.1 \cdot 10^{19}$cm in n-InN films. Measurement of the contact resistivity (ρ c) of data samples was conducted by the Circular Transmission Line Method.

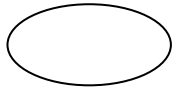
7) The resulted value of contact resistivity ρ c at room temperature was ρ c =3.0·10^{-4} ohm·cm ^{2} f of doping level 8.3·10 ^{18} cm $^{-3}$ and ρ c = 3.2·10^{-3} ohm·cm ^{2} for doping level 4.1·10 ^{19} cm^{3}. To improve the contact between the metallization and semiconductor, rapid thermal annealing was used for 2 minutes at temperature of 350° C.

8) As a result, the contact resistivity decreased by 6 times to ρ c = 5.0·10^{-5} ohm·cm and by 20 times to ρ c = 1.6·10^{-4} ohm·cm^{2} for contacts with different concentration of donors 8.3·10^{18} ~ 4.1·10^{19} .

9) Additional annealing at temperature of 370° C for 2 minutes led to a further reduction of the contact resistivity to ρ c =3.2·10^{-5} ohm·cm^{2} and ρ c = 5.6·10^{-5} ohm·cm^{2}, and the reduction of dispersion more than three times compared to initial samples.

10) Temperature dependences ρc (T) obtained in this study are characteristic of metals, that is ρc increases were observed with temperature rise. It can be described by a novel concept explaining the unusual behavior

of ohmic contacts in the model considering the current flow through the metal shunts along the dislocations.



11) In our previous researches of similar ohmic contacts Au-Ti-Pd-n-InN, which differed by lower doping (10^{18} cm^{-3}), an increasing dependence ρc (T) was also observed. The dependence obtained cannot be described by classical transfer mechanisms. It became possible to explain this dependence with regard to the mechanism described, that is the current flowing through the metal shunts associated with dislocations is determined by electron diffusion. It is shown that current flows through the semiconductor near-surface areas where electrons are accumulated.

In the case of a degenerate semiconductor the temperature dependence of the contact resistance is determined by formula (1) in the process of thermionic emission.

The coordination with theory was obtained with the use of the following parameters: leading dislocation density $N_D \approx 5 \cdot 10^9$ cm^{-2}, shunt radius $r = 5 \cdot 10^{-8}$cm, shunt length dD ~ 0.1microns.

The model was proposed by d.f.m.s., prof. Anatoly Vasilyevich Sachenko.

12) The presence of high density of dislocations in this structure is partially confirmed by photomicrographs of cleavage of the structure that can be seen in this figure. The structures of InN and GaN layers are cordwood, due to the fact that the significant mechanical stresses exist at interfaces InN / GaN and GaN / Al_2 O_3. This is caused by the crystal lattice mismatch and thermal expansion coefficients of linear data layers.

13)

1. The existing ohmic contacts to the n-InN are reviewed, as well as their advantages and disadvantages and types of degradation factors that can optimize their manufacturing. It's defined that the multilayer contacts are optimal. Rapid thermal annealing is a factor that will generate the least amount of defects and can optimize these ohmic contacts.

2. Measurements of resistivity are conducted for two types of contacts (with concentrations of

electrons in n-InN layer 8,3 • 10^{18} cm^{-3} and 4,1 • 10^{19} cm^{-3}) by linear and radial TLM methods. The optimal use of radial TLM method for contact data is determined, measurements are made over 25 contacts of each type. On the basic of these data the most probable supports as 3,0 • 10^{-4} ohm • cm^2 (8,3 • 10^{18} cm^{-3}) and 3,2 • 10^{-3} ohm • cm^2 (4,1 • 10^{19} cm^{-3}) are defined, which are characterized by a large spread formations of resistivity.

3. The optimal contact degradation was achieved after rapid thermal annealing for 2 minutes at 370° C. The most probable value of the resistivity which was obtained, decreased in order and accounted for 3,2 • 10^{-5} (8,3 • 10^{18} cm^{-3}) and 5,6 • 10^{-5} ohm • cm^2 (4,1 • 10^{19} cm^3).

