

МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ



**ОДЕСЬКА ДЕРЖАВНА
АКАДЕМІЯ БУДІВНИЦТВА ТА
АРХІТЕКТУРИ**

Кафедра іноземних мов

НАВЧАЛЬНИЙ ПОСІБНИК

з навчальної дисципліни “Іноземна мова”
до практичних занять з англійської мови
для студентів Освітньо-професійної програми
“Геодезія та землеустрій”
за спеціальністю 193
“Геодезія та землеустрій”
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Даний навчальний посібник розроблений згідно до Освітньо-професійної програми “Геодезія та землеустрій” за спеціальністю 193 “Геодезія та землеустрій”, освітній рівень – перший (бакалаврський). Відбір матеріалу обумовлений як тематичною спрямованістю, так й інформаційною цінністю текстів. Лексико-граматичні вправи та тексти спрямовані на розвиток навиків перекладу, а також розмовних та письма у межах професійної тематики. За основу навчального матеріалу відібрані тексти з різних джерел, виданих англійською мовою.

ПЕРЕДМОВА

Навчальний посібник та навчальний матеріал призначені для аудиторної та самостійної роботи студентів I-II курсів Освітньо-професійної програми “Геодезія та землеустрій” за спеціальністю 193 “Геодезія та землеустрій”, освітній рівень – перший (бакалаврський).

Основна мета – опанування рівня знань, який забезпечуватиме необхідну для фахівця комунікативну спроможність в сфері професійного спілкування в усній та письмовій формах. Особлива увага приділяється розвитку навиків читання та перекладу текстів за спеціальністю для отримання інформації, а також розвитку розмовних навиків (монологічне та діалогічне мовлення) в межах професійної тематики. За основу учбового матеріалу були відібрані тексти з посібників та книг з геодезії, статті з інтернету, видані англійською мовою. Передумовами для вивчення матеріалу є набуття теоретичних та практичних навичок володіння англійською мовою за програмою середньої школи.

Лінгвістичний аналіз показує, що лексичний склад учбового матеріалу, як за своїм змістом, так и за структурою, відповідає сучасному змісту англійської мови. Повторюваність найбільш вживаних слів і термінів сприяє їх активному засвоєнню. Відбір текстового матеріалу обумовлений як тематичною спрямованістю, так й інформаційною цінністю текстів з урахуванням повторюваності термінологічної лексики. Тексти охоплюють питання професійної орієнтації.

Навчальний посібник розрахований на 180 академічних годин аудиторної та самостійної роботи студентів та складається з трьох частин: 1. 15 Units для аудиторної роботи. 2. Тексти для самостійної роботи. 3. Grammar Focus з поясненням граматичного матеріалу, вправами та тестів для контролю вивченого матеріалу.

Перша частина складається з 15 уроків, матеріал уроків розподіляється за семестрами наступним чином: I семестр (1-5 Units), II семестр (6-10 Units), III семестр (10-15 Units), текстів для самостійного читання та перекладу та окремого розділу з граматики (з тестами для перевірки вивченої граматики), а також списку неправильних дієслів. Кожен урок вивчається 6 академічних годин в аудиторії, а решту часу відведено на самостійну роботу. Структура кожного Unit:

1. Текст англійською мовою. 2. Список ключових слів та словосполучень до тексту з перекладом на українську мову. 3. Вправи та завдання. 4. Діалоги. До кожного тексту додається лексичний словник і вправи для закріплення вивченої лексики та активізації творчого потенціалу розмовної мови студентів. Кожний

урок передбачає переказ тексту та діалогів, що допомагає успішному засвоєнню лексичного мінімуму необхідного фахівцю для професійного спілкування. Студентам рекомендується скласти власний двомовний словник до кожного уроку, в якому слід виділяти вузькоспеціальну термінологію з спеціальності “Геодезія та землеустрій”.

Тексти призначені для вивчаючого читання та закріплення базових розділів лексики англійської підмови геодезія та землеустрій. До складу базових розділів лексики входять слова, що належать до загальнонавчаних, загальнонаукових та термінологічних розділів лексики. Для перекладу текстів потрібні загальні та термінологічні словники з геодезії та землеустрою.

Методичні принципи побудови даного навчального посібника визначилися конкретними завданнями згідно з його основною метою – розвиток навичок перекладу і розмовної мови у відповідності до вимог програми з англійської мови. Метою граматичних вправ є розпізнавання граматичних явищ, які мають бути засвоєні студентами. Діалоги надають можливість розвивати мовну компетенцію, яка необхідна майбутньому геодезисту для професійного спілкування.

Інформація, отримана з текстів та діалогів, може бути використана студентами в рефератах та доповідях, а також для розширення теоретичної підготовки за спеціальністю “Геодезія та землеустрій”.

Автори бажають вам успіхів!

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UNIT I.

Read and translate the following text.

ENGINEERING GEODESY

Geodetic surveying refers to the survey of the earth's surface. Also called geodesy, the branch of earth science makes allowance for the earth's curvature but gives an **accurate** framework for smaller-scale surveys.

Use of Geodetic surveying:

Engineering purposes: The engineers use Geodetic surveying for finding out the exact location of the concerned point or area. Latitudes and longitudes are needed for any engineering constructions.

Construction purposes: The builders use Geodetic surveying for finding out the **direction** of the buildings or their exact location.

Land surveying and assessment: The vertical elevation and the horizontal attributes, the latitude and longitude of the area surveyed are found out through geodetic surveying.

Geodetic surveying is thus considered as an important method of Surveying. Engineering Geodesy is a subdivision of geodesy that studies the methods of measuring and the instruments used during the surveying and construction of engineering structures.

Engineering geodesy is broken down into topographic-geodetic surveying, geodetic-engineering planning, marking out of areas, verification of structures, and observation of the deformations of structures.

What do Surveyors do?

Land surveyors work in the office and in the field – from suits to boots. Out in the field, they use the latest technology such as high order GPS, Robotic Total Stations (Theodolites), and aerial and terrestrial scanners to map an area, making computations and taking photos as evidence.



In the office, Surveyors then use sophisticated software, such as Auto-cad to draft plans and map the onsite measurements. Surveyors work on a **diverse** variety of projects from land subdivision and mining exploration, to tunnel building and major construction, which means no two days are the same. They are experts in determining land size and measurement. They also give advice and provide information to guide the work of engineers, architects and developers.

Preliminary surveys of the routes of linear structures are made using topographical maps and materials from aerial photography. The final survey is done by laying the route out in the field. **Optimal** alternatives for routes and sites are chosen by means of computers, using numerical models of the terrain. Geodetic engineering planning consists of preparing the topographical base for the project (plans, profiles), analytic data, vertical **layout** of the sites, analytic preparation for the project, and so on.

To transfer the project layout to the terrain a layout network of geodetic control points is set up in the form of tunnel, hydro-engineering, or bridge triangulation, in the form of a construction grid (at industrial sites), traverse grids (in cities), or **precise** trilateration (for high-rise and unique structures). Using the layout network, one transfers the principal axes of the structures to the physical site and all the construction axes and transverse lines are marked off in detail.

A check survey is made on completed structures. The height of structural elements is controlled using geometric and hydrostatic leveling or micro-leveling. When observing the deformation of structures, one determines sag and planar displacement of fixed points (marks). Sag is measured by high-precision leveling that is done periodically according to a strictly established program. Electronic hydrostatic systems with automatic recording of readings are also used. During this work special attention is paid to the stability of the planar and elevation geodetic base.

So why become a Surveyor?

Surveying provides a great diversity of indoor and outdoor work, meaning you won't be chained to a desk.

There is job variety; you can choose to work in many different industries from IT to Archaeology.

The high demand for Surveyors means it's easy to get a job, 95 % of students find work within 4 months after graduating.

The salaries are excellent.

Surveyors have access to the latest technology and equipment.

Surveyors can work for themselves, in private firms or in government departments.

VOCABULARY NOTES:

earth's curvature – кривизна землі

to find out – знайти

exact location – точне місце розташування

latitude – широта

longitude – довгота

verification of structures – перевірка конструкцій

sophisticated software – складне програмне забезпечення

to draft plans – складати плани

onsite – на місці

to guide – керувати

to lay the route out in the field – прокладати маршрут у полі

traverse grid – поперечна сітка

precise trilateration – точна трилатерація

a layout network – макет мережі

a check survey – контрольне опитування

a diversity – різноманітність

a government department – державний департамент

Exercise I. Answer the following questions.

1. What is Geodetic surveying?
2. Name purposes of geodetic surveying.
3. Give a definition of Engineering Geodesy.
4. What are subdivisions of Engineering Geodesy?
5. Where do Land surveyors work?

6. What does Geodetic-engineering planning consist of?
7. How are preliminary surveys made?
8. What methods are used for plan verifying?
9. What are the main advantages of becoming a Surveyor?

Exercise II. Translate the following words and phrases into English using the vocabulary of the text.

Викривлення земної поверхні, точна система розташування, широта і довгота, способи вимірювання, наземний вимірювальний прилад, сучасне програмне забезпечення, розробка родовища, попередні пошуки, аналітичні дані, вертикальна розмітка, точні радіо геодезичні виміри, візування ухилів, просторові спотворення.

Exercise III. Choose the contextual meanings of the words written in bold in the Text 1.

Accurate

- | | |
|---------------|-----------|
| a) правильний | c) певний |
| b) влучний | d) точний |

2. Direction

- | | |
|---------------|----------------|
| a) напрямок | c) керівництво |
| a) управління | c) сторона |

3. Diverse

- | | |
|--------------|-------------|
| a) відмінний | c) несхожий |
| b) інший | d) різний |

4. Optimal

- | | |
|------------------|------------------|
| a) екстремальний | c) найкращий |
| b) сприятливий | d) найвигідніший |

5. Layout

- | | |
|-------------|---------------|
| a) розмітка | c) формат |
| a) розробка | d) обладнання |

6. Precise

- | | |
|--------------|-----------|
| a) певний | c) ясний |
| b) акуратний | d) точний |

Exercise IV. Match the words similar in meaning.

- | | | | |
|--------------|--------------|---------------|-------------|
| 1) accurate | 6) method | a) aim | f) bending |
| 2) curvature | 7) variety | b) instrument | g) position |
| 3) location | 8) expert | c) technique | h) part |
| 4) purpose | 9) equipment | d) specialist | i) observe |

5) measure

10) detail

e) precise

j) diversity

Exercise V. Fill in the table with the derivatives.

NOUN	VERB	ADJECTIVE
1)	to transfer	
2) construction		
3)		optimal
4)	to measure	
5) determination		
6)		building
7)	to analyze	
8) surveyor		
9)		automatic
10)	to stabilize	

Exercise VI. Fill in the correct prepositions and translate the phrases.

1) to refer ...; 2) the direction ... the buildings; 3) to find out ... geodetic surveying; 4) to need ... engineering constructions; 5) to work ... a diverse variety ... projects; 6) to lay the route ... the field; 7) ... the form ... tunnel; 8) base ... the project; 9) to measure ... high-precision leveling; 10) according ... an established program.

Exercise VII. Translate into English.

Інженерні дослідження є одним з найважливіших видів будівельної діяльності, з них починається будь-який процес будівництва та експлуатації об'єктів. Комплексний підхід, що поєднує різні види інженерних досліджень, дозволяє проводити різнобічне та своєчасне обстеження будівельних майданчиків, будівель та споруд.

Exercise VIII. Translate the following sentences paying attention to the functions of the verb "to be".

1. Latitudes and longitudes are needed for any engineering constructions.
2. Engineering Geodesy is a subdivision of geodesy that studies the methods of measuring and the instruments used during the surveying and construction of engineering structures.
3. Surveyors are experts in determining land size and measurement.

4. Geodetic substantiation is constructed in the form of triangulation, traverse, and leveling grids.
5. It is reasonable to measure spatial deformations by the ground stereo-photogrammetric survey method.
6. During this work special attention is paid to the stability of the planar and elevation geodetic base.
7. Surveying provides a great diversity of indoor and outdoor work, meaning you won't be chained to a desk.
8. The high demand for Surveyors means it's easy to get a job.

Exercise IX. Make all types of questions to the sentence below in written form.

Surveyors can work for themselves, in private firms or in government departments.

Exercise X. Practice reading the dialogues with the partner. Learn the dialogues by heart. Act out the dialogues.

I

A: – *What does the process of making the engineering geodesy project documentation include?*

B: – It includes finding the best solution for building a certain object which is optimized from several aspects (social, financial, ecological...).

A: – *What should you pay attention to?*

B: – In order to correctly view all the characteristics of an object, (building, road, tunnel, bridge, damn...), it is necessary to pay special attention to the creation of the surveying map.

A: – *Where is it made?*

B: – The surveying map is most commonly made in the national coordinate system and contains a great number of various geospatial data.

A: – *What is important in contemporary geodesy?*

B: – Nowadays, a big accent is being put on modern/ digital technology of data gathering and their processing, whose presentational maximum is possible only digitally. In spite

of that, analog surveying map and the classic way of interpretation are still a mandatory part of project and other documentation in civil engineering.

II

A: – *What does engineering geodesy represent?*

B: – It represents a specific field within geodesy that has wide applications in all engineering disciplines, such as civil engineering, architecture, urban planning, machine engineering, shipbuilding, mining, energetics, agriculture, forestry and telecommunications.

A: – *What does it relate to?*

B: – It relates to designing and realization of survey control networks of engineering facilities, production of geodetic survey maps for designing purposes, monitoring surveys of various structures during construction and operation, survey marking projects, etc.

A: – *Does it use geodetic survey maps?*

B: – Yes, of course it does.

A: – *What do you mean by them?*

B: – Under geodetic survey maps, we imply: topographic/layout plans, orthophotos, digital models of the terrain, digital maps with required contents, a Cadaster plan and so on.

Exercise XI. Retell the following text according to the plan below.

1. What geodetic surveying is and where it is used.
2. The definition of Engineering Geodesy.
3. What Surveyors do.
4. The stages of surveying.
5. Advantages of being a surveyor.

UNIT 2

Read and translate the text

THE HISTORY OF LAND SURVEYING

The history of land surveying is very interesting and diverse and it is in fact one of the oldest professions in the world.

Land surveying is the process by which land is surveyed and measured using mathematical means.

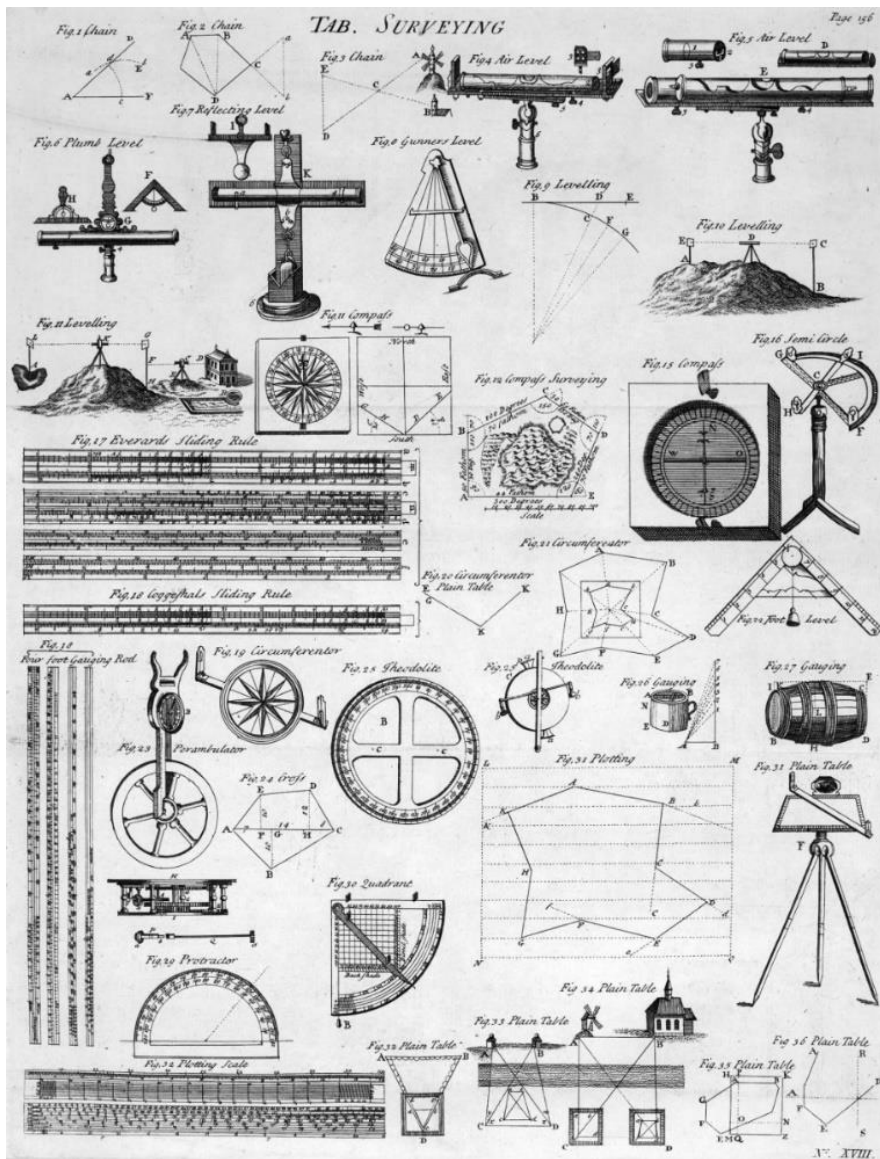
The history of land surveying dates back thousands of years and forms of land surveying have been around since ancient man in all major civilizations across the globe.

Ownership of land has and still is a very significant part of the lives of everyone in the world. Whether it was finding out which tribe owned which forest or the boundaries of major cities, the history of land surveying is incredibly interesting.

The first examples in the history of land surveying date back to the ancient Egyptians during the building of the Great Pyramid at Giza in 2700 BC. There is evidence of the Egyptians using basic geometry to redraw boundary lines when the Nile overflowed its banks.

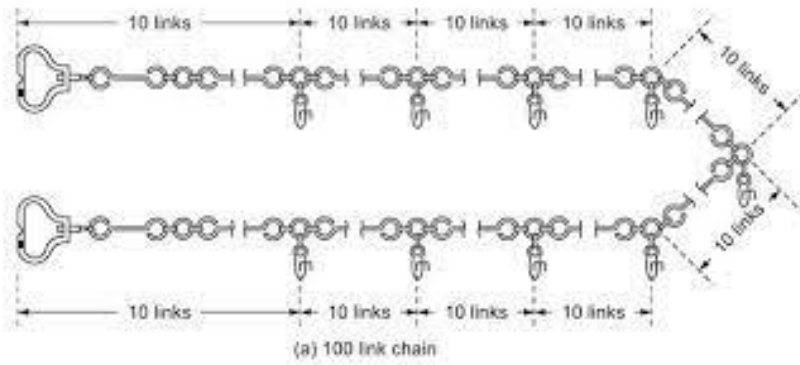
The Romans were the next civilization to advance on the initial land surveying techniques of the Egyptians. Historical evidence shows that the Roman Empire was the first civilization **to employ** an official land surveyor within their Empire. They used simple tools to create straight lines and angles. The land surveyors had a range of jobs in the Empire and some of their work is still evident today.

The Domesday Book, created by William the Conqueror in 1086 in England is another early example of the history of land surveying. The **amount** of information about the land was very impressive for the time, however the quality of land surveying was very poor and accuracy was lacking.



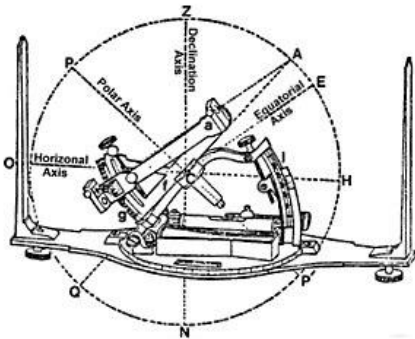
Possibly one of the best known characters in land surveying history was Napoleon Bonaparte – who was very **enthusiastic** about accurate land surveying. He always ensured that he had very precise maps, which were obviously very important when he was trying to conquer the world. He had maps produced that were drawn down to scale both at 1:2500 and 1:1250. The cadastres he had, were used widely and spread quickly, however problems were encountered in built-up areas where things changed quite rapidly.

As new technology and theories have become available, the techniques and methods used in land surveying have evolved.



Hundreds of years ago land surveyors would use all sorts of means for measuring distances – such as using **chains** with links that have a certain known length for example.

Additionally, land surveyors have to measure horizontal angles which in most cases was done using some form of compass. The quality and accuracy of compasses have increased as time has gone by.



In the past land surveying results were a lot less accurate – not due to the inabilities of the land surveyors themselves – but due to the inaccuracy of the tools that they had access to. These days, land surveyors have access to much more accurate tools such as GPS (global positioning systems).

As time has gone by, land surveying tools and **techniques** have advanced and the role of land surveyors is much broader than it was in the past.

Although the fundamentals of land surveying haven't changed, and the purpose is still the same – the techniques and methods have evolved drastically since the beginning of the history of land surveying.

One of the key changes in land surveying is the accuracy of the tools that are available to land surveyors. While in the past (up until the early 1900's) most land

surveyors had access to little more than a level, tape measure and a theodolite – modern land surveyors have access to some of the most **advanced** tools in the world.

Total Stations are very commonly used in modern land surveying. These include an EDM (electronic distance measurement device) which allows for more precise land surveying.

VOCABULARY NOTES:

land surveying – наземна зйомка

diverse – різноманітний

major civilizations – великі цивілізації

historical evidence – історичні свідчення

boundary lines – межові лінії

significant part – значна частина

to advance – просувати

the Domesday Book – Книга судного дня

to ensure – забезпечити

straight lines and angles – прямі лінії і кути

chains with links – ланцюги з ланками

to encounter – мати справу з..., зустріти

built-up areas – забудовані території

to evolve – розвиватися

advanced technique – передова техніка

global positioning systems – системи глобального позиціонування

the accuracy of the tools – точність інструментів

Exercise I. Answer the following questions.

1. What is land surveying?
2. How old is the history of land surveying?
3. Who was land surveying initially used by?
4. Who were the first to employ an official land surveyor?
5. What is the Domesday Book?
6. Why were precise maps important for Napoleon Bonaparte?
7. How were distances measured hundreds of years ago?
8. What purpose were compasses used for?
9. Why were land surveying results a lot less accurate in the past?
10. Have the fundamentals and the purposes of land surveying changed a lot?

11. What are the key changes?

12. What are the tools land surveyors used in the past and use today?

Exercise II. Match the words from the two columns to make phrases.

land	areas
international	part
significant	work
boundary	lines
surveying	surveying
built-up	device
horizontal	techniques
measurement	angles

Exercise III. Mark the following sentences True or False.

1. Land surveying is exciting and varied as it is one of the latest professions in the world.
2. Land possession is a vital part of everyone's life.
3. The Egyptians redrew boundary lines when the Nile overflowed its banks.
4. In order to create straight lines the Romans used sophisticated tools.
5. The amount of information about the land was poor, however the quality of land surveying was at the high level.
6. Napoleon Bonaparte was very passionate about precise land surveying.
7. There were no problems with cadasters which spread widely and quickly.
8. Surveying results were a lot less accurate in the past due to the inabilities of land surveyors.
9. Nowadays a surveyor's range of jobs is much broader than it was in the past.
10. The fundamentals as well as the purposes of land surveying have changed a lot.

Exercise IV. Match the words with their definitions.

- | | |
|--------------|---|
| 1. Boundary | a) the condition or quality of being true, correct or exact; freedom from error or defect. |
| 2. Built-up | b) a precision instrument having a telescopic sight for establishing horizontal or sometimes vertical angles. |
| 3. Inability | c) something that indicates limits; a limiting line. |
| 4. Accuracy | d) a global system of U.S. navigational satellites developed to provide precise positional and velocity data and global time synchronization for air, sea, and land travel. |

- | | |
|-----------------|--|
| 5. To advance | e) lack of power, capacity, or means. |
| 6. Theodolite | f) an official register of the ownership, extent, and value of real property in a given area, used as a basis of taxation. |
| 7. GPS | g) to improve or make progress. |
| 8. To ensure | h) (of an area) filled in with houses, as an urban region. |
| 9. Cadaster | i) having or expressing a meaning; indicative; suggestive. |
| 10. Significant | j) to make sure or certain. |

Exercise V. Choose the contextual meanings of the words written in bold.

1. Employ

- | | |
|--------------------|----------------------|
| a) використовувати | c) звернути |
| b) наймати | d) загрузати роботою |

2. Range

- | | |
|-------------|------------------------|
| a) ряд | c) гамма |
| b) діапазон | d) ланцюг (гір і т.п.) |

3. Amount

- | | |
|----------|---------------|
| a) об'єм | c) ступінь |
| b) доза | d) коефіцієнт |

4. Enthusiastic

- | | |
|----------------|---------------|
| a) мотивований | c) старанний |
| b) ревний | d) захоплений |

5. Chain

- | | |
|--------------------|------------|
| a) гірський хребет | c) низка |
| b) мірний ланцюг | d) конвеєр |

6. Technique

- | | |
|--------------------------|-----------------|
| a) технічна майстерність | c) метод |
| b) послідовність | d) формулювання |

7. Advanced

- | | |
|---------------------|------------------|
| a) сучасний | c) складний |
| b) висунутий вперед | d) перспективний |

Exercise VI. Match the words similar in meaning.

- | | |
|--------------|-----------------|
| 1) to employ | a) extension |
| 2) due to | b) easy |
| 3) to evolve | c) unbelievably |
| 4) widely | d) varied |

- | | |
|----------------|---------------|
| 5) accurate | e) to hire |
| 6) technique | f) possess |
| 7) quickly | g) major |
| 8) length | h) admission |
| 9) simple | i) owing to |
| 10) poor | j) rapidly |
| 11) incredibly | k) broadly |
| 12) boundary | l) limit |
| 13) diverse | m) scarce |
| 14) own | n) precise |
| 15) main | o) method |
| 16) access | p) to develop |

Exercise VII. Match the words opposite the meaning.