4. The mechanisms of current transport in optimized ohmic contacts are investigated, and a number of lawfullnesses are identified, which are not described by classical transfer mechanisms. An additional review of the literature showed that such dependences are characteristic of

semiconductors with a high concentration of dislocations. It is a current flow through metal shunts or their equivalents.

Thank you for attention!

Headings

- *Properties of Ohmic Contacts Au-Ti-Pd-n-InN/GaN/Al 2 O 3*
- *Structure of ohmic contact Au-Ti-Pd-n-InN/GaN/Al 2 O 3*
- *Temperature dependence of contact resistivity*
- *Samples and Methods*
- *Physical Parameters of Semiconductors*
- *Ohmic contact*
- *Known Contacts to Indium Nitride*
- *Conclusions*
- *Mechanism of contact resistance formation in ohmic contacts with high dislocation density*
- *Properties of Ohmic Contacts after Rapid Thermal Annealing (370°C, 2 min)*
- *Intoduction*
- *Properties of Ohmic Contacts after Rapid Thermal Annealing (350°C, 2 min)*
- *Mechanisms of current transport in the metal-semiconductor contacts*

4. *Use Ex. 2, 3 to make the presentation of your own diploma-thesis.*

Unit 2. Writing Annotations

An **annotation** or an **abstract** is a brief summary or description in your own words of an article, a book, or other publication. The purpose of an annotation is to give a reader sufficient information for him / her to decide whether or not to read the whole material. It is not evaluative and must not include your personal opinion. It should be brief and clear every sentence should convey maximum amount of information in a minimum number of words. There must be a clear organization and the content must be devoid of irrelevant ideas. The annotation should include:

1. A clear statement of the scope and purpose of a work.
2. A summary of the contents.
3. A statement of the conclusions or results.

Annotations describe the content of a book or article and indicate distinctive features. Writing annotations one should **not:**

- repeat the words of the title,
- give the same information in different phrasing,
- offer information that the intelligent person could readily infer from the text.

Step-by-step guide to annotating:

- Familiarize yourself with the contents of the book or article.
- Read as much of the book or article as is necessary to understand its content.
- Outline or make notes of the information you think you should include.

- Write a paragraph that reflects the spirit of the book or article without emphasis on any of the point.

1. *Study the list of verbs for referring to texts ideas in annotations. Translate them into Ukrainian. Use them in sentences of your own:*
   account for _____ describe _____indicate
   analyze _____ depict _____investigate
   assess _____distinguish _____justify
   assert _____ evaluate _____ narrate
   assume _____emphasize _____ persuade
   claim _____examine _____propose
   compare _____ exhibit _____recognize
   conclude _____ explain _____reflect
   criticize _____ frame _____ refer to
   define _____ illustrate _____review
   demonstrate _____ imply _____suggest

2. *Study and memorize the expressions necessary for writing annotations.*
   The beginning:
   The article analyzes the issue of…
   This article discusses the features of…
   The article deals with the problem of… It examines…
   The article discusses the problem of…
   The article depicts some project tasks and shows…
   This article presents an analysis of …
   The article is devoted to the problem of…
   The article describes … and justifies…

The main part:

The evidence indicates that…
The author identifies the reasons for…
The article questions the view that…
The concept of the "…" is defined.
The problems of … are considered.
It has been discovered that…
Different aspects of … are shown in the article such as…
The topicality of the…is discovered.
We consider the views of scientists on the issues involved.
The principles, conditions and …are grounded.
The special attention is paid to…
The role of …is characterized.

The ending:

…is determined.
…is analyzed.
… is characterized.
… is discovered.
… are shown.
… are distinguished.
… are listed.
… are grounded.

3. *Using the words and expressions above (Ex 1, 2) make up 15 sentences of your own.*

4. *Study samples of annotations copy* out *and memorize the necessary expressions*:

Journal of Mathematical Analysis and Applications

Kai Diethelm, Neville J. Ford. Analysis of Fractional Differential Equations.

Abstract

We discuss existence, uniqueness, and *structural stability* of solutions of nonlinear differential equations of fractional order. The differential operators are taken in the Riemann–Liouville sense and the initial conditions are specified according to Caputo's suggestion, thus allowing for interpretation in a physically meaningful way. We investigate in particular the dependence of the solution on the order of the differential equation and on the initial condition, and we relate our results to the selection of appropriate numerical schemes for the solution of fractional differential equations.

Mechanical Systems and Signal Processes
L. Gaul, P. Klein, S. Kemple.
Damping description involving fractional operators

Abstract

This paper uses and generalises constitutive equations of viscoelastic behaviour of materials and members in the time and frequency domain.
Weak frequency dependence of actual viscoelastic material can be fitted using only a few parameters by adopting the fractional derivative concept. The impulse response function of an oscillator with a fractional derivative damping model is integrated in the present paper with a new efficient technique using the inverse Fourier transform, this requires a unique definition of the constitutive equation in the frequency domain.

The response is shown to fulfill causality requirements. Amplitude decay of the considered damping models are compared after selection of equivalent damping properties.

Diethelm, K. An algorithm for the numerical solution of differential equations of fractional order (Article)
Institut für Mathematik, Universität Hildesheim, Marienburger Platz 22, D-31141 Hildesheim, Germany
Abstract
Differential equations involving derivatives of non-integer order have shown to be adequate models for various physical phenomena in areas like damping laws, diffusion processes, etc. A small number of algorithms for the numerical solution of these equations has been suggested, but mainly without any error estimates. In this paper, we propose an implicit algorithm for the approximate solution of an important class of these equations. The algorithm is based on a quadrature formula approach. Error estimates and numerical examples are given. Copyright © 1997, Kent State University.

5. *Write annotations to 2 English and 2 Ukrainian articles by analogy.*

6. *Annotate your own article(s).*

Структура екзаменаційного білета

1. Render the text on the profile science topic.
2. Speak on one of the topics studied.
3. Have a discussion with the teacher on the topics studied.

Список тем, що виносяться на екзамен

1. Our University.
2. My Research Interests.
3. My Recent Professional Acquaintance.
4. The Department I Study at.
5. Outstanding Scientists.
6. The Most Important Scientific Inventions and Discoveries.
7. Main Points of My Diploma Paper.
8. My Participation at a Students' Research Conference.
9. The Problem of Job Hunting.
10. Making a Career with Master's Diploma in Physics/Mathematics.
11. The British University to Study Physics/Mathematics at.
12. Getting Higher Education in US Universities.
13. The Most Famous and Prestigious Universities in Ukraine.
14. Entering a Master Course: a Step to the Academic Career or the Demand of the Time?

Список основної літератури

1. Богацкий И. С., Дюканова Н. М. Бизнес-курс английского языка. – К. : Логос, 1997. – 352 с.
2. Гапонів В. Б., Возна М. О. Лінгвокраїнознавство. Англомовні країни. – Вінниця : НОВА КНИГА, 2005. – 464 с.
3. Куліш Л. Ю., Друянова Є. О., Мотова В. Л. та ін. Прискорений курс англійської мови : підручник. – К. : Вища школа, 1996. – 303 с.
4. Ляшенко І. В., Литвиненко О. А., Меденцова Т. М. та ін. Англійська мова: Practice Abroad : навчальний посібник з англійської мови за програмою курсу поглибленого та інтенсивного вивчення іноземних мов. – Суми : Університетська книга, 2010. – 400 с.
5. Language Leader Intermediate. Coursebook. – L: Pearson Longman Publishers, 2008. – 184 p.
6. Oxford Guide to British and American Culture. – Oxford : Oxford University Press, 2005. – 599 p.