- | | |
|-----------------|------------------|
| 1) ancient | a) to decrease |
| 2) more | b) to destroy |
| 3) simple | c) meaningless |
| 4) to increase | d) to part |
| 5) rapidly | e) vague |
| 6) to create | f) narrow |
| 7) to encounter | g) inability |
| 8) significant | h) final |
| 9) accurate | i) less |
| 10) evolving | j) uniform |
| 11) broad | k) abundant |
| 12) initial | l) stagnant |
| 13) ability | m) modern |
| 14) lacking | n) slowly |
| 15) diverse | o) sophisticated |

Exercise VIII. Fill in the prepositions then choose any three items and make sentences.

1) A range ... jobs; 2) to be enthusiastic ... accurate land surveying; 3) maps drawn ... to scale ... 1:2500; 4) problems encountered ... built-up areas; 5) hundreds ... years ago; 6) means ... measuring distances; 7) to have access ... accurate tools; 8) the quality ... compasses; 9) ... most cases; 10) due ... the inability; 11) to allow ... more precise land surveying; 12) to advance ... the initial land surveying.

Exercise IX. Translate the sentences from Ukrainian into English.

1. Як відомо, геодезія виникла в давні часи як прикладна інженерна наука. З її допомогою збудовані унікальні стародавні споруди: піраміди, храми, маяки, висота яких сягала 150-200м. Ці споруди свідчать про досить високий рівень геодезичних робіт.
2. Геодезист – професія людей, які вмиють приймати рішення та нести відповідальність за виконану ними роботу. Будь-яке неуважне ставлення до виконуваної роботи спричиняє помилки, які можуть вимагати значних витрат часу та коштів на їх усунення.
3. Наразі геодезичні дослідження найбільш затребувані у сфері будівництва, а також для визначення точних 20 координат та розмірів земельних ділянок під час проведення кадастрових заходів.

Exercise X. Translate the following sentences paying attention to the functions of the verb “to have”.

1. The land surveyors had a range of jobs in the Empire and some of their work is still evident today.
2. He always ensured that he had very precise maps.
3. The cadasters he had were used widely and spread quickly.
4. As new technology and theories have become available, the techniques and methods used in land surveying have evolved.
5. Chains with links that have a certain known length were used hundreds of years ago.
6. Additionally land surveyors have to measure horizontal angles.
7. The quality and accuracy of compasses have increased.
8. These days land surveyors have access to much more accurate tools.
9. Land surveying tools and techniques have advanced.
10. The fundamentals of land surveying haven't changed though the techniques and methods have evolved drastically.

Exercise XI. Put all types of questions to the sentences below.

1. The history of land surveying dates back thousands of years.
2. They used simple tools to create straight lines and angles.

Exercise XII. Practice reading the dialogues with the partner. Learn the dialogues by heart. Act out the dialogues.

I

Student: What is land surveying?

Professor: Land surveying is an ancient practice that dates back at least to 1,400 B.C., when the ancient Egyptians used land surveying for the taxation of land plots.

Student: What did they use it for?

Professor: Four thousand years ago, Egyptians used measuring ropes, plumb bobs, and other instruments to gauge the dimensions of plots of land.

Student: Oh, I didn't know that. What were they called?

Professor: The name for Egyptian surveyors was "harpedonaptae," which means "rope stretchers" through translation.

Student: How exactly did they use ropes?

Professor: They used ropes for accurate measurements: the Egyptians would stretch a piece of rope between two stakes and rub it down with resin and beeswax, treating it so it would hold its length.

Student: What did the surveyors do?

Professor: The surveyors then used the treated rope to measure distances, sometimes tying it in knots at intervals that marked significant places.

Student: OK, thank you.

II

A: – *What do you know about Land Surveying in Mesopotamia?*

B: – An early surveying instrument that came after the Egyptian's rope method is the Groma. The Romans and Greeks used the Groma in land surveying as early as 400 B.C. This surveying instrument came from Mesopotamia.

A: – *Who was this tool used by?*

B: – This tool was used by the Romans,

A: – *Did it help establish land surveying as a profession?*

B: – Yes, it did. The Groma established basic terms of measurements the Romans used to divide the Roman Empire for taxation.

A: – *Was land surveying a serious profession at those times?*

B: – Yes, definitely. The Romans regarded land surveying as a true, even noble profession.

They even referred to Terminus as the god who protected boundaries.

Exercise XIII. Retell the following text according to the plan below.

1. About Land Surveying History: Egypt; Rome; Bonaparte.

2. Historical Land Surveying Techniques.
3. Modern Land Surveying.

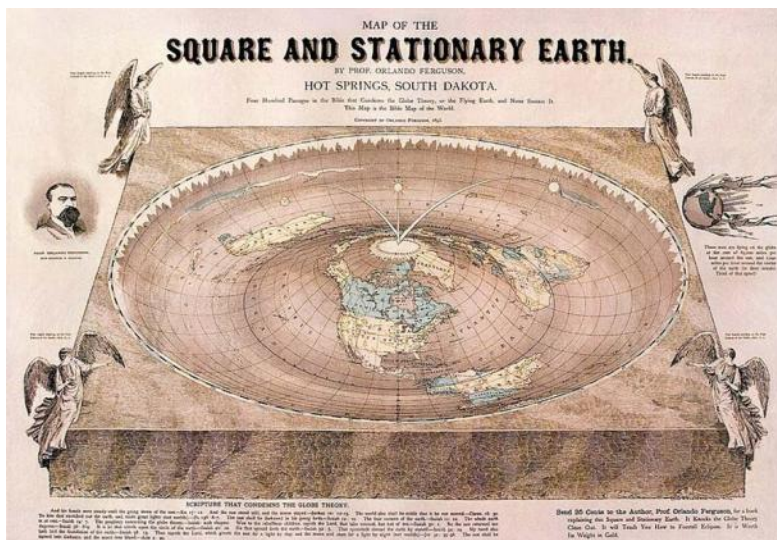
UNIT 3

Read and translate the text.

HISTORY OF GEODESY

Man has been concerned about the earth on which he lives for many centuries. During very early times this concern was limited, naturally, to the immediate vicinity of his home; later it expanded to the distance of markets or exchange places; and finally, with the development of means of transportation man became interested in his whole world. Much of this early "world interest" was evidenced by speculation concerning the size, shape, and composition of the earth.

The early Greeks, in their speculation and theorizing, ranged from the flat disc advocated by Homer to Pythagoras' spherical figure—an idea supported one hundred years later by Aristotle. Pythagoras was a mathematician and to him the most perfect figure was a sphere. He reasoned that the gods would create a perfect figure and therefore the earth was created to be spherical in shape. Anaximenes, an early Greek scientist, believed strongly that the earth was rectangular in shape.



Since the spherical shape was the most widely supported during the Greek Era, efforts to determine its size followed. Plato determined the circumference of the earth to be 40,000 miles while Archimedes estimated 30,000 miles. Plato's figure was a guess

and Archimedes' a more conservative approximation. Meanwhile, in Egypt, a Greek scholar and philosopher, Eratosthenes, set out to make more explicit measurements. He had observed that on the day of the summer solstice, the midday sun shone to the bottom of a well in the town of Syene (Aswan). At the same time, he observed the sun was not directly overhead at Alexandria; instead, it cast a shadow with the vertical equal to 1/50th of a circle ($7^{\circ} 12'$). The actual unit of measure used by Eratosthenes was called the "stadia." No one knows for sure what the stadia that he used is in today's units. The measurements given above in miles were derived using one stadia equal to one-tenth statute mile. It is remarkable that such accuracy was obtained in view of the fact that most of the "known" facts and his observations were incorrect.

Another ancient measurement of the size of the earth was made by the Greek, Posidonius. He noted that a certain star was hidden from view in most parts of Greece but that it just grazed the horizon at Rhodes. Posidonius measured the elevation of the same star at Alexandria and determined that the angle was 1/48th of circle. Assuming the distance from Alexandria to Rhodes to be 500 miles, he computed the circumference of the earth as 24,000 miles. While both his measurements were approximations when combined, one error compensated for another and he achieved a fairly accurate result.

Revising the figures of Posidonius, another Greek philosopher determined 18,000 miles as the earth's circumference. This last figure was promulgated by Ptolemy through his world maps. The maps of Ptolemy strongly influenced the cartographers of the middle ages. It is probable that Columbus, using such maps, was led to believe that Asia was only 3 or 4 thousand miles west of Europe. It was not until the 15th century that his concept of the earth's size was revised. During that period the Flemish cartographer, Mercator, made successive reductions in the size of 9 the Mediterranean Sea and all of Europe which had the effect of increasing the size of the earth.

The telescope, logarithmic tables, and the method of triangulation were contributed to the science of geodesy during the 17th century. In the course of the century, the Frenchman, Picard, performed an arc measurement that is modern in some respects. He measured a base line by the aid of wooden rods, used a telescope in his angle measurements, and computed with logarithms. Cassini later continued Picard's arc northward to Dunkirk and southward to the Spanish boundary. Cassini divided the measured arc into two parts, one northward from Paris, another southward. When he computed the length of a degree from both chains, he found that the length of one degree in the northern part of the chain was shorter than that in the southern part. This unexpected result could have been caused only by an egg-shaped earth or by observational errors.

The results started an intense controversy between French and English scientists. The English claimed that the earth must be flattened, as Newton and Huygens had shown theoretically, while the Frenchmen defended their own measurement and were inclined to keep the earth egg-shaped.

To settle the controversy, once and for all, the French Academy of Sciences sent a geodetic expedition to Peru in 1735 to measure the length of a meridian degree close to the Equator and another to Lapland to make a similar measurement near the Arctic Circle. The measurements conclusively proved the earth to be flattened, as Newton had forecast. Since all the computations involved in a geodetic survey are accomplished in terms of a mathematical surface (reference ellipsoid) resembling the shape of the earth, the findings were very important.

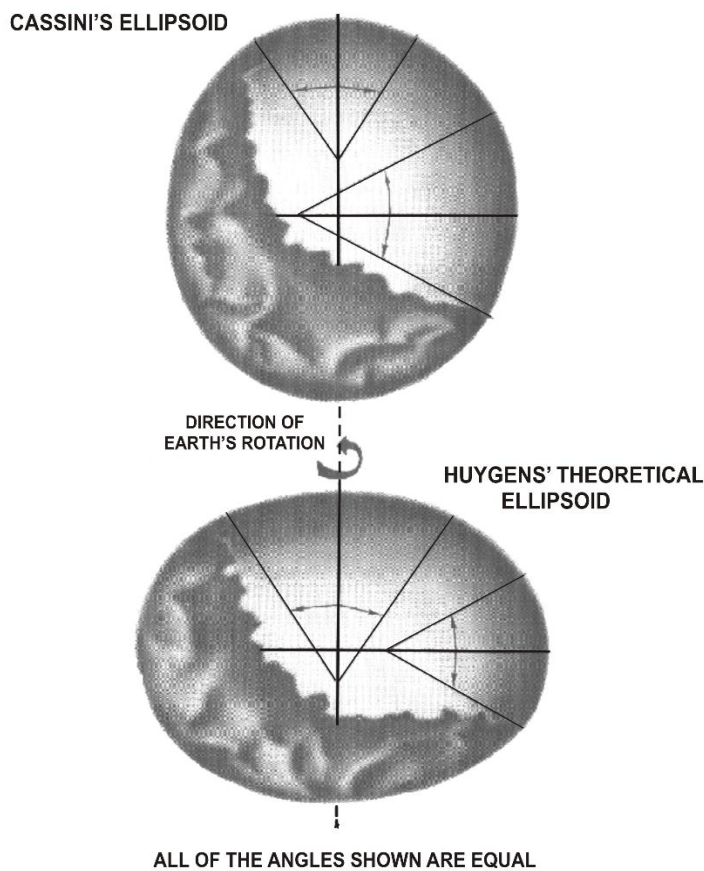


Figure 2

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http://www.ngs.noaa.gov/PUBS_LIB/Geodesy4Layman/TR80003A.HTM#ZZ4

VOCABULARY NOTES:

to concern about – хвилюватися
immediate vicinity – у безпосередній близькості
to expand – розширювати
to evidence – докази
to determine – визначити
to contribute to – сприяти
conservative approximation – консервативне наближення
explicit measurements – явні вимірювання
to derive – виводити
angle of the circle – кут кола
the earth's circumference – окружність землі
unexpected result – несподівані результати
observational errors – помилки спостереження
intense controversy – гостра полеміка
to forecast – передбачати, прогнозувати
to accomplish in terms – виконати в умовах
to resemble – нагадувати

Exercise I. Answer the following questions.

1. What has interested man about the earth for many centuries?
2. What did Pythagoras and Anaximenes consider the earth to be in shape?
3. What measurements did Eratosthenes make and what did he observe?
4. What unit of measurements did Eratosthenes use in his calculations?
5. Whose maps influenced the cartographers of the middle ages?
6. What measurements did Picard and his followers perform?
7. What controversy was between French and English scientists?

- | | |
|-----------------|---------------|
| 2. method | b. combine |
| 3. backing | c. limit |
| 4. consequently | d. compute |
| 5. value | e. means |
| 6. outstanding | f. accuracy |
| 7. precision | g. therefore |
| 8. unite | h. reduction |
| 9. calculate | i. support |
| 10. lessening | j. remarkable |

Exercise V. Match words opposite in meaning.

- | | |
|---------------|---------------|
| 1. correct | a. similar |
| 2. separate | b. increase |
| 3. imprecise | c. unexpected |
| 4. decrease | d. incorrect |
| 5. outdated | e. create |
| 6. expected | f. combine |
| 7. sharpen | g. modern |
| 8. different | h. perfect |
| 9. destroy | i. accurate |
| 10. imperfect | j. flatten |

Exercise VI. Match two halves of the statements and translate them into Ukrainian.

- | | |
|------------------|-------------------------------|
| 1. development | a. error |
| 2. spherical | b. controversy |
| 3. conservative | c. table |
| 4. to measure | d. of means of transportation |
| 5. logarithmic | e. solstice |
| 6. to perform | f. shape |
| 7. observational | g. an arc measurement |
| 8. summer | h. the elevation of the star |
| 9. the bottom | i. of a well |
| 10. intense | j. approximation |

Exercise VII. Complete the text with one word.

French Academy of Sciences

The Academy of Sciences owes its origin to Colbert's plan to create a general academy. He chose a small ... of scholars who met on 22 December 1666 in the King's library, and thereafter held twice-weekly working ... there. The first 30 years of the Academy's existence ... relatively informal, since no statutes had as yet been laid down for the institution.

On 20 January 1699, Louis XIV gave the Company ... first rules. The Academy received the name of Royal Academy of Sciences and ... installed in the Louvre in Paris. In 1816, the Royal Academy of Sciences became autonomous, while forming part of ... Institute of France; the head of State became its patron.

For three centuries women were ... allowed as members of the Academy, excluding two-time ... Prize winner Marie Curie, Nobel winner Irène Joliot-Curie, mathematician Sophie Germain, and many other deserving female scientists.

Today the Academy is one of five ... comprising the Institut de France. Its members are elected ... life. Currently there are 150 full members, 300 corresponding ..., and 120 foreign associates. They are divided into two scientific groups: the Mathematical and Physical ... and their applications and the Chemical, Biological, Geological and Medical sciences and their applications.

(http://www.absoluteastronomy.com/topics/French_Academy_of_Sciences)

Exercise VIII. Practice reading the dialogues with the partner. Learn the dialogues by heart. Act out the dialogues.

A: What is Geodesy?

B: Geodesy is a field of study that deals with the measurement and representation of the Earth.

A: When did it start?

B: It started when a clever human named Eratosthenes discovered that you could measure the circumference of the Earth by looking down a well.

A: Can we call him the 'father of geodesy and geography'?

B: Yes, we can. Eratosthenes, the ancient Greek scholar, is called the 'father of geography.

A: Why? What did he do?

B: He was the first one to use the word geography and he also had a small-scale notion of the planet that helped him to determine the circumference of the earth.

A: So can we say that he was multi-talented?

B: Yes, he was. You can read a lot about him on the Internet.

UNIT 4

Read and translate the text.

THE FIVE MAIN AREAS OF THE SURVEYOR'S WORK

Surveying has traditionally been defined as the science and art of determining relative positions of points above, on, or beneath the surface of the earth, or establishing such points. In a more general sense, however, surveying can be regarded as that discipline which encompasses all methods of gathering and processing information about the physical earth and environment. Conventional ground systems are now supplemented by aerial and satellite surveying methods, which evolved through the defense and space programs.

In general, the work of a surveyor can be divided into five parts:

1. Research analysis and decision making. Selecting the survey method, equipment, most likely corner locations, and so on.

2. Field work or data acquisition. Making measurements and recording data in the field.

3. Computing or data processing. Performing calculations based on the recorded data to determine locations, areas, volumes, and so on.

4. Mapping or data representation. Plotting measurements or computed values to produce a map, plat, or chart, or portraying the data in numerical or computer format.

5. Stakeout. Setting monuments and stakes to delineate boundaries or guide construction operations. Surveying is one of the oldest and most important arts practiced by man because from the earliest times it has been necessary to mark boundaries and divide land. Surveying has now become indispensable to our modern way of life.

Surveying continues to play an extremely important role in many branches of engineering. For example, surveys are required to plan, construct, and maintain highways, railroads, buildings, bridges, tunnels, canals, land subdivisions, sewerage systems, pipelines, etc. All engineers must know the limits of accuracy possible in construction.

VOCABULARY NOTES:

to define – визначати

to regard – розглядати

beneath the surface of the earth – під поверхнею землі
a conventional ground system – звичайна наземна система
to supplement – доповнювати
data acquisition – збір даних
plotting measurements – побудова вимірювань
to delineate boundaries – окреслювати межі
plat – невелика ділянка землі
chart – діаграма
indispensable – незамінний
a sewerage system – каналізаційна система
a pipeline – трубопровід

Exercise I. Answer the following questions and give examples.

1. What is a traditional definition of surveying?
2. What is Surveying in a more general sense?
3. What are conventional systems supplemented by?
4. How many main parts are there in surveyor's work?
5. Surveying is one of the modern arts practiced by man, isn't it?
6. Does surveying play an important part in engineering?
7. What spheres surveying is needed in?

Exercise II. Match the terms with their definitions.

a) surveying	d) equipment	g) calculations
b) surface	e) acquisition	h) representation
c) satellite	f) measurements	i) accuracy

- 1) a set of tools, devices, kit, etc., assembled for a specific purpose;
- 2) an amount, extent, or size determined by measuring;
- 3) the study or practice of measuring altitudes, angles, and distances on the land surface so that they can be accurately plotted on a map;
- 4) the act, process, or result of calculating;
- 5) a man-made device orbiting around the earth, moon, or another planet transmitting to earth scientific information or used for communication;
- 6) faithful measurement or representation of the truth; correctness; precision;
- 7) the act or an instance of representing or the state of being represented;

- 8) the process of locating a spacecraft, satellite, etc., esp. by radar, in order to gather tracking and telemetric information
- 9) the uppermost level of the land or sea.

Exercise III. Choose the right word.

1. Today, technology like satellites and global positioning systems (GPS) allow geodesists and other scientists to make extremely approximate/accurate measurements.
2. Uncommon/conventional measuring instruments with a telescope can neither be operated nor retrofitted with this device.
3. Maps based on observations and measurements were an indispensable/needless aid for journeys and voyages, and were thus highly valued.

Exercise IV. Combine the words from the column on the left with the suitable nouns from the column on the right. Translate them into Ukrainian.

- | | |
|-----------------|----------------|
| 1) relative | a) methods |
| 2) general | b) processing |
| 3) physical | c) sense |
| 4) surveying | d) program |
| 5) space | e) operation |
| 6) research | f) positions |
| 7) data | g) analysis |
| 8) construction | h) environment |

Exercise V. Match the English and Ukranian equivalents.

- | | |
|---------------------------|------------------------|
| 1) relative positions | a) встановлення точок |
| 2) establishing points | b) розміщення кутів |
| 3) processing information | c) збір даних |
| 4) research analysis | d) польові роботи |
| 5) corner locations | e) замір ділянки землі |
| 6) field work | f) обробка зведених |
| 7) data acquisition | g) аналіз пошуків |
| 8) plotting measurements | h) відносне положення |

Exercise VI. Fill in the table with appropriate derivatives if possible.

NOUN	VERB	ADJECTIVE
------	------	-----------

	to define	
information		
decision		
	to measure	
		indispensable
accuracy		

Exercise VII. Translate into English in written form.

1. Геодезичні дослідження – це комплекс робіт з дослідженню місцевості, який включає наступні заходи:

1. Збір, аналіз та обробка матеріалів досліджень минулих років. Тут обробляються дані аерофотографічних, картографічних, топографічних та топографо—геодезичних зйомок.

2. Візуальні спостереження за територією. На цьому етапі досліджень майданчик будівництва оцінюється з точки зору прилеглих будов та можливості вписати об'єкт проектування в існуючу інфраструктуру. Виявляються складні геологічні умови (яри, річки, зсуви).

3. Створення комплексу планово-висотної та опорної геодезичних мереж.

4. Проведення наземної топографічної зйомки. Якщо виникає необхідність, то можливе проведення аеро- та стереофотографічних зйомок об'єктів або акваторії.

5. Перенесення проекту в натуру з подальшою прив'язкою об'єкта на місцевості.

6. Камеральна обробка матеріалів досліджень та складання технічного звіту з геодезичних розвідок.

7. Зовнішні обміри будівель та координування їх елементів у період підготовки їх до ліквідації. Всі дослідження в галузі геодезичних досліджень необхідно проводити у суворій відповідності до нормативних документів, враховуючи прив'язку об'єктів до пунктів існуючої геодезичної мережі. По проведенню робіт є можливість дати комплексну оцінку майданчика забудови, виконати схему мереж території та обґрунтувати економічну доцільність будівництва конкретного об'єкта на конкретній ділянці.

Exercise VIII. Practice reading the dialogues with the partner. Learn the dialogues by heart. Act out the dialogues.

I

Engineer (F): Hi Will. Thanks for coming in today.

Architect (M): Hi Petra. I'm glad to be here. Were excited about our new project.

Engineer: I have your site survey partially completed.

Architect: Great. Let's see what you have so far.

Engineer: Here is your topographic survey. You'll be glad to know that the site is level.

Architect: That's great. Do you have the figure ground study, too?

Engineer: My team is still working on that. We'll have everything ready to present to you by Tuesday.

Architect: That sounds fine.

Engineer: I have some recommendations based on our results so far.

Architect: Such as?

Engineer: Your design will work better if the building faces north. The emergency and delivery access would then be via Route 12.

Architect: Hmm. I'll have to think that over. but it sounds like a good idea.

II

A: What is a surveyor?

B: Surveyors estimate property boundaries for construction projects.

A: Do they provide any data?

B: Yes, they do. They also provide useful data for mapmaking, mining, and legal purposes.

A: What else do they do?

B: Surveyors measure land features, such as depth and shape, based on reference points.

A: Do they work with documents?

B: Yes. Surveyors also prepare maps and reports, and present results to clients.

III

Anna: What are you going to do?

Andrew: I am going to apply for a job of a surveyor.

Anna: What do Surveyor job duties include?

Andrew: They include measuring property boundaries, creating records of survey results, supervising staff on-site and so on.

Anna: What skills do you need to be a surveyor?

Andrew: Surveyors usually hold a degree in Civil Engineering or relevant field.

Anna: Do you have it?

Andrew: Yes, I do.

Anna: What else do they need?

Andrew: They need to have excellent mathematical and problem-solving skills. These professionals also have the ability to effectively collaborate with diverse disciplines, such as engineers and architects.

Anna: I see. Good luck then!

Exercise IX. Retell the text according to the plan below.

1. General determination of Surveying.
2. Five parts of Surveyor's work.
3. Surveying role in branches of engineering.

UNIT 5

Read and translate the text.

DIFFERENCE BETWEEN PLANE SURVEYING AND GEODETIC SURVEYING

Surveying can simply be defined as the process or technology of making measurement in a scientific manner on, above, or below the earth's surface in order to determine points to produce a plan or map. When the area of surveying is small, and the scale to which its **result** plotted is large, then it is known as plan, and the vice versa of this is Map. Surveying is widely used in almost all civil engineering projects such as construction of building, bridges, reservoirs, dams, railways, roads, irrigation projects etc. Surveying can be classified based on different factors such as field of survey (like land survey, marine survey, photogrammetric, etc.), object of surveys (like Engineering purpose, military purpose, etc.), method of survey (like Triangulation, Trilateration, etc.), and instruments used (Like chain surveying, theodolite surveying, levelling, etc.). However, the prime classification of surveying is plane surveying and geodetic surveying.

Plane Surveying

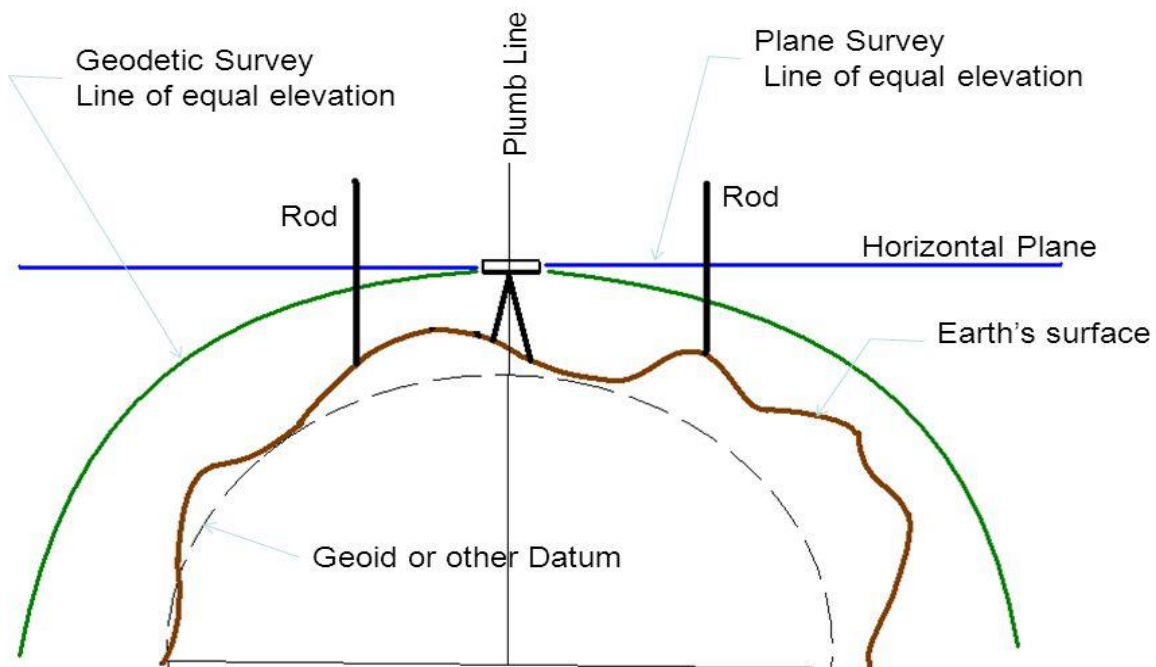
Plane surveying is a branch of surveying in which the surface of the earth is considered as plane surface. This is the most commonly 29 practicing form of surveying. This is used when the extent of the area to be surveyed is small (area less than 260 square km) as this method **neglects** the curvature of earth. In order to make calculations, normally triangles are formed on the ground and these triangles are also assumed as plane triangles and the rules of plane triangles are used to do the computations. The area to be surveyed, and the error associated to the survey results are positively correlated that is more the area more the error. So, this method is not suitable for more accurate or

precise large area surveying. Normally Plane surveying is useful for engineering projects. Normally, survey for location and construction of railroads, highway, canal, and landing fields are categorized under this method.