Додаткова використана література

1. Дорда С. В., Миленкова Р. В., Клочко Л. І. English for Business Communication (Англійська мова для ділового спілкування) : навчальний посібник. – Суми : Університетська книга, 2011. – 152 с.

2. Ширінян А. С., Корнієнко С. В. Англійська мова для студентів технічних спеціальностей : навчальний посібник. – К. : Кондор, 2005. – 208 с.
3. Misztal M. Tests in English: Thematic Vocabulary: Intermediate and advanced level. – K. : Знання, 2010. – 352 с.

Інформаційні ресурси

- http://study-english.info
- www.wikipedia.org
- www.uwgb.edu/dutchs/WestTech/xromans.htm
- www.historylerningsite.co.uk/russia
- www. About.com
- physics.org
- http://www.geniusstuff.com
- www.smbv.sz.uni-erlangen.de/…/uk/

Appendix 1

Міністерство освіти і науки України
Житомирський державний університет
імені Івана Франка
Навчально-науковий інститут іноземної філології
Кафедра іноземних мов і новітніх технологій навчання
Барановичський державний університет (Білорусь)
Академія «Ігнатіанум» у Кракові (Польща)
İstanbul Sabahattin Zaim University (Туреччина)
Томський політехнічний університет
Інститут фізики високих технологій (Росія)
Факультет іноземної філології
Уманського державного педагогічного університету
імені Павла Тичини
Житомирський державний технологічний університет
Житомирський інститут медсестринства

ПРОГРАМА
МІЖНАРОДНОЇ
НАУКОВО-ПРАКТИЧНОЇ КОНФЕРЕНЦІЇ
СТУДЕНТІВ НЕМОВНИХ СПЕЦІАЛЬНОСТЕЙ
«ТРАНСФОРМАЦІЯ МОВНОГО ОБРАЗУ СУЧАСНОГО ФАХІВЦЯ»

15 квітня 2015р.

Житомир – 2015

ПОРЯДОК ДЕННИЙ
15 квітня 2015 року
Житомирський державний університет
імені Івана Франка
Навчально-науковий інститут іноземної філології

09.00 – 10.00 – реєстрація учасників конференції	І поверх фойє Навчально-наукового інституту іноземної філології
10.00 – 11.30 – відкриття конференції, пленарне засідання	ІІ поверх фойє Навчально-наукового інституту іноземної філології, аудиторія №17
11.30 – 12.00 – перерва на каву	ІІ поверх фойє Навчально-наукового інституту іноземної філології, аудиторія №16
12.00 – 13.30 – робота секцій	ІІ поверх Навчально-наукового інституту іноземної філології, аудиторії №17, №15, №14, №13, №12
13.30 – 14.30 – перерва на обід	ІІ поверх Навчально-наукового інституту іноземної філології, аудиторія №16
14.30 – 15.00 – пленарне засідання, підведення підсумків	ІІ поверх Навчально-наукового інституту іноземної філології, аудиторія №17

РЕГЛАМЕНТ КОНФЕРЕНЦІЇ

Пленарні доповіді
до 10 хвилин
Секційні доповіді
до 5 хвилин

Робочі мови конференції:
англійська, німецька, французька, польська

ПЛЕНАРНЕ ЗАСІДАННЯ

Житомирський державний університет імені Івана Франка
Навчально-науковий інститут іноземної філології
ІІ поверх, аудиторія №17
10.00 – 11.30

1. ПРИВІТАННЯ УЧАСНИКІВ КОНФЕРЕНЦІЇ:

1. **Сейко Н. А.** – доктор педагогічних наук, професор, проректор з наукової та міжнародної роботи Житомирського державного університету імені Івана Франка
2. **Сингаївська А. В.** – кандидат філологічних наук, професор, директор Навчально-наукового інституту іноземної філології Житомирського державного університету імені Івана Франка
3. **Свиридюк В. З.** – доктор медичних наук, професор, проректор з наукової роботи Житомирського інституту медсестринства
4. **Могельницька Л. Ф.** – кандидат філологічних наук, доцент, завідувач кафедри іноземних мов Житомирського державного технологічного університету