Geodetic Surveying

Geodetic surveying is another branch of surveying in which the curvature of the earth is considered when taking measurements on earth's surface. That is the actual spherical shape of earth is taken into account. This is also known as trigonometrical surveying. The triangles formed are spherical triangles and calculations are made using spherical trigonometry. In this method, measurements are taken using high precision instruments. This method is used to determine or establish control **points** for other surveys, and to long lines and areas. The position of each geodetic station is expressed using longitude and latitude and Global Positioning System (GPS) is normally used for this purpose.

Geodetic vs. Plane Survey



What is the difference between Plane Surveying and Geodetic Surveying?

Though, both plane surveying and geodetic surveying are the methods of making measurement on earth, they are having some distinguishing **features**.

1. Mainly, plane surveying ignores the curvature of the earth, while geodetic surveying considers it.

2. Plane surveying is suitable for small areas, whereas Geodetic surveying suits for surveying of large area.

3. Geodetic surveying is more accurate than plane surveying.

4. Triangles formed in plane surveying are plane triangles, but triangles formed in geodetic surveying are spherical triangles.

5. Geodetic stations are in huge distance compared to stations formed in plane surveying.

6. Moreover plane surveying uses normal instruments like chain, measuring tape, theodolite, etc. to locate points on earth, while geodetic surveying uses more precise instruments and modern technology like GPS.

VOCABULARY NOTES:

a scale – шкала

plane surveying – площинна зйомка

geodetic surveying – геодезична зйомка

to neglect – нехтувати

to be suitable – підходити

branch – відділення

spherical triangles – сферичні трикутники

to take into account – враховувати

distinguishing features – відмінні особливості

to suit – пасувати

huge distance – величезна відстань

Exercise I. Answer the following questions and give examples.

1. How can surveying be defined?

2. Where is surveying widely used?

3. What is surveying classification based on?

4. What is the prime classification of surveying?

5. What is plane surveying?

6. What is geodetic surveying?

7. What is the main difference between Plane Surveying and Geodetic Surveying?

Exercise II. Choose the contextual meanings of the words written in bold in Text 1.

1. Result

а) висновок

с) результат

- 2) to use _ civil engineering;
- 3) construction _ irrigation projects;
- 4) to be based _ different factors;
- 5) field _ survey;
- 6) to consider _ plane surface;
- 7) the curvature _ earth;
- 8) to be categorized _ the method;
- 9) to take _ account;
- 10) to be used _ the purpose;
- 11) to compare ___ smth;
- 12) to locate points _ earth.

Exercise VI. Retell the text according to the plan below.

1. The prime classification of Surveying.
2. Definition of Plane surveying.
3. Definition of Geodetic surveying.
4. Six distinguishing features of Plane Surveying and Geodetic Surveying.

Exercise VII. Practice reading the dialogues with the partner. Learn the dialogues by heart. Act out the dialogues.

A: – What is the main difference between plane surveying and geodetic surveying?

B: – Plane surveying is the process of surveying by assuming that the earth is flat. Geodetic surveying is a process of surveying by considering the curvature or spherical shape of the earth.

A: – Can you name them in detail?

B: – In plane surveying Earth surface is assumed as plain; in geodetic surveying Earth surface is considered as spherical.

A: – What about the line which is formed by any two points?

B: – In plane surveying the line formed by any two points is considered as straight line – as the same angles are plain angles. In geodetic surveying it is considered as arch –as the same angles are spherical angles.

A: – What are they both suitable for?

B: – Plane surveying is suitable for small area surveying while geodetic surveying is suitable for large area surveying.

A: – OK. Thank you.

UNIT 6

Read and translate the text

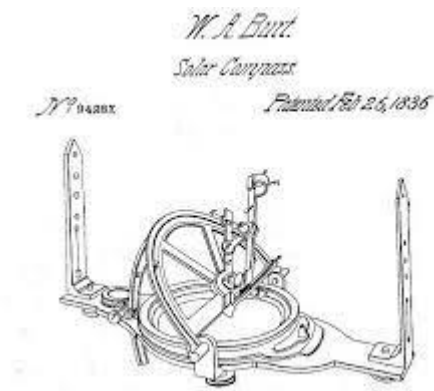
DIFFERENT TYPES OF SURVEYING EQUIPMENT: OLD AND NEW

A surveyor depends on their equipment for acquiring accurate measurements quickly and easily. The text describes the various types of surveying equipment, both ancient and modern, that are available in the market today. Many kinds of surveying equipment have been used in the past and present to help a surveyor measure various parameters of a land area. Each of these parameters is measured by a specific type of measuring equipment. In this text we will learn about the importance of the main types of surveying equipment, both old and new.

Old

In ancient times surveying equipment included chains, compass, solar compass, transit, theodolite and more. Chains with equal size links were used to measure distance between two required points. A compass was used to measure the direction of a line that was being surveyed. A Solar Compass was used for measuring both the direction and latitude of a particular point with the help of sun and stars. A Solar Compass could also measure horizontal angles and the “true north” of a particular place.

A metallic measuring tape was used to measure shorter distances. As technology gradually advanced with time, instruments used for surveying also improved. Horizontal and vertical angles were measured using a simple theodolite whereas different heights were measured by a basic level. Measuring wheels were also initially used by surveyors to measure long distances in a short duration of time.



Measuring wheels came in two types: mechanical and electrical, and both worked on the same principle of rolling the wheel from the start to the end point. In the early 1900s, surveyors started to use surveying equipment such as planimeters, theodolites, automatic levels and measuring wheels. A planimeter is the best known tool for measuring asymmetrical land areas as they eliminate the need for charts or manual calculations; whereas a theodolite allows measuring of horizontal and vertical angles.

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A theodolite consists of a movable telescope attached over perpendicular axis. It provides precise measurement of angles and is an integral part of every surveying tool kit. A transit is a type of theodolite but has less precision. An auto level or a dumpy level is also a type of surveying equipment used for measuring horizontal levels. It consists of a telescope like device fitted on a tripod stand. Auto level, tilting level, and self-leveling level are all types of leveling instruments, each providing different rotating capabilities. Most surveying instruments are fixed on a tripod, which acts as a support. As the name suggests, tripods have three legs with length varying capability. Many of these equipment is still used by surveyors around the world.

<i>Classic theodolite (1840-1890)</i>		<i>Optical theodolite (1920-1970)</i>		<i>Modern theodolite (1970-2016)</i>	
					
					

New

Recent development in technology has provided some of the finest surveying equipment present today. Moreover, with the introduction of global positioning system, the methods of surveying have also totally changed. GPS has not only made surveying faster but has increased the accuracy to amazing heights. GPS works with the help of satellite systems which provide accurate data directly on the computer screen. Various types of GPS equipment are available, from basic to highly advanced. Some GPS equipment even has night vision which facilitates surveying during the night time. However, it is said that though GPS helps in acquiring the exact position of the land; it does not provide good results in dense forest areas or concrete constructions. For this reason, an instrument known as total station is used along with the GPS.

Total station is a theodolite with an Electronic Distance Measurement Device. Total station has also been one of the reasons behind the drastic change of technology in the surveying field. EDM shifted the surveying technology from optical mechanical devices to digital electronic devices. In spite of just being distance measuring equipment, total station can also be used for leveling when adjusted in a horizontal plane. Most of the ultra-modern surveying devices are a combination of one or more of these devices. There is a long list of surveying equipment available in the market today. The selection of particular equipment depends on the type of application and accuracy required.

Though all this equipment provides a wide range of options to surveyors, it is advisable to have a thorough knowledge of both, the equipment and the desired survey.

This would not only help in bringing accuracy to the work but would also save considerable time and money.

VOCABULARY NOTES:

surveying equipment – геодезичне обладнання

a land area – земельна ділянка

equal size links – посилення однакового розміру

required points – необхідні точки

measuring wheel – мірне колесо

to eliminate – ліквідувати

an integral part – невід’ємна частина

a dumpy level – безглуздий рівень

to facilitate – полегшувати

to fit – підходити

a tripod stands – підставка для штатива

a support – опора

rotating capabilities – можливості обертання

accurate data – точні дані

to acquire – придбати

exact position – точне положення

digital electronic devices – цифрові електронні пристрої

when adjusted – при налаштуванні

a wide range of options – широкий вибір опцій

a thorough knowledge – ґрунтовні знання

Exercise 1. Answer the following questions.

1. What does a surveyor depend on for acquiring accurate measurements quickly and easily?
2. What did surveying equipment include in ancient times?
3. What was used to measure distance between two required points?
4. What could a Solar Compass measure?
5. How were measuring wheels used?
6. When did surveyors start to use planimeters, theodolites and automatic levels?
7. What is a planimeter?
8. A theodolite allows measuring of horizontal levels, doesn't it?
9. What does an auto level consist of?

10. What surveying equipment uses satellite systems?
11. Does GPS provide good results in dense forest areas or concrete constructions?
12. What is used along with the GPS?

Exercise II. Match the English and Ukrainian equivalents.

- | | |
|------------------------------------|---|
| 1) short duration of time | a) набір інструментальних засобів, інструментарій |
| 2) measuring of angles | b) різні поворотні можливості |
| 3) asymmetrical land areas | c) вимір кутів |
| 4) attached over axis | d) несиметричні ділянки землі |
| 5) surveying tool kit | e) радикальна зміна технологій |
| 6) different rotating capabilities | f) прикріплений над віссю |
| 7) satellite systems | g) коротка тривалість часу |
| 8) drastic change of technology | h) супутникові системи |

Exercise III. Match the words with their definitions.

- | | |
|-----------------|---|
| 1. Boundary | a) the condition or quality of being true, correct, or exact; freedom from error or defect. |
| 2. Built-up | b) a precision instrument having a telescopic sight for establishing horizontal and sometimes vertical angles. |
| 3. Inability | c) something that indicates limits; a limiting line. |
| 4. Accuracy | d) a global system of U.S. navigational satellites developed to provide precise positional and velocity data and global time synchronization for air, sea, and land travel. |
| 5. To advance | e) lack of power, capacity, or means |
| 6. Theodolite | f) an official register of the ownership, extent, and value of real property in a given area, used as a basis of taxation. |
| 7. GPS | g) to improve or make progress. |
| 8. To ensure | h) (of an area) filled in with houses, as an urban region. |
| 9. Cadaster | i) having or expressing a meaning; indicative; suggestive. |
| 10. Significant | j) to make sure or certain. |

Exercise IV. Match the surveying instruments with their descriptions.

- | | |
|---------------|--|
| 1) planimeter | a) was used for measuring both the direction and latitude of a particular point with the help of sun and stars |
|---------------|--|

- 2) tripod b) mechanical and electrical, worked on the principle of rolling the wheel from the start to the end point
- 3) solar compass c) the best known tool for measuring asymmetrical land areas as they eliminate the need for charts or manual calculations
- 4) total station d) a type of surveying equipment used for measuring horizontal levels
- 5) auto level e) has three legs with length varying capability
- 6) measuring wheels f) a theodolite with an electronic distance measurement device

Exercise V. Fill in the correct prepositions and translate the phrases.

1) types ... surveying equipment; 2) available ... the market; 3) distance ... two points; 4) to advance ... time; 5) to be used ... surveyors; 6) to consist ...; 7) measurement ... angles; 8) to be fixed ... a tripod; 9) to work ... the help of satellite systems; 10) to depend ... the type of application.

Exercise VI. Fill in the table with old and new equipment.

Chains, global positioning system, solar compass, transit, theodolite, metallic measuring tape, total station, planimeter, automatic levels, measuring wheels.

EQUIPMENT	
OLD	NEW

Exercise VII. Translate into English.

Широке поширення геоінформаційних систем і технологій зумовило розширення сфери застосування GPS-обладнання в різних сферах діяльності, включаючи високоточні геодезичні вимірювання, навігацію, геоінформаційні системи та ін., лазерне сканування та дистанційне зондування Землі. Причому дедалі більшої ваги набувають методи та прилади глобального позиціонування, орієнтовані на інтеграцію супутникової навігації та цифрових топографічних карт, та оперативний моніторинг територій та об'єктів нерухомості.

Exercise VIII. Translate the following sentences paying attention to the functions of the verb “to have”.

1. Many kinds of surveying equipment have been used in the past and present.
2. A transit is a type of theodolite but has less precision.
3. Tripods have three legs with length varying capability.
4. Recent development in technology has provided some of the finest surveying equipment present today.
5. The methods of surveying have also totally changed.
6. Some GPS equipment even has night vision which facilitates surveying during the night time.
7. It is advisable to have a thorough knowledge of both old and new equipment.

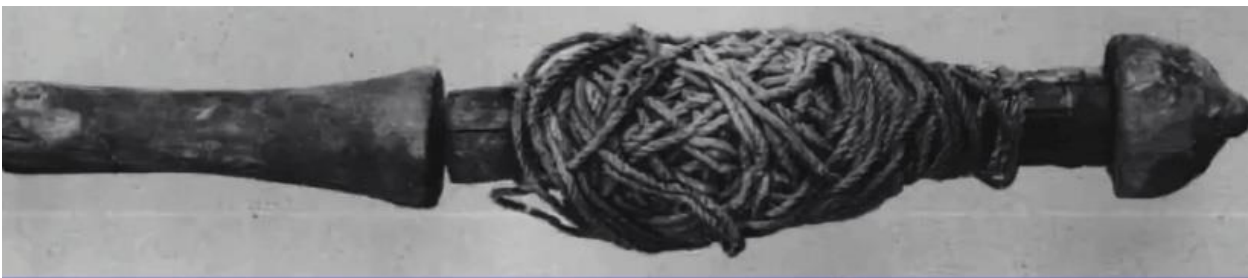
Exercise IX. Retell the text according to the plan below.

1. Surveying equipment used in ancient times.
2. Modern surveying equipment.

Exercise X. Read and complete the dialogue.

- Just have a look at the tool!
- Emm... I have no idea what it is for. Do you?
- Well, perhaps people used it to know the right vertical position.
- Let me guess! This is a ...

Look at the picture of the ancient tools for measuring. Name them and use in the dialogue of your own.





Read and complete the dialogue.

- Hello, what are you doing?
- I have just come from the site.
- What equipment did you?
- The theodolite.
- Did you ... data?
- Certainly, I did. Now I am trying to ... them.
- Ok, won't bother you anymore.
-

Read and complete the dialogue.

- Let us get down to work. What about the land in ...?
- I ... it. I visited the ..., collected ... and ... them.
- Can you ... your plans already?
- Sure. Here it is. I also ... the effectiveness of the land usage.
- Great job!
- Indeed.

Exercise XI. Practice reading the dialogues with the partner. Learn the dialogues by heart. Act out the dialogues.

A: – What do you know about geodetic surveying techniques?

B: – Terrestrial geodetic techniques observe the Earth surface and its changes, sea level, gravity field and the height by sensors on or near to the Earth surface.

A: – What are they?

B: – They are as follows: Tide Gauge measurements to measure sea surface heights at the

coast. Absolute and relative gravity measurements on ground.

A: – What does the toolbox of Geodesy comprise?

B: – It comprises different sensors and instruments on the Earth (land and oceans), in the

air, and in space.

A: – Can we say that together they compose one large, comprehensive “geodetic instrument” for monitoring the System Earth in a wide range of spatial and temporal scales.

B: – Yes, you are right.

UNIT 7

Read and translate the text.

GEODETIC SURVEYING TECHNIQUES (part I)

Four traditional surveying techniques (1) astronomic positioning, (2) triangulation, (3) trilateration, and (4) traverse are in general use for determining the exact positions of points on the earth's surface.

Horizontal positioning. Astronomic Position Determination

Astronomic positioning is the oldest positioning method. It has been used for many years by mariners and, more recently, by airmen for navigational purposes. Geodesists must use astronomic positions along with other types of survey data such as triangulation and trilateration to establish precise positions.

As the name implies, astronomic positions are obtained by measuring the angles between the plumb line at the point and a star or series of stars and recording the precise time at which the measurements are made. After combining the data with information obtained from star catalogues, the direction of the plumb line (zenith direction) is computed.

While geodesists use elaborate and very precise techniques for determining astronomic latitude, the simplest method, in the northern hemisphere, is to measure the elevation of Polaris above the horizon of the observer. Astronomic latitude is defined as the angle between the perpendicular to the geoid and the plane of the equator.

Astronomic longitude is the angle between the plane of the meridian at Greenwich (Prime Meridian) and the astronomic meridian of the point. Actually, it is measured by determining the difference in time-the difference in hours, minutes, and seconds between the time a specific star is directly over the Greenwich meridian and the time the same star is directly over the meridian plane of the point.

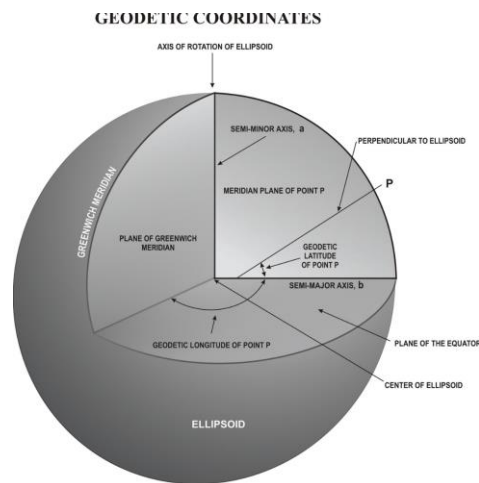
Astronomic observations are made by optical instruments-theodolite, zenith camera, prismatic astrolabe-which all contain leveling devices. When properly adjusted, the vertical axis of the instrument coincides with the direction of gravity and is, therefore, perpendicular to the geoid. Thus, astronomic positions are referenced to the geoid.

Triangulation

The most common type of geodetic survey is known as triangulation. It differs from the plane survey in that more accurate instruments are used, instrumental errors are either removed or predetermined. Another very important difference is that all of the positions established by triangulation are mathematically related to each other.

Basically, triangulation consists of the measurement of the angles of a series of triangles. The principle of triangulation is based on simple trigonometric procedures. If the distance along one side of a triangle and the angles at each end of the side are accurately measured, the other two sides and the remaining angle can be computed. Normally, all of the angles of every triangle are measured for the minimization of error and to furnish data for use in computing the precision of the measurements. Also, the latitude and longitude of one end of the measured side along with the length and direction (azimuth) of the side provide sufficient data to compute the latitude and longitude of the other end of the side.

There are four general orders of triangulation. First-Order (Primary Horizontal Control) is the most accurate triangulation. It is costly and time-consuming using the best instruments and rigorous computation methods. First-Order triangulation is usually used to provide the basic framework of horizontal control for a large area such as for a national network. It has also been used in preparation for metropolitan expansion and for scientific studies requiring exact geodetic data. Its accuracy should be at least one part in 100,000. Second-Order, Class I (Secondary Horizontal Control) includes the area networks between the First-Order arcs and detailed surveys in very high value land areas. It should



indicate an accuracy of at least one part in 50,000. The demands for reliable horizontal control surveys in areas which are not in a high state of development or where no such development is anticipated in the near future justifies the need for a triangulation classified as Second-Order, Class II (Supplemental Horizontal Control). This class is used to establish control along the coastline, inland waterways and interstate highways. The control data contributes to the National Network and is published as part of the network. The minimum accuracy allowable in Class II of Second-Order is one part in 20,000. Third-Order, Class I and 17 Class II (Local Horizontal Control) is used to establish control for local improvements and developments, topographic and hydrographic surveys, or for such other projects for which they provide sufficient accuracy. Its accuracy should be at least one part in 10,000 for Class I and one part in 5,000 for Class II. The sole accuracy requirement for Fourth-Order triangulation is that the positions be located without any appreciable errors on maps compiled on the basis of the control. Normally, triangulation is carried out by parties of surveyors occupying preplanned locations (stations) along the arc and accomplishing all the measurements as they proceed.

(adopted from http://www.ngs.noaa.gov/PUBS_LIB/Geodesy4Layman/TR80003B.HTM)

VOCABULARY NOTES:

- surveying techniques – геодезична техніка
- astronomic positioning – астрономічне позиціонування
- triangulation – триангуляція
- trilateration – трилатерація
- navigational purposes – навігаційні цілі

astronomic latitude – астрономічна широта
survey data – дані опитування
leveling device – вирівнюваний пристрій
properly adjusted – відрегульований належним чином
to coincide – збігатися
accurate instruments – точні інструменти
longitude – довгота
metropolitan expansion – розширення метрополії
coastline – берегова лінія
rigorous – суворий
inland waterways – внутрішні водні території
interstate highways – міждержавні магістралі
sole accuracy requirements – єдині вимоги до точності

Exercise I. Answer the following questions.

1. What are traditional surveying techniques? What are they used for?
2. How are astronomic positions obtained?
3. How is astronomic latitude defined?
4. What is astronomic longitude? How is it measured?
5. How do optical instruments astronomic observations made by work (function)?
6. What are the differences between the plane survey and triangulation?
7. What is the principle of triangulation based on?
8. What are four general orders of triangulation?
9. When is each triangulation order used?
10. Which accuracy should four orders of triangulation indicate?

Exercise II. Match words similar in meaning.

- | | |
|---------------|----------------|
| 1. purpose | a. method |
| 2. data | b. surveyor |
| 3. along with | c. aim |
| 4. imply | d. establish |
| 5. observer | e. information |
| 6. technique | f. mistake |
| 7. compute | g. together |
| 8. accurate | h. measure |
| 9. error | i. precise |

10. determine

j. mean

Exercise III. Give English equivalents for the following word combinations.

1. визначати точне положення
2. вимір кутів
3. широта
4. довгота
5. правильно встановлений
6. виключати помилки
7. вимагати точні відомості
8. підтверджувати необхідність
9. забезпечувати точність
10. група дослідників

Exercise IV. Give Ukrainian equivalents for the following word combinations.

1. surveying techniques
2. to measure the elevation
3. the Greenwich meridian
4. a leveling device
5. to be related to each other
6. to be costly and time-consuming
7. to provide the basic framework
8. the area networks
9. to establish control
10. to accomplish all the measurements

Exercise V. Match sentence halves.

1. The position of a point can be obtained	a. to compute the astronomic longitude of the point.
2. The difference between the time at the point and the time at Greenwich is used	b. when distances between two points are too long.
3. Astronomic positions are	c. measure much longer distances without losing accuracy.

4. The laser equipped geodimeter can	d. directly by observing the stars.
5. Flare triangulation is a method which is used	e. wholly independent of each other.

Exercise VI. Ask all possible questions to the sentences from exercise V.

Exercise VII. Read the text and give a short summary.

Snel (Snellius or Snel van Royen), Willebrord

Snel (Snellius or Snel van Royen), Willebrord (b. Leiden, Netherlands, 1580; d. Leiden, 30 October 1626), mathematics, optics, astronomy.



Snel was the son of Rudolph Snellius, or Snel van Royen, professor of mathematics at the new University of Leiden, and of Machteld Cornelisdochter. He studied law at the university but became interested in mathematics at an early age. Through the influence of Van Ceulen, Stevin, and his father, he received permission in 1600 to teach mathematics at the university. Soon afterward he left for Würzburg, where he met Van Roomen. He then went to Prague to conduct observations under Tycho. He also met Kepler, and traveled to Altdorf and Tübingen, where he saw Mästlin, Kepler's teacher. In 1602 Snel studied law in Paris. He returned home in 1604, after

having traveled to Switzerland with his father, who was then in Kassel at the court of the learned Prince Maurice of Hesse.

After his father's death in March 1613, Snel succeeded him at the university, and two years later he became professor. He taught mathematics, astronomy, and optics, using some instruments in his instruction.

Sharing the admiration of his father and of Maurice of Hesse for Ramus, Snel published Ramus' *Arithmetica*, with commentary, in 1613. During this period Snel prepared the Latin translation of two books by Van Ceulen. Snel's lack of attention to this translation may have been due to preoccupation with geodetic work. In 1615 he became deeply involved in the determination of the length of the meridian, selecting for this work the method of triangulation, first proposed by Gemma Frisius in 1533 and also used by Tycho. Snel developed it to such an extent that he may rightfully be called the father of triangulation. Starting with his house (marked by a memorial plaque in 1960), he used the spires of town churches as points of reference. Thus, through net of

triangles, he computed the distance from Alkmaar to Bergen-op-Zoom (around 130 kilometers). The two towns lie on approximately the same meridian. Snel used the distance from Leiden to Zoeterwoude (about 5 kilometers) as a baseline. His instruments were made by Blaeu; and the huge, 210-centimeter quadrant used for his triangulations is suspended in the hall of the Leiden astronomical observatory. The unit of measure was the Rhineland rod (1 rod = 3.767 meters), recommended by Stevin to the States General in 1604 (Stevin, *Principal Works*, IV [1964], 24); and, following Stevin, the rod was divided into tenths and hundredths. The results were presented in *Eratosthenes batavus* (1617).

Dissatisfied with his geodetic work Snel began to correct it, aided by his pupils, and extended his measurements to include the distance from Bergen-op-Zoom to Mechelen. Unaided by logarithms, he continued this work throughout his life. His early death in 1626 prevented him from publishing his computations, which are preserved in his own copy of *Eratosthenes batavus* at the Royal Library in Brussels. They were recently checked by N. D. Haasbroek and were found to be conscientious and remarkably accurate. Haasbroek could not say as much for the way in which Musschenbroek handled these notes in his —” *De magnitudine terrae*”, in *Physicae experimentales ...* (1729).

Snel published some observations by Biürgi and Tycho in 1618, and his descriptions of the comets of 1585 and 1618. Although he demonstrated from the parallax that the comet was beyond the moon and therefore could not consist of terrestrial vapors, he still believed in the character of comets as omina.

In 1624 Snel published his lessons on navigation in *Tiphys batavus* (*Tiphys* was the pilot of the *Argo*). The last works published by Snel himself were *Canon 21 triangulorum* (1626) and *Doctrina triangulorum* (1627), the latter completed by his pupil Hortensius.

Snel’s best-known discovery, the law of refraction of light rays, which was named after him, was formulated probably in or after 1621, and was the result of many years of experimentation and of the study of such books as Kepler’s *Ad Vitellionem paralipomena* (1604) and Risner’s *Optica* (1606). Snel’s manuscript, which contained his results, has disappeared, but it was examined by Issac Vossius (1662) and by Huygens, who commented on it in his *Dioptrica* (1703, 1728).

The priority of the publication of the law remains with Descartes in his *Dioptrique* (1637), stated without experimental verification. Descartes has been accused of plagiarism (for example, by Huygens), a fact made plausible by his visits to Leiden during and after Snel’s days, but there seems to be no evidence for it.

Snel was buried in the Pieterskerk in Leiden. The monument erected to him and his wife, who died in 1627, is still there.

(adopted from the encyclopedia.com)

Exercise VIII. Ask questions to the underlined words and phrases.

1. At Leiden, Snel prepared a Latin translation of Stevin's Wisconstighe Ghedachtenissen, which was then being published.
2. He also busied himself with the restoration of the two books of Apollonius on plane loci, preserved only in abstract by Pappus.
3. In 1608 Snel married Maria De Lange, daughter of a burgomaster of Schoonhoven; only three of their eighteen children survived.
4. The Doctrina, which comprise a plane and spherical trigonometry, includes the recession problem for two points, often named after P. A. Hansen (1841).
5. Descartes has been accused of plagiarism (for example, by Huygens), a fact made plausible by his visits to Leiden during and after Snel's days, but there seems to be no evidence for it.

UNIT 8

Read the text and match paragraphs A-D with gaps 1-5.

GEODETIC SURVEYING TECHNIQUES (part 2)

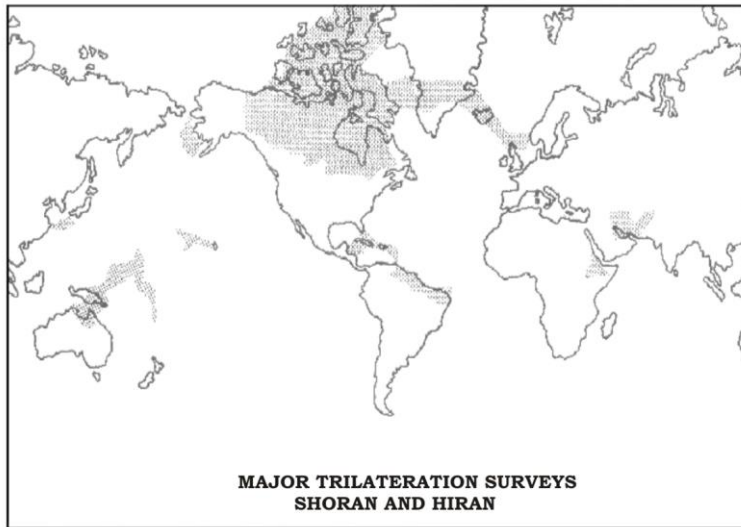
Trilateration

Another surveying method involves the use of radar and aircraft. The SHORAN, HIRAN and SHIRAN electronic distance measuring systems have been applied to performing geodetic surveys by a technique known as trilateration. Since very long lines (to 500 miles) could be measured by these systems, geodetic triangulation networks have been extended over vast areas in comparatively short periods of time. In addition, the surveys of islands and even continents separated by extensive water barriers have been connected by the techniques.

1.	
----	--

Traverse

The simplest method of extending control is called traverse. The system is similar to dead reckoning navigation where distances and directions are measured. In performing a traverse, the surveyor starts at a known position with a known azimuth (direction) to another point and measures angles and distances between a series of survey points.



2.	
----	--

If the traverse returns to the starting point or some other known position, it is a closed traverse, otherwise the traverse is said to be open. The traverse consists of a series of high-precision length, angle and astronomic azimuth determinations running approximately east-west and north-south through the conterminous states, forming somewhat rectangular loops.

Vertical positioning

Vertical surveying is the process of determining heights-elevations above the mean sea level surface. The geoid corresponds to the mean level of the open sea. In geodetic surveys executed primarily for mapping purposes, there is no problem in the fact that geodetic positions are referred to an ellipsoid and the elevations of the positions are referred to the geoid.

3.	
----	--

Precise geodetic leveling is used to establish a basic network of vertical control points. From these, the height of other positions in the survey can be determined by

supplementary methods. The mean sea level surface used as a reference (vertical datum) is determined by obtaining an average of the hourly water heights for a period of several years at tidal gauges.

There are three leveling techniques-differential, trigonometric, and barometric which yield information of varying accuracy. Differential leveling is the most accurate of the three methods. With the instrument locked in position, readings are made on two calibrated staffs held in an upright position ahead of and behind the instrument. The difference between readings is the difference in elevation between the points.

4.	
----	--

The exact elevation of at least one point in a leveling line must be known and the rest computed from it. Trigonometric leveling involves measuring a vertical angle from a known distance with a theodolite and computing the elevation of the point.

5.	
----	--

It is, therefore, a somewhat more economical method but less accurate than differential leveling. It is often the only practical method of establishing accurate elevation control in mountainous areas. In barometric leveling, differences in height are determined by measuring the difference in atmospheric pressure at various elevations. Air pressure is measured by mercurial or aneroid barometers, or a boiling point thermometer. Although the degree of accuracy possible with this method is not as great as either of the other two, it is a method which obtains relative heights very rapidly at points which are fairly far apart. It is widely used in the reconnaissance and exploratory surveys where more exacting measurements will be made later or are not required.

A With the angular measurements, the direction of each line of the traverse can be computed; and with the measurements of the length of the lines, the position of each control point computed.

B The optical instrument used for leveling contains a bubble tube to adjust it in a position parallel to the geoid. When properly "set up" at a point, the telescope is locked in a perfectly horizontal (level) position so that it will rotate through a 360 arc.

C However, geodetic data for missiles requires an adjustment in the elevation information to compensate for the undulations of the geoid above and below the regular mathematical surface of the ellipsoid. The adjustment uses complex advanced geodetic techniques.

D The Canadian SHORAN network connecting the sparsely populated northern coastal and inland areas with the central part of the country and the North Atlantic HIRAN Network tying North America to Europe are examples of the application of the trilateration technique. SHIRAN has been used in the interior of Brazil.

E With this method, vertical measurements can be made at the same time horizontal angles are measured for triangulation.

http://www.ngs.noaa.gov/PUBS_LIB/Geodesy4Layman/TR80003B.HTM

VOCABULARY NOTES:

aircraft – літак

distance measuring system – система вимірювання відстані

extensive water barrier – велика водна перешкода

leveling – вирівнювання

loop – петля

reconnaissance – розвідка, досліджування, зондування

reckoning navigation – розрахунок навігації

survey points – оглядові точки

conterminous – збіжний, прикордонний

tidal gauge – припливомір

various elevations – різні висоти

boiling point thermometer – термометр температури кипіння

fairly far apart – досить далеко один від одного

undulation – хвилястість

Exercise I. Translate words of the same root into Ukrainian.

To measure – measured – measureless – measurement – measuring – measurable – measurer

To extend – extended – extending – extensive – extension – extensible

To compute – computer – computation – computable – computing – computerize (d)

Exercise II. Match words with their definitions.

<i>barrier</i>	<i>azimuth</i>	<i>technique</i>	<i>loop</i>	<i>level</i>	<i>ellipsoid</i>	<i>elevation</i>
----------------	----------------	------------------	-------------	--------------	------------------	------------------

1. - a way of carrying out a particular task, especially the execution or performance of an artistic work or a scientific procedure;
2. - the direction of a celestial object from the observer, expressed as the angular distance from the north or south point of the horizon to the point at which a vertical circle passing through the object intersects the horizon;
3. - a three-dimensional figure symmetrical about each of three perpendicular axes, whose plane sections normal to one axis are circles and all the other plane sections are ellipses;
4. - a height or distance from the ground or another stated or understood base;
5. - the action or fact of raising or being raised to a higher or more important level, state, or position;
6. - a circumstance or obstacle that keeps people or things apart or prevents communication or progress;
7. - a length of thread, rope, or similar material, doubled or crossing itself, used as a fastening or handle

Exercise III. Mark the following sentences True or False.

1. Only distances are measured in trilateration.
2. If the traverse returns to the starting point or some other known position, it is an open traverse.
3. Reckoning navigation methods in geodesy involve the determination of an observer's position from observations of the moon, stars and satellites.
4. Vertical surveying is the process of determining heights-elevations above the mean sea level surface.
5. Trigonometric, differential and barometric leveling techniques turn in information of varying accuracy.
6. Differential leveling measures a vertical angle from a known distance with a theodolite and computing the elevation of the point.
7. In barometric leveling, differences in angles are determined by measuring the difference in atmospheric pressure at various elevations.

Exercise IV. Find words in the text similar in meaning.

1. fulfill
2. spacious
3. space
4. use

5. dot
6. apparatus
7. precision
8. right-angled
9. vertical
10. compression

Exercise V. Match adjectives with suitable nouns.

- | | |
|-------------------|-----------------|
| 1. extending | a. technique |
| 2. surveying | b. length |
| 3. rectangular | c. control |
| 4. trilateration | d. instruments |
| 5. high-precision | e. method |
| 6. vertical | f. traverse |
| 7. angular | g. pressure |
| 8. air | h. loops |
| 9. closed | i. angle |
| 10. optical | j. measurements |

Exercise VI. Complete the text using the words in CAPITALS in the correct form.

The dictionary defines the verb survey as "To determine and delineate the form, extent, position, etc., of, as a tract of land, by 1) TAKE linear and angular 2) MEASURE, and by applying the principles of geometry and trigonometry". One of the functions of the science of geodesy is defined as the 3) DETERMINE of the exact positions of points on the earth's surface. Astronomic positions are 4) REFER to the 29 geoid that is a surface along which the gravity potential is everywhere equal and to which the 5) DIRECT of gravity is always perpendicular. Another astronomic observation related to 6) HORISONT positioning is the astronomic azimuth. Very 7) ACCURACY azimuths are used in the controlling of the orientation of 8) ONE-order triangulation. Triangulation is extended over large areas by connecting and 9) EXTEND series of arcs and forming a network or triangulation system. The network is adjusted in a manner which reduces the effect of observational errors to a

minimum. A denser distribution of geodetic control 10) ACHIEVE in a system by subdividing or filling in with other surveys.

Exercise VII. Translate the following sentences into English.

1. Кінцевою метою геодезичної мережі (ГМ) є визначення координат геодезичних пунктів.
2. Існують методи побудови ГМ, вибір яких визначається умовами місцевості, необхідною точністю та економічною ефективністю.
3. Триангуляція – спосіб побудови на місцевості ГМ як трикутників, у яких виміряно всі кути і базисні вихідні дані. Довжини інших сторін обчислюють за тригонометричними формулами, потім знаходять дирекційні кути (азимут) сторін і визначають координати.
4. Трилатерація – метод побудови ГМ на місцевості у вигляді трикутників, у яких виміряні довжини сторін (відстань між геодезичними пунктами), а кути між сторонами вираховують.
5. Полігонометрія – спосіб побудови ГМ на місцевості у вигляді ломаних ліній, званих ходами, вершини яких закріплені геодезичними пунктами. Вимірюються довжини сторін ходу та горизонтальні кути між ними.
6. Лінійно-кутові побудови, в яких лінійні та кутові виміри поєднуються найбільш надійно.
7. Форма мережі може бути різною, наприклад, чотирикутник, у якого вимірюють всі горизонтальні кути та дві суміжні сторони, а дві інші сторони обчислюють.
8. Методи використання супутникових технологій, у яких координати пунктів визначаються за допомогою супутникових систем, а саме американський GPS.
9. Ці методи мають революційне науково-технічне значення за досягнутими результатами в точності, оперативності отримання результатів, всепогодності та щодо невисокої вартості робіт у порівнянні з традиційними методами відновлення підтримання геодезичної основи на належному рівні.

UNIT 9

Read and translate the text

GEODETIC SYSTEMS

A datum is defined as any numerical or geometrical quantity or set of such quantities which serve as a reference or base for other quantities. In geodesy two types of datum must be considered: a horizontal datum which forms the basis for the computations of horizontal control surveys in which the curvature of the earth is considered, and a vertical datum to which elevations are referred. In other words, the coordinates for points in specific geodetic surveys and triangulation networks are computed from certain initial quantities (datum).

Horizontal Geodetic Datum

A horizontal geodetic datum may consist of the longitude and latitude of an initial point (origin); an azimuth of a line (direction) to some other triangulation station; the parameters (radius and flattening) of the ellipsoid selected for the computations; and the geoid separation at the origin. A change in any of these quantities affects every point on the datum.

In areas of overlapping geodetic triangulation networks, each computed on a different datum, the coordinates of the points given with respect to one datum will differ from those given with respect to the other. The differences occur because of the different ellipsoids used and the probability that the centers of each datum's ellipsoid is oriented differently with respect to the earth's center. In addition, deflection errors in azimuth cause a relative rotation between the systems. Finally, a difference in the scale of horizontal control may result in a stretch in the corresponding lines of the geodetic nets.

Datum Connection

There are three general methods by which horizontal datum can be connected. The first method is restricted to surveys of a limited scope and consists of systematic elimination of discrepancies between adjoining or overlapping triangulation networks. The second one is the gravimetric method of Physical Geodesy and the third – the methods of Satellite Geodesy. These methods are used to relate large geodetic systems to each other and/or to a world system. Both the gravimetric and satellite methods produce necessary "connecting" parameters from reduction of their particular observational data.

Vertical Datum

Just as horizontal surveys are referred to specific original conditions (datum), vertical surveys are also related to an initial quantity or datum. Elevations are referred to the geoid because the instruments used either for differential or trigonometric leveling are adjusted with the vertical axis coincident to the local vertical. As with horizontal

datum, there are many discrepancies among vertical datum. There is never more than 2 meters' variance between leveling nets based on different mean sea level datum; however, elevations in some areas are related to surfaces other than the geoid; and barometrically determined heights are usually relative.

In the European area, there are fewer vertical datum problems than in Asia and Africa. Extensive leveling work has been done in Europe and practically all of it has been referred to the same mean sea level surface. However, in Asia and Africa the situation has been different. In places there is precise leveling information available based on mean sea level. In other areas the zero elevation is an assumed elevation which sometimes has no connection to any sea level surface. China has been an extreme example of this situation where nearly all of the provinces have had an independent zero reference. There is very little reliable, recent, vertical data available for much of the area of Africa and Asia including China.

The mean sea level surface in the United States was determined using 21 tidal stations in this country and five in Canada. This vertical datum has been extended over most of the continent by first-order differential leveling. Concurrent with the new adjustment of the horizontal network, mentioned previously, is the readjustment of the vertical network. Countries of North and Central America are involved. In the conterminous United States 110,000 kilometers of the basic network are being releveled.

(adopted from http://www.ngs.noaa.gov/PUBS_LIB/Geodesy4Layman/TR80003B.HTM)

VOCABULARY NOTES:

curvature – викривлення

quantity – кількість

flattening – сплющування

overlapping – перекриття

deflection error – площа прогину

relative rotation – відносне обертання

a limited scope – обмежена сфера застосування

discrepancy – невідповідність

adjoining – примикання

coincident – збігатися

sea level surface – поверхня рівня моря

concurrent – одночасний

to relevel – вирівнювати

Exercise I. Read the text and answer the following questions.

1. What is datum?
2. How many types of datum are there in geodesy?
3. What does a horizontal datum consist of?
4. Why do discrepancies between datum occur?
5. What are three methods of datum connection?
6. Why are elevations in vertical datum referred to the geoid?
7. What are discrepancies among vertical datum?
8. What are vertical datum problems in Europe and in Asia?

Exercise II. Mark the following sentences True or False.

1. A horizontal datum is a datum to which elevations are referred and vertical one is a datum in which the curvature of the earth is considered.
2. There are some quantities which may affect every point on the datum.
3. The survey of the limited scope, the gravimetric method of Physical Geodesy and the methods of Satellite Geodesy are methods of horizontal datum.
4. There are no differences among vertical datum.
5. There are more vertical datum problems in Europe than in Asia.
6. China is an example of zero elevation which has no connection to the sea level surface.
7. The mean sea level surface in Canada was determined by 31 tidal stations.

Exercise III. Match words similar in meaning.

- | | |
|--------------|---------------|
| 1. kind | a. error |
| 2. suppose | b. initial |
| 3. primary | c. restrict |
| 4. chose | d. deflection |
| 5. deviation | e. type |
| 6. adjust | f. determine |
| 7. mistake | g. consider |
| 8. limit | h. instrument |
| 9. tool | i. orient |
| 10. resolve | j. select |

Exercise IV. Match words opposite in meaning.

- | | |
|---------------|-------------|
| 1. ruin | a. differ |
| 2. lower | b. connect |
| 3. be alike | c. unify |
| 4. shrink | d. form |
| 5. enlarge | e. reduce |
| 6. separate | f. accurate |
| 7. unreliable | g. stretch |
| 8. following | h. previous |
| 9. inaccurate | i. elevate |
| 10. diversify | j. reliable |

Exercise V. Match two halves of the statements and translate them into Russian.

- | | |
|--------------------------------------|---------------------------|
| 1. neighboring | a. advanced nation |
| 2. military interests of | b. existing local surveys |
| 3. different surveys | c. countries |
| 4. various weapon | d. requirement |
| 5. technically | e. each country |
| 6. economic | f. international nature |
| 7. surveys of | g. varying size |
| 8. military | h. distance requirements |
| 9. the size and | i. systems |
| 10. the expansion and unification of | j. shape of the earth |

Exercise VI. Fill in the sentences with the statements from exercise V.

Major Datum Before World War II

By 1940, every 1) had developed its own geodetic system to an extent governed by its economic and military requirements. Some systems were developed by 2) and others by new nationwide surveys replacing outdated local ones. Normally, 3) did not use the same geodetic datum. There was no 4) for common geodetic information and the use of common datum was contrary to the 5) The only 6) based on one datum were the few measurements of long arcs accomplished for the purpose of determining 7) The net result was that there were many 8) which differed from each other remarkably.

As 9) increased, positioning information of local or even national scope became unsatisfactory. The capabilities of the 10) increased until datum of at least continental limits were required.

Exercise VII. Translate the following sentences into English.

1. Завдяки численным вимірам та вивченню статистики результатів, був обґрунтований постулат про форму Землі, як геоїда – кулі, сплюснутої у напрямку полюсів. Облік цієї обставини дозволив зробити картографію точнішою, врахувати зміни кривизни земної поверхні залежно від широти та довготи місцевості.
2. Для визначення положення будь-якої точки земної поверхні використовують три координати: широту, довготу та висоту над нульовим рівнем – рівнем моря.
3. У масштабі однієї країни нульовий рівень висот визначається виходячи з середніх показників багаторічних вимірів на кількох водомірних постах.
4. Традиційно горизонтальні та вертикальні координати розглядаються порізно і вихідні пункти встановлюються для них окремо.
5. Широко поширена як метод зйомки геодезична зйомка, за допомогою якої отримують знімальний матеріал для геодезичних карт або планів.
6. Геодезична мережа будь-якого виду представляє систему базисних точок чи опорних пунктів земної поверхні, становище яких визначено і зафіксовано у спільній їм всіх системі геодезичних координат.
7. Будь-яка мережа висотних опорних пунктів під час виконання геодезії землі будується методами геометричного чи тригонометричного нівелювання.

Exercise VIII. Practice reading the dialogues with the partner. Learn the dialogues by heart. Act out the dialogues.

I

A: – What are geodetic coordinates?

B: – Geodetic coordinates are a type of curvilinear orthogonal coordinate system used in geodesy.

A: – What are they based on?

B: – They are based on a reference ellipsoid.

A: – They include. They include geodetic latitude, longitude, and ellipsoidal height.

B: – What is this triad known as?

A: – The triad is also known as Earth ellipsoidal coordinates.

II

A: – *What is the standard used in cartography, geodesy, and satellite navigation including GPS?*

B: – It is the World Geodetic System (WGS).

A: – *What is WGS 84?*

B: – It is its current version. It defines an Earth-centered, Earth-fixed coordinate system and a geodetic datum.

A: – *Does it describe anything?*

B: – Yes, it does. It also describes the associated Earth Gravitational Model (EGM) and

World Magnetic Model (WMM).

A: – *Where can we find the standard?*

A: – The standard is published and maintained by the United States National Geospatial-

Intelligence Agency.

UNIT 10

Read and translate the text

PHYSICAL GEODESY (part 1)

Physical geodesy utilizes measurements and characteristics of the earth's gravity field as well as theories regarding this field to deduce the shape of the geoid and in combination with arc measurements, the earth's size. With sufficient information regarding the earth's gravity field, it is possible to determine geoid undulations, gravimetric deflections, and the earth's flattening.

In using the earth's gravity field to determine the shape of the geoid, the acceleration of gravity is measured at or near the surface of the earth. It might be interesting to compare the acceleration measured by the gravimetrist and the acceleration experienced in an airplane. In an airplane, the acceleration is simply called a G force and is measured by a G meter. A G factor of one is used to indicate the acceleration due to

the attraction of the earth and is considered a neutral condition. The gravity unit used and measured in geodesy is much smaller. A G factor of one is approximately equal to one thousand gals, a unit named after Galileo. The still smaller unit used in geodesy is the milligal (mgal) or one-thousandth part of a gal. Thus, in geodesy we are dealing with variations in acceleration equal to one millionth of one G aircraft acceleration. The most accurate modern instruments permit measurement of acceleration changes of one hundred millionth part of the well-known G factor or better.

Gravity Measurements

Two distinctly different types of gravity measurements are made: absolute gravity measurements and relative gravity measurements. If the value of acceleration of gravity can be determined at the point of measurement directly from the data observed at that point, the gravity measurement is absolute. If only the differences in the value of the acceleration of gravity are measured between two or more points, the measurements are relative.

Absolute measurement of gravity

Until the middle of the 20th century, virtually all absolute measurements of gravity were made using some type of pendulum apparatus. The most usual type of apparatus contained a number of pendulums that were swung in a vacuum. By measuring the period of the pendulums, the acceleration of gravity could be computed. In 1818, Kater developed the so-called reversible pendulum that had knife edge pivots at both ends. These pendulums were flipped over (reversed) during the measurements and, using this procedure, a number of important error sources were eliminated. Still, there were numerous other problems and error sources associated with pendulum measurements of absolute gravity, and the results obtained were not sufficiently accurate to meet the needs of geodetic gravimetry. Consequently, in recent years, the pendulum method has been superseded by the ballistic method which is based on timing freely falling bodies. The acceleration of gravity can be determined by measuring the time taken by a body to fall over a known distance.

Relative measurement of gravity

Solution of some of the problems of gravimetric geodesy requires knowledge of the acceleration of gravity at very many points distributed uniformly over the entire surface of the earth. Since absolute gravity measurements have been too complicated and time consuming and, until recently, could not be obtained with sufficient accuracy, relative gravity measurements have been used to establish the dense network of gravity measurements needed. The earliest relative gravity measurements were made with reversible pendulums. The most accurate relative pendulums to be developed were the

Gulf quartz pendulum and the Cambridge invar pendulum. These two instruments were used as late as 1969.

Modern relative gravity measurements are made with small, very portable, and easily used instruments known as gravimeters (gravity meters). Using gravimeters, highly accurate relative measurements can be made at a given site, known as a gravity station, in half-an-hour or less. Modern gravimeter-type instruments were first developed in the 1930's. There are two other important considerations when relative gravity measurements are made: drift and base station connections. Gravimeter drift is a phenomenon related to certain instrumental instabilities that cause the dial reading to change slowly with time even when the acceleration of gravity remains constant. Since relative gravity surveys can determine only differences in gravity from point to point, every relative gravity survey must include measurements at one or more reoccupied points where acceleration of gravity is known. Such points are called base stations. Then all gravity difference measurements are computed with respect to the known gravity value at the base station. Hence, tying a relative gravity survey to a base station establishes the "gravity datum" of that survey. The earliest "gravity datum" was the so-called Potsdam System. The Potsdam system, however, was found to be in error and, in 1971, was replaced by the International Gravity Standardization Net 1971 (IGSN71).

http://www.ngs.noaa.gov/PUBS_LIB/Geodesy4Layman/TR80003C.HTM

VOCABULARY NOTES:

to deduce the shape – вивести форму

geoid undulations – хвилястість геоїда

gravimetric deflections – гравіметричні прогини

acceleration – прискорення

absolute gravity measurements – вимірювання абсолютної сили тяжіння

relative gravity measurements – вимірювання відносної сили тяжіння

pendulum apparatus – маятниковий прилад

knife edge pivots – центри леза ножа

to flip over – перевертати

to eliminate – ліквідувати

sufficient accuracy – достатня точність

drift – дрейф

instrumental instabilities – інструментальні нестабільності

with respect to – відносно до...

gravity datum – відлік сили тяжіння

Exercise I. Read the text and answer the following questions.

1. What does Physical Geodesy study?
2. What types of gravity measurements exist?
3. What did scientists use to measure the gravity until the middle of the 20th century?
4. Why was the pendulum method superseded by the ballistic method?
5. What instruments were used for relative gravity measurements?
6. When was the first gravimeter developed?
7. What is drift?
8. What points are called base stations?

Exercise II. Mark the following sentences True or False.