2. ДОПОВІДІ:

1. **Anastasiya Prosyuk** – „DOUBLE CHANNEL MEMS-GRAVIMETER“ Zhytomyr State Technological University

2. **Yuriy Dederkal** – „MECHANOTRONIC ROBOTIC DEVICE FOR PRODUCTION OBJECTS RECOGNITION“ Zhytomyr State Technological University
3. **Weronika Hodakiwska –** „WPŁYW DWUJĘZYCZNOŚCI NA KOMUNIKACJĘ JĘZYKOWĄ“ Katolicki Uniwersytet Lubelski Jana Pawła II
4. **Marianna Hodakiwska –** „POLSKO – UKRAIŃSKI TRANSFER JĘZYKOWY“ Katolicki Uniwersytet Lubelski Jana Pawła II
5. **Bogdan Dumansky –** „DENARII AS THE MEANS OF PROPAGANDA OF THE OFFICIAL POLITICS IN ROMAN EMPIRE“ I. Franko Zhytomyr State University
6. **Oleksandr Kovalchuk –** „PRINCIPLES OF JAPANESE MODEL OF LABOUR POTENTIAL AND HUMAN RESOURCE MANAGEMENT FORMATION I. Franko Zhytomyr State University
7. **Yaroslav Plotnitskiy –** „PROBLEM OF METHODS TESTING PROGRAM SYSTEMS IN IT SECTOR“ I. Franko Zhytomyr State University
8. **Diana Pryshchepa –** „APPLICATION OF GAME-THEORETIC APPROACH TO DECISION MAKING UNDER RISK“ I. Franko Zhytomyr State University
9. **Arseniy Shelestyuk –** „TOLERANCE INTERNET USERS IN CONDITION OF WAR AGGRESSION“ I. Franko Zhytomyr State University
10. **Vitaliy Svintsitskiy –** „THE MARKETING EFFECT“ I. Franko Zhytomyr State University

11. **Marija Gorban** – „DER PARATEXT IN WERKEN VON T. G. SCHEWTSCHENKO“ Shytomyrer Staaliche I. Franko Universität
12. **Anna Pavlina** – „DIE PROBLEME DER PLANUNG VON VERKEHRSNETZEN“ Polytechnische Universität Tomsk (Russland)
13. **Tyllagozel Osmanowa –** „MANAGEMENT STRATÉGIQUE“ Université d'Etat de Jitomir I. Franko

СЕКЦІЙНІ ЗАСІДАННЯ

Житомирський державний університет імені Івана Франка
Навчально-науковий інститут іноземної філології

Доповіді англійською мовою

***СЕКЦІЯ І*: Гуманітарні науки: філологія, психологія, педагогіка**
***СЕКЦІЯ ІІ*: Суспільні науки: соціологія, історія, правознавство, релігієзнавство, філософія**
***СЕКЦІЯ ІІІ*: Природничі науки: біологія, хімія, екологія**
Фізико-математичні науки: інформатика, математика, фізика
Економічні науки: менеджмент, маркетинг, економіка
***СЕКЦІЯ IV*: Медичні науки**
(аудиторія №13)

СЕКЦІЯ ІІІ

Природничі науки: біологія, хімія, екологія
Фізико-математичні науки: інформатика, математика, фізика
Економічні науки: менеджмент, маркетинг, економіка