1. Having information about the earth's gravity field, you can determine geoid undulations, gravimetric deflections and the earth's flattening.
2. In geodesy it is dealt with variations in acceleration equal to one thousandth of one G aircraft acceleration.
3. Kater developed a pendulum but measurements and results were not rather accurate.
4. Absolute gravity measurements were simple but time consuming.
5. Reversible pendulums are small, portable and easily used instruments.
6. Gravimeter-type instruments were first developed at the beginning of the 20th century.
7. Base stations are reoccupied points where acceleration of gravity is known.
8. The Potsdam System was replaced by the IGSN in 1977.

Exercise III. Ask questions to the underlined words and phrases in the text.

Exercise IV. Match words with their definitions.

<i>point geoid instability gravity apparatus pivot instrument acceleration</i>
--

1. - a hypothetical solid figure whose surface corresponds to mean sea level and its imagined extension under (or over) land areas;
2. - the force that attracts a body towards the centre of the earth, or towards any other physical body having mass;
3. - the rate of change of velocity per unit of time;

4. - a tool or implement, especially one for precision work;
5. - tendency to unpredictable behaviour or erratic changes of mood;
6. - the technical equipment or machinery needed for a particular activity or purpose;
7. - the central point, pin, or shaft on which a mechanism turns or oscillates;
8. - a particular spot, place, or position in an area or on a map, object, or surface.

Exercise V. Complete the text with one word.

In the United States, the basic falling body apparatus was ... in the early 1970's jointly by J.A. Hammond of the Air Force Geophysics Laboratory and J.E. Faller of the Joint Institute for ... Astrophysics. In the so-called Hammond-Faller apparatus, a corner cube reflector falls in a vacuum ... distance and time are measured continuously ... a laser beam in conjunction with a photo multiplier tube. This ... weighed about 800 kilograms and considerably ... accurate than the best absolute 44 pendulum apparatus. Hammond recently ... completed fabrication of a somewhat ... and more accurate version of the original Hammond-Faller apparatus. The new instrument ... about 700 kilograms when packed for shipment in nine units. Hammond's apparatus has ... used to establish very accurate ... for absolute gravity at a number of sites within the United States. Faller is also developing a more refined falling ... apparatus.

Exercise VI. Reorder the words to make a sentence.

1. stations - contains - The - 1854 - distributed - reoccupied - worldwide - IGSN.
2. basic - The - for - established - "gravity datum" - gravity - IGSN71 - today's - surveys - the - relative.
3. For - US - contains - example - stations - the - gravity - network - 50 - base - approximately.
4. measurements - are - national - by - networks - The - usually - established - precise - base - gravimeter.
5. at - Drift - considered - constant - occur - to - a - often - rate - is.
6. at - Consequently - time - measurement - which - is - with - is - each - recorded - the - along - dial - the - made - reading.
7. at - 28 - types - least - different - extensively - kinds - developed - gravimeters - have - of - been - only - two - have - used - been - Although.

Exercise VII. Translate the following sentences into English.

1. Відносні визначення сили тяжіння виробляються маятниковими приладами з точністю до кількох сотих часток мгл.
2. Найбільш поширений прилад вимірювання сили тяжкості – гравіметр, використовуваний для відносних вимірів, тобто, різниці значень сили тяжіння у двох пунктах.
3. Існує спеціальна гравіметрична апаратура для вимірювань сили тяжіння об'єктів, що рухаються (підводних і надводних кораблів, літаків).
4. Для проведення абсолютних вимірювань сили тяжіння потрібна велика кількість допоміжного обладнання, тому їх недоцільно проводити за звичайних геодезичних зйомок.
5. Міжнародна гравіметрична стандартна мережа станом на 1971 р. включала 10 гравіметричних станцій для абсолютних вимірювань і 1854 пункти для відносних вимірювань сили тяжіння.
6. Хоча статичні гравіметри дозволяють отримати найбільш точні значення, їх використання у польових умовах потребує значних витрат праці та часу.
7. Визначення сили тяжіння виробляються відносним методом, шляхом вимірювання за допомогою гравіметрів та маятникових приладів різниці сили тяжіння у досліджуваних та опорних пунктах.
8. Мережа опорних гравіметричних пунктів по всій Землі пов'язана зрештою з пунктом у Потсдамі, де оборотними маятниками на початку ХХ століття було визначено абсолютне значення прискорення сили тяжкості (981 274 мгл).
9. Нові абсолютні вимірювання, що виробляються більш ніж у 10 пунктах Землі, показують, що наведене значення прискорення сили тяжкості в Потсдамі перевищено, мабуть на 13-14 мгл.
10. Найточніше абсолютне значення сили тяжіння визначається з дослідів з вільним падінням тіл у вакуумній камері.

UNIT 11

Read and translate the text

PHYSICAL GEODESY (part II)

Gravity measurement at sea

The earliest measurements at sea were made by F.A. Vening Meinesz who, in 1927, installed a pendulum apparatus in a submarine. The submarine pendulum gravity measurements of Vening Meinesz are mainly of historical interest today. The first gravimeters installed in surface ships appeared during the 1950's. These early ocean surface gravity measurements were only of modest accuracy and, again, now are mainly of historical value. Reasonably accurate measurements from gravimeters on surface ships date only from the late 1960's. Instruments used include LaCosteRomberg S Meter, Askania Meter, Bell Meter, and the Vibrating String Gravimeter. All of these meters are compensated to minimize the effects of oscillatory motion of the ship due to ocean surface waves. The effects are also eliminated or averaged out by computational techniques. A big problem with ocean surface measurements is that the forward motion of the ship adds a centrifugal reaction component to measured gravity which must be eliminated by the so-called Eotvos correction. Therefore, the ship's velocity and heading, as well as the ship's position, must be known accurately. Near shore, shore based electronic positioning/navigation systems (such as LORAN) are used. In the deep ocean, satellite navigation and inertial systems must be used.

Gravity measurement in the air

Problems in airborne gravity measurements are similar to those encountered for surface ships. The position, velocity, and heading of the aircraft must be known accurately. Because of the higher aircraft speeds, the Eotvos correction is much larger for airborne measurements than for surface ship measurements. It also is very difficult to compensate for spurious aircraft accelerations. In addition, reduction of the gravity value from aircraft altitude to an equivalent surface value is a problem that has not yet been solved satisfactorily.

Gravity Anomalies

Gravity measurements provide values for the acceleration of gravity at points located on the physical surface of the earth. Before these measurements can be used for most geodetic purposes, they must be converted into gravity anomalies.

A gravity anomaly is the difference between a gravity measurement that has been reduced to sea level and normal gravity. Normal gravity, used to compute gravity anomalies, is a theoretical value representing the acceleration of gravity that would be generated by a uniform ellipsoidal earth. By assuming the earth to be a regular surface without mountains or oceans, having no variations in rock densities or in the thickness of the crust, a theoretical value of gravity can be computed for any point by a simple

mathematical formula. The most common type of gravity anomaly used for geodetic applications is the so-called free-air gravity anomaly.

Undulation and Deflections by the Gravimetric Method

The method providing the basis from which the undulations of the geoid may be determined from gravity data was published in 1849 by a British scientist, Sir George Gabriel Stokes. However, the lack of observed gravity data prevented its application until recent years. In 1928, the Dutch scientist, Vening Meinesz, developed the formulas by which the gravimetric deflection of the vertical can be computed. The computation of the undulations of the geoid and the deflections of the vertical require extensive gravity observations. The areas immediately surrounding the computation point require a dense coverage of gravity observations and detailed data must be obtained out to distances of about 500 miles. A less dense network is required for the remaining portion of the earth. While the observational requirements for these computations appear enormous, the results well justify the necessary survey work. Effective use of the gravimetric method is dependent only on the availability of anomalies in sufficient quantity to achieve the accuracy desired. Successful use of Stoke's integral and Vening-Meinesz formulas depends on a good knowledge of gravity anomalies in the immediate vicinity of the point under consideration and a general knowledge of anomalies for the entire earth.

There are many large regions on the continents where gravity measurements are lacking or available only in small quantities. Gravity data for ocean areas has always been sparse, however, Satellite Altimetry has overcome this deficiency. In regions where an insufficient number of gravity measurements exists, some other approach must be used to obtain or predict the mean gravity anomalies for the areas.

Correlations exist between variations in the gravity anomaly field and corresponding variations in geological, crustal, and upper mantle structure, regional and local topography and various other types of related geophysical data. In many areas where gravity information is sparse or missing, geological and geophysical data is available. Therefore, the various prediction methods take into account the actual geological and geophysical cause of gravity anomalies to predict the magnitude of the anomalies.

(adopted from)http://www.ngs.noaa.gov/PUBS_LIB/Geodesy4Layman/TR80003C.HTM)

VOCABULARY NOTES:

to install – встановити

modest accuracy – помірна точність

forward motion – рух вперед
to eliminate – ліквідувати
velocity and heading – швидкість і курс
airborne gravity measurements – вимірювання повітряної сили тяжіння
rock densities – щільність порід
the undulations – хвилястість
to prevent – запобігти
gravimetric deflection – гравіметричний прогин
surrounding – оточення
immediate vicinity – безпосереднє оточення
lacking or available – відсутні або доступні
approach – підхід
an insufficient number – недостатня кількість
upper mantle structure – структура верхньої мантії
to be sparse or missing – бути рідкісним або відсутнім
prediction methods – методи прогнозування
to take into account – враховувати, брати до уваги

Exercise I. Read the text and answer the following questions.

1. When did first gravimeters on ships appear?
2. What instruments were used on surface ships?
3. What is a problem with ocean surface measurements?
4. What systems are used near the shore and in the deep ocean?
5. What problems are there with gravity measurements in the air?
6. What is gravity anomaly?
7. What is the most common type of gravity anomaly?
8. Who developed formulas for computing the gravimetric deflection of the vertical?
9. What does the effectiveness of the gravimetric method depend on?
10. What geophysical data are correlated with each other?

Exercise II. Mark the following sentences True or False.

1. V. Meinesz used submarines for marine gravity surveys.
2. Early ocean surface gravity measurements were of precise accuracy.
3. Problems with gravity measurements in the air and in the sea are different.
4. The problem of reduction of gravity value from aircraft altitude to an equivalent surface is not solved.

5. Before being used for geodetic purposes, gravity measurements are converted into gravity anomalies.
6. In 1939 a British scientist published his method of determining the undulations of the geoid from gravity data.
7. Extensive gravity observations are necessary for computing the undulations of the geoid and the deflection of the vertical.
8. Geological and geophysical data is not available in areas where gravity information is sparse or missing.

Exercise III. Match words similar in meaning.

- | | |
|------------|--------------|
| 1. precise | a. recent |
| 2. expel | b. heading |
| 3. speed | c. accurate |
| 4. route | d. dense |
| 5. resolve | e. eliminate |
| 6. normal | f. variation |
| 7. variety | g. velocity |
| 8. modern | h. extensive |
| 9. vast | i. regular |
| 10. thick | j. solve |

Exercise IV. Give English equivalents for the following word combinations.

1. коливальний рух
2. обчислювальна техніка
3. швидкість та рух корабля
4. система навігації
5. товщина/потужність земної кори
6. недостатня кількість даних
7. у достатній кількості
8. брати до уваги

Exercise V. Give Ukrainian equivalents for the following word combinations.

1. gravity measurements
2. forward motion of the ship
3. the acceleration of gravity
4. to compute gravity anomaly

5. undulation of the geoid
6. to require extensive observations
7. to justify the necessary survey work
8. other types of related geophysical data

Exercise VI. Match sentence halves.

1. The word, anomaly, as used in geodesy refers to a deviation from the normal	a. suitable for use aboard a fixed wing KC-135 aircraft.
2. To make use of the anomalies,	b. and a Del Norte transponder electronic navigation system to establish aircraft position,
3. The axis of rotation for the ellipsoid passes	c. geoid undulations cannot be computed directly but must be determined point by point.
4. The theoretical value of gravity at a point on the ellipsoid's surface depends both	d. and can be used either for a single point or to describe a regional or area effect.
5. The distance between the mathematical ellipsoid and the actual geoid	e. the observed gravity must be reduced to a common frame of reference, the geoid-mean sea level.
6. In 1959, the US Air Force was instrumental in developing a gravimeter	f. through the earth's center of gravity.
7. The gravity measurement system aboard the helicopter uses a LaCosteRomberg S Meter to sense gravity	g. on the size and shape of the ellipsoid and on a value, computed from observational data.
8. Since the geoid is so irregular,	h. is called the undulation of the geoid.

Exercise VII. Ask all possible questions to the sentences from exercise VI.

Exercise VIII. Make a brief report on one of the following topics:

- a. Vening Meinesz;
- b. Loran – A, Loran – C and eLoran navigation systems

UNIT12

Read the text and fill it with sentences A-F.

GEODESY AND SATELLITE NAVIGATION

There has always been a love-hate relationship between geodesy and satellite navigation. **1** When the first satellite, Sputnik 1, started orbiting the Earth in 1957, geodesists in several countries realized that satellites offered substantial potential as a geodetic positioning and navigation tool.

The basic technologies of terrestrial geodesy of the day, notably triangulation, traversing, and precise leveling, were slow and cumbersome, mainly because of the effect of the curvature of the surface of the Earth, which limited the range of measurements to theodolite observations between points situated on hilltops, observation towers, and triangulation masts. The advent of EDM (electronic distance measurement) in the 1960s helped terrestrial geodesy, but it, too, was affected by the same limitation, namely the shortness of observable EDM ranges due to the Earth's curvature.

Earth orbiting satellites did not suffer from this drawback. They could be viewed simultaneously from several points on Earth, and therefore direction and range measurements made, provided that the space vehicles were not obscured by high natural features or tall man-made structures. **2**

The first of these was satellite triangulation, which was used initially to supplement and strengthen terrestrial triangulation networks. This situation changed significantly when geodesists realized that they could use the Doppler shift on the signal broadcast from a satellite to obtain differential range measurements that, together with the known Keplerian orbit of the satellite, could lead to a relatively fast positioning, or navigation, method. **3**..... . Transit-Doppler was used in the late 1970s and early 1980s not only for the positioning of naval ships and of submarines surfacing in the polar regions, but also for the strengthening and scaling of national and continental terrestrial triangulation networks.

Enter GPS

These were the early days of a new global satellite positioning, navigation, and timing system, first called the NAVSTAR Global Positioning System, a name later shortened to just GPS. The close relationship between the early GPS and geodesy was

further demonstrated by the adoption of WGS84, the World Geodetic System 1984, as the basis of the 3-D coordinate system of GPS.

As always, human ingenuity did not disappoint, and two new differential techniques were developed. The first was the differential GPS (DGPS) technique, which improved relative positioning accuracies of GPS by at one order of magnitude, down to a few meters. **4** The next advance in improving the accuracy of satellite positioning was made on the advice of radio-astronomers, who proposed replacing the standard GPS pseudo-range measurements, which are based on timing the modulated signal from satellite to receiver.

Instead, they suggested making measurements on the basic carrier frequencies of these signals, just as they did with extra-galactic signals arriving at, say, two widely spaced radio telescopes in so-called very long baseline interferometry (VLBI), leading as a by-product to the Cartesian coordinate differences between the two telescopes. **5**

GPS had now become the universal high precision quasi-instantaneous positioning and navigation tool, creating the basis for hundreds of new applications. **6** These included surveying and mapping, positioning in offshore engineering, the monitoring of local crustal dynamics and plate tectonics, the relative vertical movements of tide gauges, and the continuous 3-D movements of critical engineering structures, such as tall buildings, dams, reservoirs, and long suspension bridges.

- A.** As a result, DGPS soon became the standard methodology for the offshore positioning of oil platforms, pipelines, etc.
- B.** Indeed, satellite positioning started life as an extension of terrestrial geodesy.
- C.** Again, geodesists led the way, concentrating on high precision scientific and engineering applications.
- D.** This technical advance gave birth to Transit-Doppler, the first satellite navigation technology.
- E.** This was the beginning of centimetric positioning by the carrier phase GPS method, which was later developed further by geodesists into kinematic GPS and centimetric navigation.
- F.** This led to several new satellite geodesy positioning methodologies.

(adopted from <http://www.insidegnss.com/node/885>)

VOCABULARY NOTES:

substantial potential – значний потенціал

navigation tool – інструмент навігації

terrestrial geodesy – наземна геодезія
cumbersome – громіздкий
precise leveling – точне нівелювання
electronic distance measurement – електронний вимірювач відстані
suffer from a drawback – страждати від недоліку
simultaneously – одночасно
shortness of observable ranges – обмеженість спостережуваних діапазонів
space vehicles – космічні апарати
human ingenuity – людська винахідливість
close relationship – близькі стосунки
offshore engineering – офшорна інженерія
surveying – геодезія
mapping – картографія
a long suspension bridge – довгий підвісний міст
a pipeline – трубопровід
extension of terrestrial geodesy – розширення наземної геодезії
engineering applications – інженерні програми

Exercise I. Read the text again and answer the following questions.

1. What limited the range of measurements to theodolite observations?
2. What was the advantage of satellite observations?
3. What was satellite triangulation used for?
4. What technology was used for strengthening and scaling of national and continental terrestrial triangulation networks?
5. What was the basis of the 3D coordinate system of GPS?
6. What is the difference between DGPS and VLBI?
7. What applications did GPS serve for?

Exercise II. Mark the following sentences True or False.

1. Geodesy and satellite navigation has always got a good relationship.
2. The curvature of the surface of the Earth was the main obstacle to theodolite observations.
3. Transit-Doppler was the first satellite navigation technology.
4. Transit-Doppler technology was used to supplement and strengthen terrestrial triangulation networks.

5. The adoption of WGS84 was the result of the close relationship between GPS and geodesy.
6. VLBI technique is used for the offshore positioning of oil platform, pipelines, etc.
7. The monitoring of local crustal dynamics and plate tectonics was one of the applications based on GPS.

Exercise III. Match words with their definitions.

receiver	navigation	network	vehicle	broadcast	tectonics	magnitude
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- 1 - a thing used for transporting people or goods, especially on land, such as a car, lorry, or cart;
- 2..... - a group or system of interconnected people or things;
- 3..... - transmit (a programme or some information) by radio or television;
- 4 - the process or activity of accurately ascertaining one's position and planning and following a route;
5. - the degree of brightness of a star, as represented by a number on a logarithmic scale;
6. - a piece of radio or television apparatus that detects broadcast signals and converts them into visible or audible;
7. - large-scale processes affecting the structure of the earth's crust.

Exercise IV. Match adjectives with suitable nouns.

- | | |
|-----------------|---------------------------|
| 1. substantial | a. leveling |
| 2. precise | b. signal |
| 3. terrestrial | c. engineering structures |
| 4. global | d. potential |
| 5. human | e. movement |
| 6. modulated | f. geodesy |
| 7. local | g. crustal dynamics |
| 8. differential | h. satellite positioning |
| 9. critical | i. range measurements |
| 10. vertical | j. ingenuity |

Exercise V. Complete the text with one word.

Initially, GPS was considered a standard navigation tool for military vehicles on land, and air, but not safety-critical civilian transportation. This was because, military positioning and navigation, safety-critical civilian not only requires quasi-instantaneous and positioning, but also so-called —high integrity..... good coverage. Geodesists will immediately realize that —integrity stands the geodetic concept of —reliability, whereas —coverage refers the availability of a sufficient of satellites that can be sighted a receiver continuously and are not obscured by or man-made obstructions.

On own, GPS cannot these requirements to the level required in safety-critical civilian transportation. Military transportation, on the hand, has relatively modest requirements, which can be met GPS.

Exercise VI. Reorder the words to make a sentence.

1. horizontal - The - on - coordinates - aviation - were - and - based - existing - latitudes - longitudes - civil.
2. and - Heights - still - barometric - aviation - were - are - civil - based - in - on - altimetry.
3. The - change - ground - of - barometric - natural - on - do - the - features - not - changing - heights - with - pressure.
4. The - coordinates - challenge - required - civil - was - first - to - the - community - their - aviation - that - horizontal - international - geodetic - a - proper - convince - datum.
5. led - adoption - the - WGS84 - to - aids - of - resurveying - runways, - of - most - airports, - and - en route - and - The - landing - navigation - various.
6. adoption - first - The - GPS - receivers - did - market - mass - not - lend - themselves - to.
7. receivers - four - satellites - Early - by - measuring - operated - pseudo-ranges - sequentially - to - four - different.
8. One - all - satellite - available - signals - these - track - and - could - measurements - process.

Exercise VII. Make a brief report on one of the following satellite navigation systems:

- a. GALILEO;
- b. GLONASS;
- c. BEIDOU.

UNIT 13

Read and translate the text

CREATION OF GEODETIC SATELLITE NETWORK (part 1)

Methods and technologies of geodetic satellite survey based on GNSS methods are widely used for creation of reference geodetic networks, field aerial survey control point referencing, on-board positioning of aerial imagery photos perspective centers, field topographic survey, land management and cadaster works, monitoring of critical objects.

In the modern world geodetic base network is usually created with the use of global navigation satellite systems (GNSS) GLONASS/GPS principally by application of a differential method. The differential method is the most efficient where there is a network of reference (base) stations with specified geodetic coordinates. Application of the differential method provides for spatial objects' coordinate setting of ± 2 cm accuracy in real time and ± 5 cm in post-processing.

Satellite geodetic network consisting of reference stations can be used for solution of the following tasks: geodesy, cartography, cadaster; planning, construction, exploitation of automobile and railroads; navigation and security control of automobile, railway, air, river and marine transport; planning, construction and exploitation of buildings and engineering constructions, complex engineering objects: bridges, tunnels, oil and gas pipelines, etc.; real-time monitoring of critical objects.

Digital aerial survey

Digital aerial survey is performed with the use of modern topographic mapping aerial survey systems of high productivity, geometric accuracy, spatial resolution and photometric radiometric image quality.

Aerial survey data obtained with the use of full large-format digital aerial cameras is presented in a set of colour and multispectral images in four spectral ranges (red, green, blue, near infrared). Imagery in spectral channels can be used for creation of spectrozonal color-infrared images which possess high decoding interpretation features ability.

Digital aerial survey is performed with the use of on-board positioning and orientation systems which allow direct in-flight determination of imagery horizontalization exterior orientation parameters and thus cutting of expenses on field aerial ground control points referencing survey and the timing of work performance.

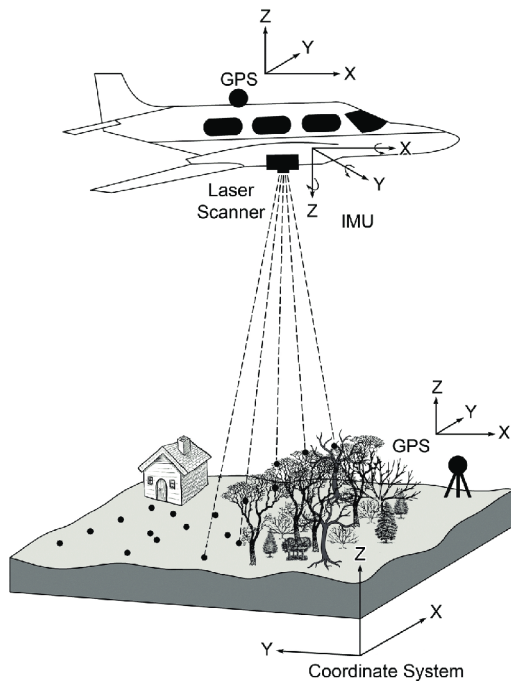
Apart from field aerial survey performed at the vertical position of a visual optical axis, oblique aerial survey (tilted visual optical axis) can be performed as well, which allows more efficient spotting recognition of objects and analyzing of their relative spatial position.

Digital aerial survey is efficiently applied for solution of the following tasks: creation and updating of topographic and special plans maps; creation of the mapping base for real estate cadaster; ecology and nature management (agriculture and forestry); monitoring of various objects; creation of 3D models of objects and territories; reaction to emergencies; creation of visual information systems.

Aerial laser scanning

Aerial laser scanning (lidar aerial survey) implies optic-mechanical scanning of an area by high-frequency pulse laser emission_(for instance, 150 kHz), receiving and registration of a signal (pulse) reflected from the object's surface, determination of the distance from the reflection point and coordinates setting computation of the reflection point laser scanning points.

In order to ensure compute coordinates of laser scanning points (LSP) the aerial laser scanning system (aerial survey lidar) comprises equipped with a positioning and orientation system providing on the base of GNSS and inertial measurements for location position and orientation of a laser scanning system at the moment of pulse emission. This allows acquiring a high-density cloud of laser reflection points with set spatial coordinates.



Aerial laser scanning data is used for: topographic terrain survey and creation of high-accuracy detailed 3D terrain models; lidar survey has unquestionable advantages in solution of this task as this technology provides for high-accuracy survey and point density and allows coordinate setting to get laser reflection scanning points even in forest areas under the canopy; creation of 3D network models of territories and objects (surface models); 3D modelling of buildings and constructions, built-up territories; inspection of electric-technical objects (high voltage power transmission lines, electric substations, etc.); inspection of transport infrastructure objects; bathymetry of inland water-storage bodies reservoirs and the shelf (with use special kind of laser scanning system); inventory and monitoring of forests; inventory of the land and asset complex; monitoring of big engineering objects, for instance, open mines of natural resources.

Laser scanning data processing is performed by a software complex Terra Scan H and TerraModeler based on Micro Station.

(adopted from http://www.agpmeridian.com/technology/creating_a_network_geodzicheskoy/)

VOCABULARY NOTES:

on-board positioning – позиціонування на борту
 accuracy in real time – точність в реальному часі
 post-processing – подальша обробка
 reference station – довідкова станція

oil and gas pipelines – нафто- і газопроводи

exploitation of automobile and railroads – експлуатація автомобільного та залізничного транспорту

image quality – якість зображення

high decoding interpretation features ability – висока здатність інтерпретації декодування

digital aerial survey – цифрова аерозйомка

oblique aerial survey – перспективна аерофотозйомка

tilted visual optical axis – нахилена зрима оптична вісь

reaction to emergencies – реагування на надзвичайні ситуації

laser scanning points – точки лазерного сканування

high-density cloud – хмара високої щільності

water-storage bodies – водосховища

open mines of natural resources – відкриті шахти природних ресурсів

Exercise I. Read the text and answer the following questions.

1. What is aerial laser scanning used for?
2. What are methods and technologies of geodetic satellite survey used for?
3. What is the most efficient method in the modern geodetic base network?
4. What tasks does satellite geodetic network solve?
5. What systems are used to perform digital aerial survey?
6. What can be used for creation of spectrozonal colour-infrared images?
7. What does oblique aerial survey allow to do?
8. What are the tasks of digital aerial survey?
9. What does aerial laser scanning imply?
10. What allows acquiring a high-density cloud of laser reflection points?

Exercise II. Mark the following sentences True or False.

1. Methods and technologies based on GNSS methods are used for many geodetic works.
2. GLONASS and GPS were used to create geodetic base network.
3. Planning, construction and exploitation of building and engineering constructions are the tasks that satellite geodetic network solve.
4. Aerial survey data is presented in a set of colour and multispectral images in six spectral ranges.

5. The use of on-board positioning and orientation systems rise the expenses on field aerial ground control points referencing survey.
6. Aerial laser scanning can be used for creation of 3D network models territories and objects.

Exercise III. According to the text find words opposite in meaning.

1. destroy
2. inaccuracy
3. out of date
4. give away
5. coding
6. interior
7. inefficient
8. absorption
9. questionable
10. forbid

Exercise IV. Match adjectives with suitable nouns.

- | | |
|----------------------|-----------------|
| 1. modern | a. applications |
| 2. unencrypted civil | b. incentives |
| 3. intentional | c. signals |
| 4. essential | d. broadcast |
| 5. spoofing | e. element |
| 6. strong | f. businesses |
| 7. myriad | g. advantage |
| 8. illegitimate | h. attacks |

Exercise V. Fill in the text with the statements from exercise IV.

During the past two decades, the Global Positioning System, together with other GNSSes, has become an **1** ... of the global information infrastructure, with **2** ... in almost every facets of **3** ... and lifestyles, including communication, energy distribution, finance and insurance, and transportation. Ever-growing dependence on GNSS creates **4** ... to attack civil GNSS, for either an **5** ... or a terrorism purpose. Unfortunately, security is not a built-in feature of GNSS open service. It has been known that low-received-power, **6** ... are vulnerable to jamming and **7** Jamming is the **8** ... of a

high-power —blocking signal at the GNSS frequency. Hence, jamming is disruptive but usually detected by the receiver whenever it stops tracking satellites.

Exercise VI. Complete the text using the words in CAPITALS in the correct form.

So far, a variety of methods have been proposed to 1) HARD civil GNSS receivers against spoofing attacks. These defensive methods can be 2) GENERAL categorized into three groups: external 3) ASSIST, signal statistics, and cryptographic authentication. The first group performs consistency checks against metrics external to the GNSS 4) SYSTEM, such as the information from inertial sensors, odometers, cellular networks, and high-stability clocks. The second group performs statistical tests on features inherent in GNSS signals, 5) INCLUDE angle of arrival, signal quality, signal power, and multipath. The third group relies on cryptographic, 6) PREDICT information carried by GNSS signals. Unlike the first group of methods, cryptographic methods need no 7) ADDITION hardware. In comparison to the second group, cryptographic methods enable users to 8) DIFFERENT authentic signals from counterfeit signals with higher 9) CONFIDENT, especially in a complex environment where the statistics of authentic signals can be highly 10) STABLE.

Exercise VII. Make a brief report on one of the following topics:

- a. A Reference station;
- b. On-board positioning and orientation systems;
- c. Lidar survey.

UNIT 14

Read and translate the text

CREATION OF GEODETIC SATELLITE NETWORK (part 2)

Thermal aerial survey

Thermal aerial survey is registration of electromagnetic objects' emission in thermal infrared spectrum range and its reflection in an image and representation of its result like an image.

Thermal emission, whose intensity depends on temperature, can be detected by thermal detectors and transformed into a visible image showing differences in objects' temperature. Thermal survey can be performed both in day and at night time.

At thermal-range Earth remote sensing transmission windows are used with a 3-5, 8-14 micrometer wave length. This range shows own emission of earth surface objects.

Thermal vision observation is a type of thermal control for which a thermal observation device is used as measuring equipment. The thermal observation device allows —seeing the heat and detecting a thermal image on the display. The main distinctive feature of this method is that the thermal observation device allows seeing what cannot be seen with an unaided eye. Man's eye cannot detect objects' temperature, but the thermal observation device is capable of showing its display a ± 1 °C accuracy thermogram of an object.

Thermal survey application areas are engineering applications, ecology, forest resources management, agriculture, engineering geology and hydrology.

Georadar sensing

Georadar sensing is performed with the use of georadars operating at depths up to 5 m and a 20 cm resolution and providing for detection of density fluctuations of the surveyed surface at creation of georadiolocation profile, thus enabling this method to reveal underground communications including those without a temperature contrast.

Georadiolocation or georadar survey is a modern non-destructing method of soil and construction base inspection which implies analysis of pulses reflected from boundaries of spheres with different electro physical characteristics.

Modern georadars are a powerful geophysical instrument whose application provides for acquisition of large amounts of detailed data during a relatively short time period. Application of a georadar for survey allows creation of a high-reliability volumetric picture during analysis of different spheres at varied depths.

Georadar survey is used for inspection of: soil, which allows detecting the composition and width of layers, presence of frozen or over-moisturized areas, land slide processes and tectonic distortions, cavities, deconsolidation areas, underground communications, boundaries of soil and anthropogenic waters, etc.; automobile roads, which allows assessing the width of road surface construction layers, types, humidity and density of soil and under-surface base; location of soil water levels, location of a sliding curve at land slide areas, spatial contour of geologic horizon base under a back of ballast bed, locations of deconsolidated soil, cavities and infiltration of underground waters; bases and industrial floorings; constructions of buildings (beams, floors, pillars, etc.), which allows detection of inner cracks, uneven settlement, presence of iron

reinforcement and its deformation, infringement of construction regulations and project requirements, assess the density and toughness of materials; ice situation, which allows performing control of the width and condition of ice both during freeze-up and flood water periods.

In automobile roads planning the economic effect of application of 3D models acquired with the use of georadars is reached due to reduction of drilling operations with a several-times' enhancement of reliability of the engineering-geologic data, choosing of efficient reconstruction and overhaul types differentiated by automobile road areas.

Exploitation of a shelf zone requires acquisition of data on sea bottom condition, underwater and on-surface constructions. A modern method of sea bottom, underwater and on-surface construction inspection implies analysis of pulses reflected from boundaries of spheres with different electro physical characteristics.

The georadiolocation method allows observation of ice for assessment of its width, monitoring in the areas of automobile ice passages, winter trails, detection and localization of uneven areas inside ice massive.

Georadiolocation survey can be performed by contact - shifting a georadar antenna on the ice surface, and non-contact - placing a georadar on board an aerial survey aircraft with the use of a side-looking locator.

VOCABULARY NOTES:

electromagnetic objects' emission – випромінювання електромагнітних об'єктів

thermal infrared spectrum range – тепловий інфрачервоний діапазон спектру

wave length – довжина хвилі

measuring equipment – вимірювальне обладнання

distinctive feature – відмінна риса

an unaided eye – неозброєним оком

density fluctuations – коливання щільності

non-destructing method – неруйнівний метод

acquisition – придбання

land slide process – зсувний процес

tectonic distortions – тектонічні порушення

humidity and density of soil – вологість і щільність ґрунту

ballast bed – баластний пласт

pillar – стовп

inner cracks – внутрішні тріщини

uneven settlement – нерівномірне осідання

infringement of construction regulations – порушення будівельних норм
project requirements – вимоги до проекту
toughness of materials – міцність матеріалів
freeze-up and flood water periods – періоди замерзання та паводку
drilling operations – бурові роботи
enhancement of reliability – підвищення надійності

Exercise I. Read the text and answer the following questions.

1. What is thermal aerial survey?
2. What devices are used to detect thermal emission?
3. What is a peculiarity of the thermal observation device?
4. What areas is thermal aerial survey used?
5. What does georadiolocation imply?
6. What geophysical instruments are used to get large amounts of data during a short period of time?
7. Where is georadar survey used?
8. What does exploitation of a shelf zone require?
9. What method analyses pulses reflected from boundaries of spheres with different electro physical characteristics?
10. How is georadiolocation survey performed?

Exercise II. Mark the following sentences True or False.

1. Thermal survey can be performed only in day time.
2. Thermal observation device is used to detect a thermal image on the display.
3. Georadar sensing reveals underground communication including those with a temperature contrast.
4. It is possible to get a high-reliability volumetric picture with a help of georadars.
5. Using georadar survey one can detect the inner cracks of the building, composition and width of soil layers.
6. The economic effect of application of 3D models is reached due to increasing of drilling operations.
7. The georadiolocation method allows detection and localization of even areas inside ice massive.

Exercise III. According to the text find words similar in meaning.

1. evident

2. to discover
3. to convert
4. a machine
5. to work
6. to supply
7. an instability
8. to contain
9. a border
10. a distortion

Exercise IV. Match words with their definitions.

application data survey transmission radar equipment layer emission

- 1..... - examine and record the area and features of (an area of land) so as to construct a map, plan, or description;
- 2..... - a program or signal that is broadcast or sent out;
- 3..... - the production and discharge of something, especially gas or radiation;
- 4..... - the necessary items for a particular purpose;
- 5..... - the action of putting something into operation;
- 6..... - a system for detecting the presence, direction, distance, and speed of aircraft, ships, and other objects, by sending out pulses of radio waves which are reflected off the object back to the source;
- 7..... - a sheet, quantity, or thickness of material, typically one of several, covering a surface or body;
- 8..... - facts and statistics collected together for reference or analysis.

Exercise V. Match sentence halves.

1. GPR (ground penetrating radar) can search for objects	a. to locate buried objects.
2. GPR can be detected both metal and non-metallic objects,	b. GPR is used to define landfills, contaminant plumes.
3. GPR uses the principle of scattering of electromagnetic waves	c. through the thickness of the ice and water, sand, earth and stone.

4. The fundamental principle of operation is the same as that used to detect aircraft overhead,	d. and buried evidence.
5. The depth range of GPR is limited by the electrical conductivity of the ground	e. as well as empty under a layer of Earth, masonry walls, and foundations.
6. Optimal depth penetration is achieved in ice where the depth of penetration	f. can achieve several hundred meters.
7. In environmental remediation,	g. but with GPR that antennas are moved over the surface rather than rotating about a fixed point.
8. GPR is used in law enforcement for locating clandestine graves	h. the transmitted center frequency and the radiated power.

Exercise VI. Ask all possible questions to the sentences from exercise V.

Exercise VII. Reorder the words to make a sentence.

1. into GPR been the near developed a sophisticated detailed that can provide technique images of has surface.
2. the research on for has GPR been environmental conducted and of engineering Most applications.
3. depths GPR few provides a pseudo-image three that can that converted easily be to are to accurate down dimensional a centimeter.
4. GPR responds to both metallic and non-metallic objects.
5. is a tool in homogeneity for mapping any in the that subsurface is excellent GPR characterized by a density nearly small porosity difference in or.
6. Thermal monochrome is data in to full retain resolution recorded.
7. Conversion purposes analysis to useful for presentation is color specific and.

Exercise VIII. Make a brief report on the following topic:

- a. Ground penetrating radar (GPR)

UNIT 15

Read and translate the text.

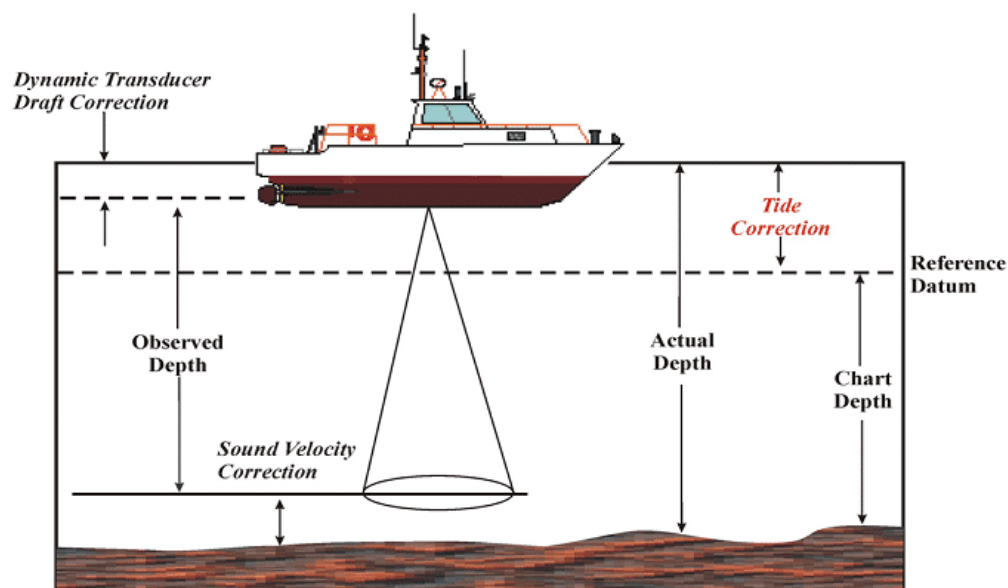
CREATION OF GEODETIC SATELLITE NETWORK (part 3)

Hydrographic research

Hydrographic research is a survey process of separate hydrosphere areas which includes scientific design, performance of hydrographic works, processing and analysis of their results. The contents of a hydrographic survey are determined by the composition and amount of the data the Orderer-Customer requires.

Similar to assessment of altitude determination of large numbers of points in an area during topographic earth terrain survey, in hydrography for survey of underwater terrain depths are measured in all surveyed area. In fact, hydrographic works are a continuation of topographic and geodetic works in the areas of the World Ocean and inland waters.

But qualities of every geographic sphere and specific purposes lead to important features both in operational methods and applied means. What are these features? First of all, the necessity of special carriers for measuring equipment. When in shore survey geodetic and topographic devices can be placed directly in any point of the surveyed area, for performance of underwater terrain survey as well as other types of hydrographic operations special platforms shall be used and duly equipped to be kept on water surface or under water. Surface vessels and deep-sea submersibles are used as such platforms. Only at complete freezing of a water zone survey can be performed directly from the ice surface.



Further, the platform with the mounted equipment will move in order to perform survey of all water zone of the surveyed area. Consequently, its position is changing non-stop. Even if the vessel is anchored, its shift must be taken into consideration. It is evident that for attribution of measurement results to any fixed point the measurements will be performed very fast. The said circumstance entails the following important feature of hydrographic works: they will be accompanied with frequent and precise coordinate setting of a point in which the measurements were carried out. Ideally, it should be determined non-stop so that measurements at any moment would be linked with the real place.

The purpose of the survey is not only to reliably determine mutual location of different objects at sea, but also to specify the precise location of surveyed objects on the Earth surface. To achieve this, their planned fixing shall be made to a uniform coordinate system of the earth ellipsoid. In on-surface survey planned fixing is made with the use of geodetic networks. At sea there are no such networks, which lead to significant features of plan substantiation of hydrographic works.

The modern hydrographic survey complex includes survey of the following main elements: underwater terrain; sea shores; sea bottom soil; geophysical fields; oceanographic and hydrologic characteristics.

Measurements and observations carried out in water zones and in the process of hydrographic survey are called hydrographic works.

TrueOrtho

A digital orthophoto is simply a photographic map that can be used to measure true distances. It is an accurate representation of the earth's surface. To create a digital orthophoto, several key input files are necessary: aerial photos with a high percentage overlap, scanned imagery, aero triangulation (A.T.) results, and a digital elevation model (DEM). Scanned imagery can be obtained from scanning aerial photo diapositives or negatives on an image-quality scanner. The A.T. results include a camera calibration report and the ground control. At a minimum, the DEM can be a regularly spaced grid of mass points, each containing an x, y, and z value. A more robust digital terrain model (DTM) can also be used because it includes strategically placed mass points, dense breaklines, and ridgelines.

Digital orthophotography is a resource being utilized by a significant portion of GIS users. It has become a popular base layer in modern GIS. With the price of disk space dropping and the speed of computers increasing, digital orthophotos are a viable option for building a fully developed GIS. Digital orthophotos can be used for

technically specific needs such as plan metric or cadastral mapping; utility data capture and quality control; and accurate project analysis and design implementations.

Digital orthophotos can also be used to explain projects and issues to the general public because real-world pictures are easier for the untrained eye to understand. They contain landmarks and recognizable places. For example, digital imagery can help an audience visualize the new light rail corridor by showing existing conditions. Proposed changes can be overlaid as vector information. The world is constantly changing, and digital orthophotography can help monitor change.

<http://www.esri.com/news/arcuser/1001/standup.html>

VOCABULARY NOTES:

Orderer-Customer – клієнт-замовник

the composition and amount of the data – склад і кількість даних

assessment – оцінка

underwater terrain depths – глибини підводного рельєфу

applied means – прикладні засоби

a surface vessel – надводне судно

a deep-sea submersible – глибоководний підводний апарат

to mount – монтувати

to anchor – закріплювати

to entail – тягти за собою

to accompany – супроводжувати

frequent and precise coordinate setting of a point – часте і точне встановлення координат точки

planned fixing – плановий ремонт

significant features of plan substantiation – істотні ознаки обґрунтування плану

an accurate representation – точне уявлення

high percentage overlap – високий відсоток перекриття

digital elevation model – цифрова модель рельєфу

dense breaklines – щільні лінії розриву

ridgelines – хребти

to utilize – використовувати

utility data capture – збірних корисних даних

design implementations – реалізація дизайну

landmarks and recognizable places – наземні орієнтири та впізнаванні місця

Exercise I. Read the text and answer the following questions.

1. What is hydrographic research?
2. How is hydrographic work considered regarding topographic and geodetic works?
3. What devices are used for hydrographic operations?
4. How is the hydrographic survey performed?
5. What is the purpose of the hydrographic survey and how to achieve it?
6. What are the main elements of the modern hydrographic survey?
7. What is a digital orthophoto?
8. What files are necessary to create a digital orthophoto?
9. What are digital orthophotos used for?

Exercise II. Mark the following sentences True or False.

1. Composition and amount of the data is the basis of hydrographic survey.
2. Geodetic and topographic devices should be placed in special point of the surveyed area.
3. Geodetic networks are used for underwater survey.
4. Hydrographic works are measurements and observations carried out in water zones.
5. Aerial photo diapositives or negatives are necessary to obtain a scanned imagery.
6. The DEM includes a camera calibration report and the ground control.
7. Digital orthophotography is an option for building a fully developed GIS.

Exercise III. According to the text find words similar in meaning.

1. gist
2. region
3. particular
4. coast
5. ship
6. connect
7. site
8. constant

Exercise IV. According to the text find words opposite in meaning.

1. exclude
2. foreign
3. strip
4. shallow

5. individual
6. trivial
7. false
8. die

Exercise V. Match two halves of the statements and translate them into Russian.

- | | |
|---------------------------|----------------------------|
| 1. the assignment of | a. methods |
| 2. standardization of | b. photograph |
| 3. ground | c. X & Y coordinate values |
| 4. optical | d. improvements |
| 5. came into | e. features |
| 6. the radiometric or | f. displacement |
| 7. removing the relief | g. use |
| 8. vertical aerial | h. software algorithms |
| 9. sophisticated computer | i. tonal adjustments |
| 10. technological | j. scale |

Exercise VI. Fill in the sentences with the statements from exercise V.

1. Orthophotography first ... in the 1960's.
2. By the early 1970's, ... brought this data source into affordable commercial applications and its use has continued to expand.
3. The first orthophotography was produced by computer driven ... and equipment.
4. Today, these pieces of equipment have been replaced by the computer workstation and
5. The orthophoto is able to display actual ..., not cartographic representations of those features.
6. Regardless of the method of construction, four basic operations or corrections must be applied to the standard ... to produce the orthophoto.
7. The first correction is the ... across the image.
8. The second correction involves ... to position the terrain in its true location.
9. The third operation entails ... to the image.
10. The final task involves ... to allow the image to blend with neighboring images.

Exercise VII. Make a brief report on the following topic:

- a. Geodetic satellite network

PART II

SUPPLEMENTARY READING FOR WRITTEN TRANSLATION

Surveying

Surveying or land surveying is the technique, profession, and science of determining the terrestrial or three-dimensional position of points and the distances and angles between them. A land surveying professional is called a land surveyor. These points are usually on the surface of the Earth, and they are often used to establish land maps and boundaries for ownership, locations like building corners or the surface location of subsurface features, or other purposes required by government or civil law, such as property sales.

Surveyors work with elements of mathematics (geometry and trigonometry), physics, engineering and the law. They use equipment like total stations, robotic total stations, GPS receivers, prisms, 3D scanners, radios, handheld tablets, digital levels, and surveying software.

Surveying has been an element in the development of the human environment since the beginning of recorded history. The planning and execution of most forms of construction require it. It is also used in transport, communications, mapping, and the definition of legal boundaries for land ownership.

The American Congress on Surveying and Mapping (ACSM), defines surveying as the science and art of making all essential measurements to determine the relative position of points or physical and cultural details above, on, or beneath the surface of the

Earth, and to depict them in a usable form, or to establish the position of points or details.

How to Use Surveying Equipment to Determine Land Boundaries

Surveying is the technique, profession, and science of determining the dimensions and contour of the Earth's surface. Using specialized surveying equipment, professional surveyors determine land boundaries for a variety of important reasons. One of the most common reasons for a consumer to acquire the assistance of a surveyor is the acquisition of a new piece of land, as it has to be legally determined where one person's property ends and another begins for government issued deeds. Additionally, surveyors work with cartographers to create accurate maps.

Surveying has existed in one form or another for at least 5,000 years; virtually all of recorded human history and likely even beyond. The pyramids in Egypt and Stonehenge in England are believed to have been created with the assistance of an ancient surveyor. It is an essential element of civilized society. Working with a combination of skills derived from physics, engineering, law, and the mathematics, surveyors are well trained to accurately measure flat and three-dimensional points, as well as the distance and angles between them.

Surveying Tools

Surveying requires data from three primary components. This includes the measurement of distance, angles, and elevation. There are several different types of survey tools but each tool is capable of providing the necessary data from one or more of the measurement types.

The art of surveying remained relatively unchanged until the late 1990s. Since the advent of more technologically advanced survey equipment, such as global positioning systems and electronic measurement devices, the tools available to the surveyor have become greater and more enhanced. As a result, some of the older techniques, such as the use of chains and tape are falling out of favor.

Surveying Techniques

Historically, distances were measured using a variety of means, such as with chains having links of a known length, for instance a Gunter's chain, or measuring tapes

made of steel or invar. To measure horizontal distances, these chains or tapes were pulled taut according to temperature, to reduce sagging.

Historically, horizontal angles were measured using a compass, which would provide a magnetic bearing, from which deflections could be measured. This type of instrument was later improved, with more carefully scribed discs providing better angular resolution, as well as through mounting telescopes with reticles for more-precise sighting atop the disc. The simplest method for measuring height is with an altimeter – basically a barometer – using air pressure as an indication of height. But surveying requires greater precision. A variety of means, such as precise levels (also known as differential leveling), have been developed to do this. With precise leveling, a series of measurements between two points are taken using an instrument and a measuring rod.

Triangulation is another method of horizontal location made almost obsolete by GPS. With the triangulation method, distances, elevations and directions between objects at great distance from one another can be determined. Since the early days of surveying, this was the primary method of determining accurate positions of objects for topographic maps of large areas. A surveyor first needs to know the horizontal distance between two of the objects. Then the height, distances and angular position of other objects can be derived, as long as they are visible from one of the original objects. High-accuracy transits or theodolites were used for this work, and angles between objects were measured repeatedly for increased accuracy.

Particle Swarm Optimization in Comparison with Classical Optimization for GPS Network Design

In recent years, satellite methods such as the Global Positioning System (GPS) have gradually been replacing traditional procedures for conducting precise horizontal control surveys. In fact, GPS not only yields horizontal positions, but it gives ellipsoidal heights as well. Thus, GPS provides three-dimensional surveys.

Upon development of the Global Positioning System (GPS), it became very attractive for surveyors due to its fast, accurate and economical results. GPS also can be operated in all weather and 24 hours a day, while still giving precise surveying measurements.

Nowadays, with increasing technological developments, GPS networks have taken place of terrestrial networks.

Optimal design of geodetic GPS networks is an essential part of most geodesy related projects. Whether or not the datum and point locations of a network are known,

the process of determining the optimal baseline configuration and their optimal weights—the —second order design problem (SOD)—with respect to the selected design criteria can be achieved by optimizing the observational plan. The scalar design criteria can only satisfy limited demands for a network, however. Thus, criterion matrices are mostly used; these can be defined as the computed variance covariance matrix in the design stage that meets many of the accuracy demands. Analytical approximations of the criterion matrices are an effective method of reaching objective functions formulated with criterion matrices.

Theoretically, the best precision and reliability of the relative positions of a GPS network can be obtained if all visible satellites are tracked as long as possible and all possible baselines in the network are measured. Due to the limitations of time and expense, however, that will rarely happen in practice, and therefore an optimum survey design has to be made in order to achieve some prescribed design criteria while minimizing effort.

In the present study, the optimization procedure gives the optimal observational weights, which can be grouped into significant and zero or insignificant weights. The significant weights, some of which may be smaller than the initial weights, are then replaced by their corresponding initial weights. Baselines that obtain a zero or insignificant weight represent those that should be deleted from the final observing plan.

There are two methods for design of a GPS network, classical methods and intelligent optimization techniques. Classical methods include the trial and error method and the analytical method, while intelligent optimization techniques include global optimization techniques and local optimization techniques. Recently, some global optimization methods such as the Particle Swarm Optimization (PSO) algorithm or genetic algorithms have begun to be used in geodetic science.

The PSO method was originally intended for simulating the social behavior of flocks of birds, but the algorithm was simplified and the realization was made that the agents, here typically called particles, were actually performing black-box optimization. In PSO the population of particles is typically called a swarm. In the PSO method, particles are initially placed at random positions in the search-space, moving in randomly defined directions. The direction of a particle is then gradually changed so it will start to move in the direction of the best previous positions of itself and its peers, searching in their vicinity and potentially discovering even better positions.