Зав. секцією: кандидат педагогічних наук,
старший викладач **Плахотнюк Н. П.**

1. **Voitsitska L.** – “EFFECT OF NICKEL SULFATE WATER ENVIRONMENT ON INDICATORS OF BREATHING OF HORNY PLANORBARIUS CORNEUS (MOLLUSCA, GASTROPODA, PULMONATA, BULINIDAE) IN NORNAL CONDITIONS AND TREMATODES BY INFESTIONED” I. Franko Zhytomyr State University
2. **Chayka M.** – “MODIFICATION OF A SURFACE OF MAGNETITE BY HYDROXYAPATITE” Chuiko Institute of Surface Chemistry
3. **Yatskevych Y.** – “THE SPECIES COMPOSITION OF PERITRICHOUS INFUSORIA (CILIOPHORA, PERITRICHIA) TETERIV RIVER” I. Franko Zhytomyr State University
4. **Dubovenko M.** – “APPLICATION OF SYMMETRIC POLYNOMIALS“ I. Franko Zhytomyr State University
5. **Bahinskii S.** – “STOHASTIC METHOD OF CALCULATING THE NUMBER "e" I. Franko Zhytomyr State University
6. **Kukhtyuk V.** – “ANDROID DEVELOPMENT” I. Franko Zhytomyr State University
7. **Maidanovich Y.** – “THE MATHEMATICAL PARADOX” I. Franko Zhytomyr State University

8. **Mankovskiy A.** – “BUILDING WEB APPLICATIONS FOR WORK AUTOMATION AT THE RECRUITMEN AGENCY” I. Franko Zhytomyr State University
9. **Matuh A.** – “SIMILARITY AS METRIC TRANSFORMATIONS IN EUCLIDEAN GEOMETRY” I. Franko Zhytomyr State University
10. **Moshon T.** – “SOFTWARE DEVELOPMENT FOR ANDR” I. Franko Zhytomyr State University
11. **Overchuk O.** – “ANALYSIS OF CREATING BLOGS” I. Franko Zhytomyr State University
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13. **Plotnitskiy Y.** – “PROBLEM OF METHODS TESTING PROGRAM SYSTEMS IN IT SECTOR” I. Franko Zhytomyr State University
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15. **Polischuk I.** – “DIOPHANTINE EQUATIONS” I. Franko Zhytomyr State University
16. **Sai P.** – “MODIFICATION OF OHMIC CONTACTS TO N-INN BY RAPID THERMAL ANNEALING” V.Ye. Lashkaryov Institute of Semiconductor Physics
17. **Svyrydenko M.** – “QUALITY ASSURANCE ENGINEERING” National Technical University of Ukraine “KYIV POLYTECHNIC INSTITUTE”
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19. **Sinovets A.** – “GOLDEN RATIO AND ITS APPLICATION” I. Franko Zhytomyr State University

20. **Siryk I.** – “THE ESSENCE AND MEANING OF THE FIBONACCI NUMBERS” I. Franko Zhytomyr State University
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22. **Yacenko O.** – “CLASSIFICATION OF WEB-SITES AND THEIR DESIGN” I. Franko Zhytomyr State University
23. **Kovalchuk O.** – “PRINCIPLES OF JAPANESE MODEL OF LABOUR POTENTIAL AND HUMAN RESOURCE MANAGEMENT FORMATION” I. Franko Zhytomyr State University
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28. **Svintsitskiy V.** – “THE MARKETING EFFECT” I. Franko Zhytomyr State University
29. **Singayevska A.** – “SELF-MANAGEMENT AS CONDITION OF PERSONAL AND PROFESSIONAL SUCCESS” I. Franko Zhytomyr State University
30. **Shuban A.** – “HARRINGTON EMERSON’S TWELFE PRINCIPLES OF EFFICIENCY” I. Franko Zhytomyr State University.

Appendix 2

5th Cornell Conference
Analysis, Probability, and Mathematical Physics on Fractals
June 11–15, 2014

Please check in between 8:00 and 8:50am in the 5th oor faculty lounge (532 Malott Hall). The main talks and courses will all be held in 406 Malott Hall according to the following schedule. Light refreshments will be available in the lounge (room 532) at 8:30am and during breaks.