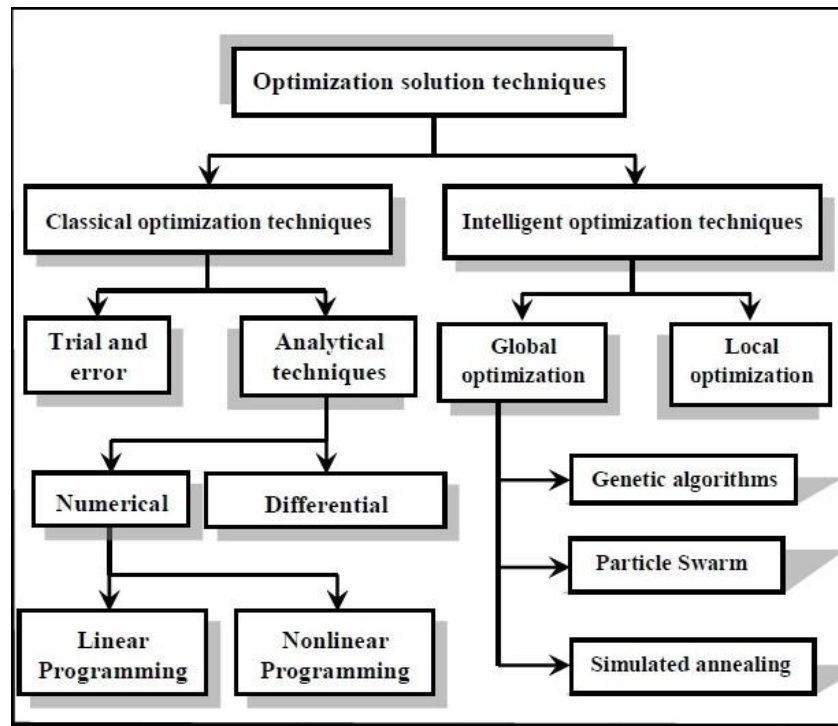


Figure 1. Optimization solution techniques

In the present study, our aim was to carry out observational plan optimization of GPS networks with respect to the accuracy criteria, based on the PSO technique.

In general, there are several techniques that can be applied for solving the problem of determining the maximum or minimum value of a function. The main kinds of these techniques are (see Fig. 1) classical optimization techniques and intelligent optimization techniques.

The classical optimization techniques are useful for finding the optimum solution or unconstrained maxima or minima of continuous and differentiable functions.

Classical techniques are not exempt from problems. For instance, there may be either no consistent solution, or a solution wherein the proposed network contains many observations which are assigned a weight of zero, which makes these sites disappear from the observation plan and drastically diminishes network redundancy. Many new attempts and applications have been derived for network design problems such as intelligent optimization techniques. The successful performance of these intelligent optimization techniques has also led to their application in many other problems in geodesy and geodynamics. Intelligent optimization techniques represent a new approach to addressing complex problems with uncertainties. Intelligent systems are defined by such attributes as having a high degree of autonomy, being capable of reasoning under uncertainty, having higher performance in a goal seeking manner, working at a high

level of abstraction, being able to fuse data from a multitude of sensors, learning and adapting to a heterogeneous environment, and so on. Intelligent optimization techniques can be divided into two categories: local and global optimization.

A local maximum is a candidate solution that has a higher value from the objective function than any candidate solution in a particular region of the search space. Many optimization algorithms are only designed to find the local maximum, ignoring both other local maxima and the global maximum.

Recently, new solutions for optimization problems for geodetic networks have emerged which are intelligent (global) optimization techniques. These include Genetic Algorithms (GAs), Particle Swarm Optimization (PSO) and Simulated Annealing (SA).

Medium to high-frequency static DGPS error reduction using multi-resolution de-noising vs.de-trending procedures

Multipath mitigation in the final measurements domain (carrier/ code observables) is a result of the large amount of residuals from mitigation in the antenna/receiver domain. (Raquet and Lachapelle 1996) used a multi-antenna array to mitigate the multipart error at the GPS reference station. (Han and Rizos 1997) were the first to propose the use of finite impulse response (FIR) filters to extract or eliminate multipath. However, this technique has certain limitations because signals (i.e.: crustal deformation) that fall into the same frequency band will be removed. A more effective technique, based on the use of an adaptive filter to extract and eliminate multipath, was suggested by (Linlin et al. 2000, Lee 2008). Since GPS observation noise tends to change with time, it was determined to be more appropriate to use an adaptive filter rather than a fixed filter for the purpose of multipath mitigation. The implementation of such a technique is dependent on the selection of an appropriate value for the step-size parameter and the filter length. (Zhang and Bartone, 2004) developed a multipath mitigation technique based on the multipath frequency spectrum analysis. They used code minus carrier to model multipath errors and identify window size before the error was transformed into the frequency domain using the Fast Fourier Transform (FFT). In the Fourier coefficients domain, the authors mitigated the multipath error based on the estimated multipath frequency. The reconstruction stage uses the Inverse Fast Fourier Transform (IFFT) to compute the multipath error-reduced code-phase measurements. This technique effectively reduces code multipath error, particularly in the static mode,

where the multipath fading frequency is well predicted and the fading frequency ranges from zero to 1 Hz.

However, more investigation is required to apply this correction in kinematic mode given the rapid change in multipath frequency. Wavelets are used extensively as an alternative to FFT analysis because their elements are essentially waveforms indexed by three parameters: position, scale and frequency. This is what produces such strong localized time–frequency properties, which gives the wavelets the ability to provide an accurate location of the transient component in the signal while retaining information about the fundamental frequency. Therefore, wavelet transforms offer advantages over the frequency domain analysis (Fourier analysis) and the time domain analysis (Kalman filter). Most of the research conducted on wavelet multipath mitigation uses wavelet transform on its own or combined with other techniques to mitigate high-frequency multipath error. (Dammalage et al. 2010) used biorthogonal wavelets to de-noise code measurements for DGPS applications and reached a 60% error reduction. (Ogaja and Satirapod 2007) applied the Symlet base function at the fourth scale decomposition level to detect and separate high frequency multipath errors from receiver noise when using high-rate (1-Hz) GPS data. (Souza and Monico, 2004) investigated the use of both Symlet and Daubechies base functions to reduce the high-frequency multipath in GPS relative positioning. They tested both the hard and soft threshold along with the median threshold estimator and concluded that Symlet12 along with the hard threshold performed the best and achieved a 30% error reduction. (Satirapod and Rizos 2005) used wavelets to mitigate multipath at permanent stations.

The use of wavelets as a de-noising tool for processing and mitigating multipath error proved to be an effective tool for high-frequency multipath mitigation. In contrast, de-noising techniques cannot remove this type of error in medium to low-frequency multipath components. As a result, wavelets should be used differently according the type of errors being mitigated, for high frequency errors wavelet de-noising should be used to mitigate that error while in low frequency error wavelet de-trending should be the method of mitigation. Many of the techniques discussed above already used wavelets as a de-noising tool but it is still not clear which wavelet parameters should be used with GPS double difference data to mitigate the medium to high-frequency errors (mainly multipath and uncorrelated ionospheric error). Moreover, there is no comparative analysis made using different wavelet thresholding estimators or techniques to mitigate the medium to high frequency errors or the best wavelets de-noising technique for GPS error mitigation.

This research paper will introduce two different multi-resolution techniques that can be used separately or combined to remove the low to high-frequency GPS errors. The first technique is applied using the wavelets as a de-noising tool to tackle the high-frequency errors in the double difference domain and to obtain a de-noised double difference signal that can be used in a positioning calculation. The second technique discussed in this paper uses the wavelets technique as a de-trending tool to tackle the low-frequency portion of the double differenced measurements. The de-trended and the de-noised double differenced measurements will be used to compute accurate positions for the baselines length from a few hundred meters to 50 km.

Wavelets De-Noising

Double difference errors may have low (coarse-gain) and/or high frequency (fine-gain) fluctuations. Fortunately, the high-frequency aspect is relatively easy to remove if the proper de-noising threshold is applied. Multi-resolution analysis has been proven to be an important tool for eliminating noise in signals. The strong localization properties of the wavelets in the time and frequency domain allow the wavelets to detect fine and coarse variations in the signal. A basic wavelet de-noising algorithm consists of three steps:

1. Decompose the noisy signal (double difference GPS signal) using a wavelets multi-resolution analysis of its details and approximations.
2. De-noise the details' wavelets coefficients, which contain the high-frequency portion of the signal.
3. Reconstruct the de-noised signal by applying the inverse wavelet transform to de-noised coefficients.

One of the main advantages of wavelets is the presence of various parameters that can be controlled to help in the classification and separation of different types of signals with different frequencies. The concept of wavelet analysis is based on finding the similarities between the candidate base function and the signal, therefore the wavelet parameters must be selected to match the properties of the GPS double difference error. Four different parameters are used in this research to create several combinations to detect the optimum combination in reducing the high-frequency GPS errors. These parameters are:

1. Wavelet base function and vanishing moment
2. Level of decomposition
3. Threshold type
4. Threshold estimator

All the possible combinations among the parameters are investigated to ensure that the use of the wavelet transform technique is efficient for GPS error mitigation.

Wavelet De-Trending

The low-frequency portion of multipath is what creates the largest error, which in carrier phase measurements can reach up to 5 cm. Wavelets are used to remove the high-frequency oscillation from the investigated signal by changing the detail coefficient values of the wavelet decomposition to zero and reconstructing the signal using the modified wavelet coefficients. If the details associated with noise cannot be determined properly, either useful signals will be missed or a reconstructed signal may contain severe noise. In the case of a double difference signal, multipath is distributed at varying levels of decomposition. In order to reach the low-frequency multipath error, a higher level of decomposition is required. Thresholding the details at a level where the largest low-frequency multipath error is suspected will reduce the overall error. But to reach that error, other unwanted frequencies are induced in the reconstructed signal at the lower levels of decomposition.

A new approach based on a wavelet de-trending technique is introduced to remove the long wavelength carrier phase multipath error in the measurements domain. In order to mitigate multipath, GPS double difference observables are introduced to an adaptive wavelets analysis procedure based on high and low pass filter decomposition with varying levels of resolution. The procedure is applied after cycle slips detection and repair. Based on the previous knowledge and facts that the largest errors are caused by the low-frequency multipath, the wavelet transform approach is used to separate the multipath error at high levels of decomposition. The separated wavelet coefficients (approximation or high-level decomposition coefficients) are truncated using wavelets thresholding techniques before the reconstruction of the signal to acquire the true double difference carrier phase residuals out of the low-frequency multipath.

The experiment showed that the de-noising technique gives consistent results for both short and long baselines. The average bias reduction that can be achieved from the de-noising technique is around 20-30% and the average RMS reduction is around 30-40%. Moreover, the de-trending technique outperforms the de-noising technique for RMS improvement in short and long baselines. The performance in the de-trending technique is almost three times better than the traditional de-noising technique for bias and RMS reduction. Although the de-trending technique outperforms the de-noising technique in the RMS reduction, it does produce inconsistent result for the bias reduction. The de-trending methodology performed impressively for short baselines in RMS and bias reduction as the average RMS and bias reduction were around 80%.

However, for longer baselines the bias reduction is minimal although the RMS reduction is still in the range of 70 – 80%. It can be concluded that the de-trending technique can reduce the double difference errors dramatically for short baselines. Conversely, the de-trending technique can cause a biased solution for long baselines depending on the low frequency part of the error (ionosphere, low multipath), as it will enhance the RMS value and indicate good statistics for the solution but not enhance the bias to the same level. Therefore, it is important to isolate ionospheric error by modeling (and not spectrum filtering) before dealing with multipath, as it is hard to separate between both errors in the spectral domain.

Geodetic use of global digital terrain and crustal databases in gravity field modeling and interpretation

Current terrestrial and satellite observation methods and the corresponding data analysis procedures lead to the construction of global digital databases for the description of the earth's crust and topography with an increasing resolution and accuracy. Today global digital terrain models are available, which can reach a spatial resolution of up to 30×30 meters. However, such a resolution is neither global nor homogeneous and can only be achieved over continents. The question of mapping the ocean topography still remains mainly a methodological task with the major contribution being the inversion of altimetry data and altimetry-derived surface gravity data to produce the corresponding interface, i.e. the relief of the oceanic bottom separating water from oceanic crust. The production of global crustal models on the other hand is based on the exploitation of active seismic data, the compilation of available geological information and the generalization that physical properties of certain tectonic types have global character and can be assigned to similar tectonic settings. Using this methodological approach, the model CRUST 5.1 and its follow-up CRUST 2.0 provide a global representation of the geometry and consistency of six (seven, if one includes ice thickness) distinct crustal layers starting from the visible topographic relief and expanding down to the crust-mantle boundary with a unified resolution of 5×5 and 2×2 respectively. The geometry of the last layer of a global crustal model provides directly a global estimate of the Mohorovicic discontinuity, information that can be opposed either regionally or globally to other independent sources of Moho data. A further example of exploiting the global crustal data is for local or regional applications of gravity field modeling, where the shape and density data emerging from the database can be used in

the frame of some forward or inverse modeling procedure. However, the main asset of global digital databases with direct relation to gravity field analysis is the spatial resolution of the respective datasets.

The exploitation of this information is linked to the spectral analysis of the global geographical grids and leads to the computation of a particular class of gravity field coefficients, the so-called topographic/isostatic (t/i) spherical harmonic coefficients. The highest degree and order up to which these coefficients can be evaluated depends in this case solely on the spatial analysis of the input information, i.e. the global terrain or crustal data. The denser these global grids are, the higher the maximum degree and order of the corresponding t/i spherical harmonic sets. Thus, the incorporation of dense global digital terrain and crustal data in the appropriate spherical harmonic analysis scheme enables the retrieval and therefore interpretation of the high and very high frequencies of the observed gravity field.

The analysis of global digital terrain and crustal databases leads to the recovery of the medium to high frequencies of the observed gravity field signal. The continuous release of databases with very high resolution enables furthermore the retrieval of the very high frequency part. The significance of the obtained topographic/isostatic models is twofold. On the one hand they provide a direct insight to the corresponding bandwidth of the observed gravity field in terms of their dimensionless potential harmonic coefficients. At the same time, they act complementary to other gravity field information, especially when it does not contain information on the small wavelength features of the gravity field, e.g. the currently available satellite-only gravity field models. In this way the geometrical and physical data of the databases can assist the challenging task of gravity field analysis and interpretation. With the resolution of the available global databases steadily increasing the t/i approach presents an efficient tool for an advanced band-limited analysis for capturing, interrelating and interpreting the medium, high and very high frequency part of the observed gravity field of the available, and especially forthcoming satellite only and combined Earth gravity models at all computational scales (global, regional and local). Apart from the resolution of the input data the features of a t/i approach in terms of gravity field recovery are determined by the type of compensation that is applied to the crustal masses. The different compensation mechanisms affect the mathematical formulation of the t/i model and thus the actual computed t/i spectrum. The two standard approaches are the Airy/Heiskanen and the Pratt/Hayford isostatic hypotheses. These two models appear also in the related literature of t/i models, either for the computation of purely isostatic Earth gravity models, or in the frame of the development of synthetic Earth gravity model. The

spectral representation of the t/i models that are produced from these two compensation mechanisms reveals a complementary aspect of the two isostatic hypotheses in the spectral domain. One of the main features of t/i models is their smoothing effect on the observed field, without any loss of physical information that any low-pass filtering would cause. This smoothing feature can be seen spectrally by the decrease in power of a t/i model when compared to an uncompensated topography spectrum or some observed reference gravity field. The displayed computations showed that the A/H based t/i model acts in a compensating manner for the long wavelength and most of the medium to short wavelength part of the gravity spectrum. Up to degree 400 it reduces significantly the power of the observed field, and starts to converge to the uncompensated topography spectrum for the high and very high frequencies, the part of the spectrum where the uncompensated topography coincides spectrally with the EGM2008 reference field. The P/H model on the other hand performs in a reversed manner, and thus complementary to A/H as far as its compensation effect is concerned. It shows no compensating effect for the long wavelengths, but starts to act as one would expect a t/i model to perform, only for the high and very high frequencies, where it reduces the power of the uncompensated topography and EGM2008 spectra in almost the same order of magnitude as the A/H model does in the lower degrees. This complementary feature is important and can be utilized in current gravity field analysis, as the incorporation of databases with increasing resolution permits the retrieval of even higher frequencies of the observed gravity field.

Examination of two major approximations used in the scalar airborne gravimetric system — a case study based on the LCR system

As a physical variable that is closely related to the mass distribution of the Earth, gravity is very helpful to geodesists and geophysicists in determining the figure of the Earth and understanding its subsurface structure. For instance, in geodesy, gravity is needed almost everywhere, because only this quantity offers the spatial orientation of the local horizon plane. Many methods such as SST (satellite-to satellite tracking), SGG (satellite gravity gradiometer), INS/GPS vector gravimeter, and airborne scalar gravimetry have been developed for gravity field determination over the decades.

The satellite missions are mainly designed to obtain medium to long ($\sim > 50$ km) wavelength gravity field information, while the other moving base gravimetric systems are used for detecting the medium to short ($\sim < 50$ km) wavelength contribution. For

instance, in the scalar system, Olesen (2003) reported a spatial resolution of 6km or even better with 1~2 mGal accuracy. A relatively recent study in the vector system obtained about 2km spatial resolution with 1~3 mGal precision and as good as sub-mGal (0.64 mGal) repeatability. SGL (Sander Geophysics Limited) showed even better resolution and accuracies (30 0m with RMS=0.4 mGal) in their unique AIRGrav (Airborne Inertially Referenced Gravimeter) system, which is based on a customized gyroscopically stabilized platform, when operating in a slow speed (~16 m/s). Note: these sub-km spatial resolution and sub-mGal accuracy from SGL were not along the survey lines as it is customary. They were the grid resolution and grid accuracy, which were based on 1.25 km frequency domain spatial low pass of the 20-second filtered line data that were 50 to 100 meters apart to each other. However, Staudinger et al. (2008) indeed showed in a case study that the AIRGrav system is superior to the LCR system in terms of resolution and accuracy.

Beside the mechanical differences of these two systems, where geodesists have limited power to control, the equations in the scalar systems have several ambiguous issues that need to be cleared when compared with the equations used in the 3D cases. At present, the scalar airborne equations used in most of cases ignore the higher order terms in the Eötvös term and have a fuzzy positioning transformation from the phase center of the GPS antenna to the gravimeter's mass center. Several groups tried to analyze these problems in some case studies, and found that these approximations can be 'safely' neglected in their applications. By both rigorous yet succinct derivations and extensive numerical evaluations, this study confirms the magnitudes of these approximation effects are indeed small in the context of the current airborne survey accuracies, i.e., mGal level, especially after filtering, smoothing or de-noising processes. However, these approximations need to be removed for the theoretical completeness and for the future high accuracy systems, μ Gal level.

Unlike the equations of vector gravimetry that solves the full gravity vector, the scalar system only computes the vertical gravity component. Usually, they are solved in the local navigation frame, which requires the computation of the Eötvös correction that is the gravity changes due to the change in the centrifugal acceleration induced by the horizontal velocities of the reference frame. Even though the closed form equation for this computation had been published for many years, some researchers are still using the approximated version developed by Harlan (1968), where higher order (O_2) terms of the Earth's flattening were omitted.

Due to the physical limitations in airborne surveying, the position of the GPS antenna cannot coincide exactly with the position of the gravimeter. As a result, the GPS

positioning solution needs to be transformed into the gravimeter's position. Thus, the lever-arm correction has to be applied to account for the position difference between the GPS antenna and the gravimeter = $[\Delta x, \Delta y, \Delta z]^T$. In the 3D cases, this can be done rigorously by using all the attitude angles provided by the IMU. However, for the scalar system based on the LCR system, the lever-arm correction is a gray area in some previous publications, where not too much information was given. Olsen (2003) found in a case study that the RMS value of the filtered lever-arm effect was 0.4 mGal when the —horizontal‖ component of the lever-arm is 7.2 m, and concluded that for —horizontal‖ offsets less than 1 meter, the effect can safely be neglected.

Based on a set of real pitch and roll angles that were provided by the on board IMU during a typical airborne flight, the lever-arm effects on the vertical accelerations at various scenarios are computed. By altering the appearance of the attitude angle and the components of the lever-arm, we can easily compute the lever arm effects in other scenarios, which gives a thorough understanding of the effects resulted from various cases.

The approximations in the Eötvös computation and lever-arm correction in the LCR based scalar gravimetric system are rigorously evaluated based on both simulated and real flight data sets. Numerical analysis shows that the magnitude of the higher order terms (not only the second order effect, but also the combination effect of all high order terms) is indeed very small, at the μGal level. But it shows a systematic characteristic that is largely dependent on latitude and height. Thus, once the meter's observables are corrected into the local navigation frame, the exact formula such as given in Jekeli (2000) needs to be applied if one cannot tolerate these systematic effects or simply wants to avoid any arguments related to this issue. With the on-board IMU provided attitude information, the lever-arm effects are also thoroughly analyzed. Simulation tests clearly show that the —horizontal‖ components of the lever-arm need to be kept as small as possible to avoid large (hundreds of mGals) errors. For real flights with poor lever-arm setup, large smoothing windows have to be applied if no accurate attitude information is available. However, this will definitely reduce the spatial resolution of the gravity data. Even in the ideal lever-arm setup scenario, where no —horizontal offset‖ between the GPS antenna and the gravimeter is in presence, accurate (10 arc-minutes for mGal level and 5 arc-minutes for sub-mGal level) attitude information is required in order to totally remove the lever-arm induced noise that is in the accuracy range of most of the current airborne surveys. The benefit is that the wrong signal is directly removed from the raw gravity observables instead of by using various filters which are essentially stochastic tools whose result is always an estimate.

PART III
GRAMMAR FOCUS
TENSES ACTIVE VOICE
ТЕПЕРІШНІЙ НЕОЗНАЧЕНИЙ ЧАС
(THE PRESENT SIMPLE TENSE)

Теперішній неозначений час вживається для опису регулярної дії чи постійного стану. При цьому часто називаються такі обставини часу: *always, often, usually, sometimes, seldom, rarely, never, every (month, year)*.

Наприклад:

She always **eats** fruit for breakfast.

They sometimes **go** to the park on Sunday.

1. Put the verbs in brackets into the correct form.

- 1) Ann sometimes ... (to drink) milk for breakfast.
- 2) They ... (to like) to skate in winter.
- 3) My friends and me sometimes ... (to walk) in the park after school.
- 4) His parents ... (to spend) their vacations in the countryside.
- 5) Her brother ... (to work) as a security officer.
- 6) The lessons at our Academy ... (to start) at 8.30.
- 7) My friend ... (to walk) his dog twice a day.
- 8) We sometimes ... (to play) a game of chess in the evening.
- 9) My granny usually ... (to buy) vegetables in the market.
- 10) My cousin often ... (to visit) me at weekends.

Стверджувальна форма теперішнього неозначеного часу утворюється таким чином:

I/we/you/they + V₁

3-я особа однини he/she/it + V_s

Заперечна форма теперішнього неозначеного часу утворюється додаванням допоміжного дієслова *do/does* і заперечної частки *not*, причому основне дієслово 3-ї особи однини закінчення не має.

I/we/you/they + do not (don't) + V₁

He/she/it + does not (doesn't) + V₁

Наприклад:

I **watch** TV in the evening. – I **don't watch** TV in the evening.

He **knows** my brother. – He **doesn't know** my brother.

2. Put the verbs in brackets into the correct form and learn the proverbs.

- 1) All roads ... (to lead) to Rome.
- 2) Dog ... (not to eat) dog.
- 3) The end ... (to crown) the work.
- 4) God ... (to help) those who ... (to help) themselves.
- 5) Many hands ... (to make) light work.
- 6) One swallow ... (not to make) a summer.
- 7) The last drop ... (to make) the cup run over.
- 8) The appetite ... (to come) with eating.

Питальна форма теперішнього неозначеного часу (загальне запитання) утворюється за допомогою допоміжного дієслова *do/does* що розташовується на початку речення перед підметом, причому основне дієслово 3-ї особи однини закінчення не має. Відповіді на такі запитання даються короткі, з використанням тих самих допоміжних дієслів.

Do + I/we/you/they + V₁? – Yes, I/we/you they do. No, I/we/you/they don't.

Does + he/she/it + V₁? – Yes, he/she/it does. No, he/she/it doesn't.

Наприклад:

They **study** English. – **Do** they **study** English? – Yes, they **do**. No, they **don't**.

She **studies** at the Academy. – **Does** she **study** at the Academy? – Yes, she **does**. No, she **doesn't**.

Складаючи спеціальні запитання у теперішньому неозначеному часі, слова розташовують у такому порядку: питальне слово, допоміжне дієслово *do/does* підмет, основне дієслово (без закінчення у 3-й особі однини).

Запам'ятайте питальні слова: *who, what, where, when, why, which, whose, whom, how, what kind of*.

Наприклад:

What **do** you **do** in the evening?

Where **does** he **go** in summer?

What kind of books **does** she **like** to read?

Запитання до підмета утворюються без допоміжних дієслів, а основне дієслово обов'язково має закінчення –s:

Who **knows** this girl?

Whose friend **likes** going to the cinema?

3. Write questions to the underlined words.

1) Young leaves appear in the trees in spring.

2) My parents usually leave home early.

3) She understands German very well.

4) We need three apples for the fruit salad.

5) The cat looks at the sausage because it is hungry.

6) My friend helps me to make calculations.

7) The student wants to borrow this book from the library.

ТЕПЕРІШНІЙ ТРИВАЛИЙ ЧАС (THE PRESENT CONTINUOUS TENSE)

Теперішній тривалий час вживається для описання дії, що відбувається під час мовлення. При цьому можуть називатися такі обставини часу: *now, at the moment, today*.

Стверджувальна форма теперішнього тривалого часу утворюється таким чином:

$I + am + V_{ing}$
 $He/she/it + is + V_{ing}$
 $you/we/they + are + V_{ing}$

Наприклад:

I am (I'm) preparing for my English lesson now.

He is (he's) speaking to his friend at the moment.

We are (we're) meeting our friends today.

Заперечна форма теперішнього тривалого часу утворюється з використанням допоміжного дієслова *am/is/are*, заперечної частки *not* та основного дієслова із закінченням

$I + am not + V_{ing}$
 $He/she/it + isn't + V_{ing}$
 $you/we/they + aren't + V_{ing}$

Наприклад:

I'm making a sandwich now. – **I'm not making** a sandwich now.