Wednesday, June 11

8:30am Refreshments room 532
Morning session 8:55am – 11:45am
8:55–9:35 Robert Strichartz, Cornell University
Two way conversations between fractal analysis and classical analysis
9:40–10:10 Jun Kigami, Kyoto University
Geometry of self-similar sets and time change of Brownian motion

Break

10:40–11:10 Martina Zaehle, University of Jena
(S)PDE on fractals Regularity of the solution
11:15–11:45 Takashi Kumagai, Kyoto University
Simple random walk on the two-dimensional uniform spanning tree and the scaling limits

Lunch

Afternoon Session 1:10pm – 5pm
1:10–1:55 Course 1: Robert Strichartz, Cornell University
Energy on [0; 1] and the Sierpinski Gasket
1:15 Elaborations: Jun Kigami Room 203
1:45 Elaborations: Martina Zaehle Room 203
2:00–2:45 Course 2: Benjamin Steinhurst, McDaniel College
Random Walks on the Sierpinski Gasket and Related Questions
2:15 Elaborations: Takashi Kumagai Room 203
2:50–3:20 Conrad Plaut, University of Tennessee
Discrete homotopies and the fundamental group

Break

3:50–4:10 Joe Chen, University of Connecticut
Asymptotics of cover times of random walks on fractal-like graphs
4:15–4:35 Baris Ugurcan, Cornell University
Extensions and their minimizations on the Sierpinski gasket
4:40–5:00 Daniel Kelleher, Purdue University
Intrinsic metrics and vector analysis for Dirichlet forms on fractals

Thursday, June 12

8:30 Refreshments room 532
Morning session 9am – 11:45am
9am–9:30 Christoph Bandt, University of Greifswald
A non-pcf fractal which makes analysis easy
9:35–10:05 Nageswari Shanmugalingam, University of Cincinnati
Geometry and 1-Poincare inequality vs. p-Poincare inequality

Break

10:40–11:10 Ka-Sing Lau, Chinese University of Hong Kong
Lipschitz equivalent of self-similar sets and hyperbolic graphs
11:15–11:45 Uta Freiberg, Universitat Stuttgart
Di_erential operators and generalized trigonometric functions on fractal subsets of the real line

Lunch

Afternoon Session 1:10pm – 5pm
1:10–1:55 Course 1: Robert Strichartz, Cornell University
Laplacian, normal derivatives, Gauss-Green Formula
1:15 Elaborations: Christoph Bandt Room 203
1:30 Elaborations: Ka-Sing Lau Room 207
1:45 Elaborations: Nageswari Shanmugalingam Room 203

2:00–2:45 Course 2: Daniel Kelleher, Purdue University
Resistance Estimates and Harnack Inequalities on Fractals
2:00 Elaborations: Uta Freiberg Room 207
2:15 Elaborations: Conrad Plaut Room 203
2:50–3:20 David Croydon, Warwick University
Modulus of continuity for local times of random walks on graphs

Break

3:50–4:10 Janna Lierl, Hausdor_ Center for Mathematics, Bonn
Boundary Harnack principle on fractals
4:15–4:35 Yehonatan Sella, UCLA
Di_erential equations on cubic Julia sets
4:40–5:00 Jun Jie Miao, Michigan State University
Generalised q dimension of self-a_ne set on Heisenberg group

6 pm Conference Dinner

Friday, June 13

8:30 Refreshments room 532
Morning session 9am – 11:45am
9am–9:30 Jiaxin Hu, Tsinghua University
Heat kernel and Harnack inequality
9:35–10:05 Michael Hinz, Universitat Bielefeld
Nakao's theorem and magnetic Laplacians on fractals

Break

10:40–11:10 Palle Jorgensen, University of Iowa
Harmonic analysis on fractals
11:15–11:45 Eva Curry, Acadia University
Martin and Poisson boundary and low-pass _lters

Lunch

Afternoon Session 1:10pm – 5pm
1:10–1:55 Course 1: Robert Strichartz, Cornell University
Spectral Decimation
1:15 Elaborations: Jiaxin Hu Room 203
1:30 Elaborations: Palle Jorgensen Room 207
1:45 Elaborations: Michael Hinz Room 203
2:00–2:45 Course 2: Daniel Kelleher, Purdue University
Resistance Estimates and Harnack Inequalities on Fractals
2:00 Elaborations: Eva Curry Room 207
2:15 Elaborations: David Croydon Room 203
2:50–3:20 Benjamin Steinhurst, McDaniel College

Generalized Witt vectors and Lipschitz functions between Cantor sets

Break

3:50–4:10 Patricia Alonso-Ruiz, University of Ulm
Existence of resitance forms in some (non self similar) fractal spaces
4:15–4:35 Gamal Mograby, Technical University of Berlin
Anderson localisation on the Sierpinski triangle
4:40–5:00 Nadia Ott, San Diego State University
Using Peano curves to contstruct Laplacians on fractals

Saturday, June 14

8:30am Refreshments room 532
Morning session 9am – 11:45am
9am–9:30 Eric Akkerman, Technion
Recent results on fractals in physics
9:35–10:05 Hans Martin Reuter, University of Mainz
Quantum gravity, asymptotic safety, and fractals

Break

10:40–11:10 Luke Rogers, University of Connecticut
Sobolev spaces that are not algebras
11:15–11:45 Alexander Teplyaev, University of Connecticut
Waves, energy on fractals and related questions

Lunch

Afternoon Session 1:10pm – 5pm
1:10–1:55 Course 1: Robert Strichartz, Cornell University
p.c.f Fractals
1:15 Elaborations: Eric Akkerman room 203
1:30 Elaborations: Luke Rogers Room 207
1:45 Elaborations: Hans Martin Reuter Room 203
2:00–2:45 Course 2: Luke Rogers, University of Connecticut
Elements of Di_erential Geometry on Fractals
2:00 Elaborations: Benjamin Steinhurst Room 207
2:15 Elaborations: Alexander Teplyaev Room 203

2:50–3:20 Huojun Ruan, Zhejiang University
The hot spots conjecture on p.c.f. self-similar sets

Break

3:50–4:10 Lizaveta Ihnatsyeva, Aalto University
Hardy inequalities in Triebel-Lizorkin spaces
4:15–4:35 Robert Giza, Cal Poly Pomona
Lattice approximation of attractors in the Hausdor_ metric
4:40–5:00 Sean Watson, University of California at Riverside
Fractal geometry and complex dimensions in metric measure spaces

Sunday, June 15

8:30am Refreshments room 532
Morning session 9am – 11:45am
9am–9:30 Sze-Man Ngai, Georgia Southern University
Eigenvalue estimates of Laplacians de_ned by fractal measures
9:35-10:05 Hua Qiu, Nanjing University
Exact spectrum of the Laplacian on a domain in the Sierpinski gasket

Break

10:40–11:10 Roberto Peirone, Universitat di Roma Tor Vergata
Uniqueness of eigenform on fractals
11:15–11:45 Marius Ionescu, Colgate University and University of Maryland
Some spectral properties of pseudo-di_erential operators on the Sierpinski Gasket

Lunch

Afternoon Session 1:10pm – 5pm
1:10-1:55 Course 1: Robert Strichartz, Cornell University
Blowups, Fractafolds and Products
1:15 Elaborations: Sze-Man Ngai room 203
1:30 Elaborations: Marius Ionescu Room 207
1:45 Elaborations: Hua Qiu Room 203
2:00–2:45 Course 2: Luke Rogers, University of Connecticut
Elements of Di_erential Geometry on Fractals

2:00 Elaborations: Huojun Ruan Room 207
2:15 Elaborations: Roberto Peirone Room 203
2:50–3:20 Sa'ar Hersonsky, University of Georgia
Uniformization of planar Jordan domains

Break

3:50–4:10 Thibaut Deheuvels, Ecole Normale Suprieure de Rennes
Trace and extension results for a class of rami_ed domains with fractal self-similar boundary
4:15–4:35 Philippe Charmoy, University of Oxford
Heat content asymptotics for some random Koch snowakes