She is reading a letter. – **She isn't reading** a letter.

We are translating a text. – **We aren't translating** a text.

Питальна форма теперішнього тривалого часу (загальні запитання) утворюються з використання допоміжного дієслова *am/is/are*, що розташовується на початку речення перед підметом, та основного дієслова із закінченням *-ing*.

$Am + I + V_{ing}$
 $is + he/she/it + V_{ing}$
 $aren't + you/we/they + V_{ing}$

Відповіді на такі запитання даються короткі, із використанням тих самих допоміжних дієслів:

Are you washing your hands? — Yes, **I am**./ No, **I'm not**.

He is swimming. — **Is he swimming**? — Yes, he **is**. /No, he **isn't**.

They are working. — **Are they working**? — Yes, they **are**./No, they **aren't**.

4. *Put the words into correct order to make up sentences.*

- 1) gathering/forest/We/the/mushrooms/are/in.
- 2) horses/are/The/not/now/boys/riding/the.
- 3) breakfast/sister/now/your/having/Is?
- 4) whitewashing/garden/the/They/in/trees/are/the.
- 5) m e/waiting/Are/for/you?
- 6) having/not/now/is/lunch/Roger.
- 7) to/teacher/speaking/Our/them/is/now.
- 8) carpet/the/Vicky/Is/the/vacuuming/ living-room/in?
- 9) is/coffee/Helen/for/making/not/me.
- 10) friend/going/and/My/are/the/me/cinema/to.
- 11) The/new/concert/learning/children/a/for/song/are/the.
- 12) is/now/brother/for/His/looking/not/work.
- 13) you/hall/the/hanging/in/the/Are/garlands?
- 14) the/in/dusting/is/now/sister/furniture/bedroom/the/My.
- 15) party/Everybody/the/enjoying/is.

ТЕПЕРІШНІЙ НЕОЗНАЧЕНИЙ ЧИ ТЕПЕРІШНІЙ ТРИВАЛИЙ ЧАС (THE PRESENT SIMPLE TENSE OR THE PRESENT CONTINUOUS TENSE)

<p>Теперішній неозначений час вживається у таких випадках.</p> <p>1) Для позначення постійних дій чи станів: <i>She lives in this house.</i></p> <p>2) Для вираження повторюваних дій, особливо якщо поруч називаються прислівники, що вказують на частоту дій: <i>He sometimes goes to the cinema.</i></p> <p>3) Коли йдеться про загальновідомі факти, закони природи тощо: <i>The Moon goes around the Earth.</i></p> <p>4) Коли йдеться про розклади: <i>The bus arrives at five o'clock.</i></p> <p>Запам'ятайте обставини часу, що</p>	<p>Теперішній тривалий час вживається у таких випадках.</p> <p>1) Для позначення дій, що відбуваються під час мовлення: <i>The boys are playing football now.</i></p> <p>2) Для опису тимчасових ситуацій: <i>He is looking for a new job.</i></p> <p>3) Коли йдеться про дії, заплановані на найближче майбутнє та які обов'язково відбудуться: <i>We are moving to a new flat next week.</i></p> <p>Запам'ятайте обставини часу, що</p>
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вживаються у теперішньому не-означеному часі: <i>always, every, often, usually, sometimes, rarely, seldom, from time to time, never, etc.</i>	вживаються у теперішньому тривалому часі: <i>now, at the moment, today, at present, tonight, etc.</i>
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5. Put the verbs in brackets into the Present Simple or Present Continuous Tense.

- 1) Jack often ... (to wait) for me after classes.
- 2) Jack ... (to wait) for his friend at the bus stop now.
- 3) Linda and Kelly sometimes ... (to go) shopping on Saturday.
- 4) It is Saturday and Linda ... (to go) shopping with her cousin Kelly.
- 5) We ... (to buy) fresh bread every day.
- 6) I'm at the baker's now and I ... (to buy) a big cake.
- 7) The train ... (to arrive) at eleven o'clock.
- 8) It is eleven o'clock and the train ... (to arrive) at the station.
- 9) Be quiet! Father ... (to write) a report now. He often ... (to write) reports about the results of his work.
- 10) Take your umbrella. It ... (to rain) heavily.
- 11) It often ... (to rain) in autumn.
- 12) The pupils ... (to ask) the teacher questions on the topic now.
- 13) This pupil seldom ... (to ask) questions during the lessons.
- 14) Den ... (not to sleep) now. He ... (to prepare) for his English test.
- 15) Sandy usually ... (not to come) home late.
- 16) We ... (not to give) ice cream to the child every day.
- 17) The boys ... (not to boat) now. They ... (to dive).
- 18) My father's friend ... (to come) to our town tomorrow.
- 19) Fish ... (not to fly), they ... (to swim).
- 20) I ... (not to vacuum) the carpet now. I ... (to dust) the furniture.

6. Put the verbs in brackets into the Present Simple or Present Continuous Tense.

- 1) What... you usually ... (to do) after classes? — I sometimes ... (to play) basketball with my friend but usually I ... (to hurry) home.
- 2) What ... your sister ... (to do) now? — She ... (to walk) with her friends. She often ... (to go) for a walk when she ... (to have) nothing to do about the house.

3) Where ... Sam ... (to go) on Sundays? — Well, he usually ... (to meet) his friends and they ... (to go) to the cinema or to the sports ground. But this Sunday Sam ... (to translate) the text for tomorrow's English lesson.

4) How often ... your sister ... (to go) to the Art Studio? — She ... (to go) there three times a week.

5) What ... you ... (to eat)? — I ... (to eat) a strawberry cake. My Granny always ... (to bake) tasty cakes.

6) What ... Nelly ... (to type)? — She ... (to type) an important document for her boss. He often ... (to ask) her to type documents.

7) Who ... (to call) you now? — It ... (to be) my mother. She always ... (to phone) me in the afternoon when I ... (to come) home from school.

8) What... Diana ... (to do) in the kitchen? — She ... (to make) tea for us. We always ... (to drink) tea at this time.

7. Translate into English.

1) Вони зараз готуються до змагань у спортивній залі.

2) Моя сестра часто телефонує своїм подругам.

3) Що ви робите? — Я роблю подарунок братові на день народження.

4) Коли прибуває автобус? — Він прибуває о п'ятій.

5) Кому ви готуєте обід? — Я готую обід сину. Він завжди повертається додому в цей час.

6) З ким вона розмовляє? — Вона розмовляє з тіткою.

7) Він пише? Що він пише? — Він готує статтю для наукового журналу.

8) Чому ти смієшся? — Я слухаю інтерв'ю з відомим комедійним актором. Він зараз розповідає одну дуже кумедну історію.

9) Ден ще спить? — Ні. Він завжди встає дуже рано. Він зараз миє посуд після сніданку.

Запам'ятайте дієслова, які не вживаються в теперішньому тривалому часі, але вживаються в теперішньому неозначеному:

to be, to believe, to belong, to cost, to feel, to forget, to have (= to possess), to hate, to hear, to hope, to know, to like, to love, to mean, to need, to prefer, to realize, to remember, to recognize, to see, to seem, to smell, to sound, to suppose, to taste, to think, to understand, to want, to wish, etc.

Наприклад: I **hear** you well now. She **doesn't understand** you.

8. Complete the sentences with the verbs in brackets in the Present Simple or Present Continuous as in the example.

Example: Mike ... a bar of chocolate at the moment. He ... milk chocolate without nuts, (to prefer, to choose) — Mike is choosing a bar of chocolate at the moment. He prefers milk chocolate without nuts.

- 1) Helen and Betty ... for the test. They ... that the results of this test are very important for their future education, (to prepare, to understand)
- 2) Witty ... tea for us. Please, tell her that I ... strong tea. (not to like, to make)
- 3) Ted and I ... to Susan's party. I ... we won't be late, (to hope, to hurry)
- 4) My secretary ... to remind me about the meeting. I often ... about such things, (to phone, to forget)
- 5) What... you ...? This dish ... very tasty! (to cook, to smell)
- 6) They ... to catch a taxi. They ... to miss the plane, (not to want, to try)
- 7) We ... shopping. We ... to buy some food for supper, (to need, to go)
- 8) Whose dictionary ... you ...? This one ... to me. (to belong, to take)
- 9) Whom... Tim ... to? I ... this woman, (to talk, not to recognize)

9. Put the verbs in brackets into the Present Simple or Present Continuous Tense.

Mother: Hello, honey! How are you?

Jane: Hi, Mum! We ... (to be) fine. Where ... (to be) you?

M: I ... (to be) in the train. What... you ... (to do) Jane?

J: Well, I ... (to write) an essay about my winter holidays. You ... (to know) our teacher often ... (to ask) us to write essays.

M: And what ... Paul ... (to do)? ... he ... (to want) to speak to me?

J: Paul ... (to listen) to music in his room. The music ... (to play) so loudly that I ... (to be) afraid he ... (not to hear) anything.

M: OK. And what... father ... (to do)?

J: He ... (to try) to cook something in the kitchen. I ... (to think) he ... (to want) to make a surprise for you.

M: It ... (to sound) impressive. I ... (to hope) he ... (to remember) to meet me at the station tomorrow morning.

J: Sure, he What time ... the train ... (to arrive)?

M: It ... (to arrive) at seven o'clock in the morning.

J: Good. Then see you tomorrow morning, Mum. Have a good trip!

M: Bye, dear!

СПОСОБИ ВИРАЖЕННЯ МАЙБУТНЬОГО ЧАСУ (MEANS OF EXPRESSING FUTURE ACTIONS)

Майбутній неозначений час (the Future Simple Tense) вживається для вираження дій та подій, що відбудуться у майбутньому. Майбутній неозначений час утворюється додаванням допоміжного дієслова *will* до інфінітива без *to*.

При цьому часто називаються такі обставини часу: *tomorrow, next, week (month, year), in a week (few days)*.

I/you/he/she/it/we/they + will + Vf

I/you/he/she/it/we/they + will not (won't) + V

Will + I/you/he/she/it/we/they + Vf? — Yes, I/h e ... will. (No, I/h e/... won't.)

Наприклад: He **will have** an exam tomorrow.

They **will not (won't) meet** me tomorrow.

Will you return me the book next week?

10. Make up sentences.

- 1) they/ trip/ return/ When/ their/ will from?
- 2) tomorrow/ the/ sign/ Our/ morning/ will/ boss/ documents.
- 3) not/ early/ bed/ will/ to/ tonight/ I/ go.
- 4) publish/ in/ They/ article/ the newspaper/ will/ your/ local.
- 5) problem/ they/ solve/ this/ will/ How?
- 6) for/ will/ birthday/ What/ give/ you/ her/ her?
- 7) after/ They/ not/ me/ classes/ meet/ will.
- 8) receive/ the/ in/ The/ documents/ morning/ will/ secretary/ the.
- 9) you/ Where/ from/ the/ will/ flat/ put/ your/ key?
- 10) Next/ will/ in/ train/ minutes/ arrive/ twenty.

Допоміжне дієслово вживається у питальних реченнях майбутнього неозначеного часу із займенниками 1-ї особи *I, we*, коли ми висловлюємо пропозицію або хочемо отримати розпорядження щодо якихось дій.

Наприклад:

Shall I take your bag? (Мені взяти вашу сумку?)

Shall I give you a lift? (Вас підвезти?)

Shall we buy ice-cream? (Ми купимо морозиво?)

Shall we write an essay? (Ми писатимемо твір?)

11. Complete the sentences with *shall, will, or won't*.

- We ... go to the mountains. ... you join us, Mary?
 - Of course I Where ... we stay?
 - We ... stay in a hotel. I ... phone and book the room tomorrow.
 - Ok. ... I help you with the preparations?
 - Yes, please. ... you buy the tickets for the train?
 - Surely. What train ... I buy the tickets for?
 - I think it's better to take the night train. Then we ... arrive early in the morning.
 - How many tickets ... I buy?
 - For you, my friend Liz and me.
 - ... Ron go with us?
 - No, he He ... be very busy next week.
 - What's a pity! ... we go skiing?
 - Of course we The weather forecast promises it ... be cold and snowy.
 - Fine. I ... take some warm sweaters then. ... I take my camera, Mary?
 - Good idea. My camera doesn't work.
- Ok. Then I ... start packing things. See you tomorrow, Mary.

Для вираження майбутньої дії використовується як майбутній неозначений час, так і структура *to be going to*.

Майбутній неозначений час вживається у таких випадках.

- 1) Коли ми повідомляємо про факти чи дії у майбутньому, на здійснення яких ми не можемо вплинути:
You will be sixteen next month.
- 2) Коли ми не впевнені, що дії чи події, про які повідомляємо, відбудуться у майбутньому (чи ще не прийняли остаточного рішення):

Структура *to be going to* у таких випадках.

- 1) Коли ми повідомляємо про чийсь наміри чи плани:
They're going on holidays and they're going to travel a lot.
- 2) Коли ми повідомляємо про події у найближчому майбутньому, якщо ми впевнені, що вони відбудуться:
She is going to send you some photos.

<p><i>I think he will write to you.</i></p> <p>3) Якщо ми прийняли рішення в момент мовлення:</p> <p><i>I'm thirsty. I'll have a glass of juice.</i></p> <p>4) Коли ми висловлюємо сподівання, побоювання, погрози, прогнози щодо майбутнього, даємо обіцянки тощо. Як правило, в таких випадках вживаються слова <i>hope, believe, think, expect, I'm afraid, I'm sure, I know, Perhaps, probably, etc.:</i></p> <p><i>I'm sure we'll come in time.</i></p> <p><i>Perhaps she'll come to our party.</i></p>	<p><i>(She has already decided).</i></p> <p>3) Якщо в момент мовлення ми розуміємо, що трапиться найближчим часом:</p> <p><i>Be careful! You are going to hurt your leg!</i></p>
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12. Circle the correct item.

- 1) It will/is going to be Friday tomorrow.
- 2) I'm afraid it won't/isn't going to be sunny tomorrow.
- 3) She has bought a computer. She will/is going to attend computer courses.
- 4) Watch out! Your bike will/is going to fall down!
- 5) I think Nick and Andy will/are going to take part in this competition.
- 6) Sue has finished her work so she will/is going to have a rest tonight.
- 7) We have saved enough money so we will/are going to buy a new fridge.
- 8) Helen will/is going probably to visit us next Saturday.
- 9) One-day people will/are going to live on other planets.
- 10) It's getting cold. I will/am going to put on my warm sweater.

13. Open the brackets using *will, shall or to be going to*.

- ... (you to help) me to cook supper, Liz? Uncle David and Aunt Elsa ... (to visit) us tonight.
- And what... you ... (to cook), Mum?
- I ... (to cook) a rabbit. You know, Uncle David likes rabbits.
- Me too. What ... I ... (to help) you to do, Mum?
- I think you ... (to cut) an onion. And I ... (to prepare) the rabbit.
- ... that be OK, Mum?
- Yes, good. And now ... (you to give) me a bigger saucepan? I'm afraid this saucepan ... (to be) too small for the rabbit.

- Here you are, Mum. ... I ... (to do) anything else?
- ... you ... (to wash) these tomatoes and cucumbers? I think we ... (to make) a vegetable salad.
- The vegetables are ready. ... I ... (to slice) them?
- Yes, please. Be careful! You ... (to cut) your finger!
- The rabbit smells delicious. I'm sure Uncle David ... (to enjoy) it.
- You are right. But I ... probably ... (to add) some more salt. That's nice.
- Oh, we ... (to have) a wonderful dinner today!

МИНУЛИЙ НЕОЗНАЧЕНИЙ ЧАС (THE PAST SIMPLE)

Минулий неозначений час вживається для повідомлення про регулярно повторювані у минулому дії, а також для опису послідовності дій, що відбувались у минулому. При цьому можуть вживатися такі обставини часу: *yesterday, last month (year, night), two days ago*.

У минулому неозначеному часі до основи правильних дієслів додається закінчення *-ed*: *work — worked, help — helped*.

Неправильні дієслова мають спеціальні форми минулого часу:
come — came, see — saw, buy — bought.

Стверджувальна форма минулого неозначеного часу утворюється так:

I/you/he/she/it/we/they + V₂ (V_{ed})

Наприклад:

We **watched** TV yesterday. He **swam** in the river last week.

Форми минулого часу для дієслова

to be - was/were: I/he/she/it - was, you/we/they - were.

Питальна форма минулого неозначеного часу (загальні запитання) утворюється таким чином: допоміжне дієслово *did* ставиться на початку речення перед підметом, причому основне дієслово вживається без *-ed* або в першій формі.

Did + I/you/he/she/it/we/they + V /

Відповіді на такі запитання даються короткі, із використанням того самого допоміжного дієслова:

Did you cook dinner? - Yes, I **did**. /No, I **didn't**.

Did she buy milk? — Yes, she **did**. /No, she **didn't**.

Якщо в реченні до складу присудка входить форма дієслова *to be*, питальне речення та відповідь утворюються за його допомогою:

Was he tired yesterday? — Yes, he **was**. /No, he **wasn't**.

Were they at the cinema? — Yes, they **were**. /No, they **weren't**.

14. Put the verbs in brackets into the correct form.

- 1) Where ... Susan ... (to be) yesterday? She ... (to go) to the birthday party. Who ... (to have) the party? Angela ... (to have). She ... (to be) fifteen yesterday.
- 2) Who ... (to phone) a few minutes ago? It ... (to be) your friend Eric. He ... (to want) to invite you to the cinema.
- 3) ... you ... (to watch) this film? Yes, I ... I ... (to watch) it some days ago. How ... you ... (to like) it? Well, not very much. It ... (to seem) to be rather boring.
- 4) How many subjects ... she ... (to study) last year? She ... (to study) twelve subjects. She also ... (to attend) the Music Studio.
- 5) Where ... you (to be) during your last holidays? — My parents and me ... (to go) to China. We ... (to visit) some very interesting places. ... you ... (to enjoy) your trip? Of course, we
- 6) ... your sister ... (to go) shopping yesterday? What ... she ... (to buy)? Well, she ... (to go) to a new shopping center and ... (to buy) a pair of nice shoes and a pretty hat there.
- 7) Why ... Dick (to be) late for the lecture? He ... (to oversleep) and ... (to miss) the bus.
- 8) When ... the concert ... (to begin)? It ... (to begin) twenty minutes ago.
- 9) Who ... (to be) at the meeting yesterday? Well, there ... (to be) a lot of people, but I ... (not to meet) anyone I know.
- 10) ... B ill... (to repair) his mobile phone? No, he His parents ... (to promise) him to buy a new one.

15. Translate into English.

- 1) Учора була чудова погода.
- 2) Ми не отримали вашого повідомлення вчора.
- 3) Ви бачили цю п'єсу? Так, я бачив її минулого місяця.
- 4) Вона прибрала квартиру та приготувала вечерю.
- 5) Вашому братові сподобалась вечірка? Так. Він зустрів там багато цікавих людей.
- 6) Вчитель був задоволений моїми відповідями.
- 7) Вона зупинилась і подивилася на годинник. Було пів на восьму.
- 8) Стара жінка була рада побачити своїх онуків.

- 9) Я не був удома вчора. Я відвідував свого двоюрідного брата.
 10) Ваша сестра залишилася вдома вчора? Так. У неї боліла голова, і вона вирішила відпочити.
 11) Вибачте, я не зрозумів вашого запитання.
 12) Вони грали у волейбол на майданчику після уроків.
 13) Ви писали диктант учора? Ні.
 14) Я не зателефонував вам, бо не знав вашого номера телефону.
 15) Він приніс вам словник? Так, він приніс його два дні тому.

МИНУЛИЙ ТРИВАЛИЙ ЧАС (THE PAST CONTINUOUS TENSE)

Минулий тривалий час вживається для описання дій, які тривали 1 у певний момент у минулому.

Стверджувальна форма минулого тривалого часу утворюється за допомогою допоміжного дієслова *was/were* та закінчення *-ing*, яке додається до основи дієслова-присудка.

I/he/she/it + was + V_{ing}
You/we/they + were + V_{ing}

Наприклад:

The woman **was cooking** dinner at 2 o'clock yesterday.

They **were watching** TV all day yesterday.

Показники часу, які вживаються з минулим тривалим часом: *when, while, as*.
While вживається, коли дві дії, названі в одному реченні, відбуваються одночасно:

While he was playing computer games his sister was speaking on the phone.

When та *as* вживаються, якщо одна дія, названа в реченні, триває, а інша її перериває:

The children **were singing** when (as) their parents **entered** the class

Заперечна форма минулого тривалого часу утворюється за допомогою дієслова *was/were* та заперечної частки *not*, що ставляться перед дієсловом-присудком із закінченням *-ing*.

I/he/she/it + was not (wasn't) + V_{ing}

You/w e/they + were not (weren't) + V_{ing}

Наприклад: I **wasn't listening** to music at that time. They **weren't dancing** then.

Питальна форма минулого тривалого часу (загальне запитання) ! утворюється таким чином: допоміжне дієслово was/were розташовується на початку речення перед підметом, а дієслово-присудок має закінчення -ing.

Was + I/he/she/it + V_{ing}

Were + you/we/they + V_{ing}

Відповіді на такі запитання даються короткі, з використанням того самого допоміжного дієслова:

Was he **watching** TV? — Yes, he **was**. / No, he **wasn't**.

Were they **playing** in the yard? — Yes, they **were**./No, they **weren't**.

16. Make up sentences using the Past Continuous Tense.

- 1) A man/to fish/on the bank of the river.
- 2) They/to make notes/during the lecture?
- 3) She/not to smile/any more.
- 4) Polly/and her cousin/to have tea.
- 5) You/to dig/in the garden?
- 6) Mike/to hang/a picture in the living-room.
- 7) Sue/not to swim/in the swimming-pool.
- 8) They/to wait/for the doctor?
- 9) I/not to look/at the actors.
- 10) She/to speak/in a friendly way.

17. Put the verbs in brackets into the correct form.

- 1) Where ... you ... (to go) yesterday evening? — I ... (to go) to the railway station to meet my uncle.
- 2) Where ... your sister ... (to shop) yesterday morning? — Well, she ... (to shop) in a new shopping center all day yesterday.
- 3) How long ... they ... (to prepare) for the test last Sunday? — They ... (to prepare) for the test from 2 to 6 o'clock.
- 4) What book ... he ... (to read) at five o'clock yesterday? — He ... (not to read). He ... (to translate) a short story for his English lesson.
- 5) What ... Dick ... (to do) yesterday evening? — He ... (to play) a new computer game all the evening.

- 6) Why ... Chris and Sam ... (to laugh) so loudly? — Because they ... (to watch) a comedy film.
- 7) Who ... (to sing) that nice song when we came into the hall? — My friend ... (to sing).
- 8) Why ... you ... (to bake) a cake yesterday morning? — Because I ... (to wait) for the guests.
- 9) Whom ... she ... (to speak) to when I met her? — She ... (to speak) to her coach.
- 10) Whose car ... Bill ... (to drive) yesterday? — He ... (to drive) his cousin's car.

Зверніть увагу на відмінності у вживанні минулого тривалого та минулого неозначеного часів.

<p>Минулий тривалий час вживається у таких випадках.</p> <p>1) Якщо дія тривала у певний час у минулому: <i>She was tidying her room at five o'clock yesterday.</i></p> <p>2) Якщо дві та більше дій тривали одночасно у минулому: <i>While he was painting the fence his brother was cutting the grass in the yard.</i></p> <p>3) Якщо одна дія тривала у минулому, а інша її перервала: <i>He was reading a newspaper when the telephone rang.</i></p>	<p>Минулий неозначений час вживається у таких випадках.</p> <p>1) Якщо дія відбулась (і закінчилась) у певний момент у минулому: <i>She met me at 5 o'clock yesterday.</i></p> <p>2) Якщо дві та більше дій відбулись одна за одною послідовно та без великих інтервалів у часі: <i>He had dinner and then went for a walk.</i></p> <p>3) Якщо присудком у реченні виступають дієслова, які не вживаються у минулому тривалому часі, то вони вживаються у минулому неозначеному часі: <i>(believe, belong, forget, cost, know, feel, like, love, mean, need, prefer, realize, see, suppose, understand, want, etc.)</i> <i>She wanted to buy a newspaper.</i></p>
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18. Put the verbs in brackets into the correct form. Use the Past Continuous Tense.

- 1) Peter ... (to write) the invitations for the party at seven o'clock last Saturday.
- 2) The postman ... (not to deliver) the mail at four o'clock yesterday.
- 3) ... you ... (to do) the shopping all day last Sunday? — No, I

- 4) What ... Oscar ... (to read) all the evening yesterday? — He ... (to read) the latest computer journal.
- 5) Whom ... they ... (to speak) to at three o'clock yesterday? — They ... (to speak) to their manager.
- 6) Where ... you ... (to walk) at two o'clock yesterday? — I ... (to walk) to the library. 7) Whose motor-bike ... Johnny ... (to ride) all the evening last Friday? — He ... (to ride) his uncle's motor-bike.
- 8) ... Maria ... (to swim) in the swimming-pool? — No. she She ... (to cut) the grass in the backyard.
- 9) What film ... they ... (to watch) in the evening? — They ... (to watch) a thriller.
- 10) Why ... Nick ... (to hurry) to the metro yesterday morning? — Because his friends ... (to wait) for him there.

19. Translate into English.

- 1) Вчора о шостій вона готувалася до іспиту.
- 2) Поки Ганна різала хліб, її подруга робила чай.
- 3) Жінка прибирала кухню, коли її маленька донька розбила чашку.
- 4) Ви чекали на нас учора о восьмій? — Так.
- 5) Вони обговорювали це питання вчора з другої до четвертої.
- 6) Поки студенти писали тест, їх вчитель писав завдання на дошці.
- 7) Що мама готувала вчора, коли ми вийшли з дому?
- 8) Про що він розмовляв з лікарем, коли ми їх зустріли?
- 9) Ми стояли біля будинку, коли приїхало таксі.
- 10) Вона взяла квіти і посміхнулася.

**ТЕПЕРІШНІЙ ДОКОНАНИЙ ЧАС
(THE PRESENT PERFECT TENSE)**

Теперішній доконаний час вживається, коли йдеться про події, що відбулися нещодавно, або якщо час у минулому, коли вони мали місце, не зазначено. Стверджувальна форма теперішнього доконаного часу утворюється додаванням допоміжного дієслова *have/has* до дієслова-присудка у третій формі (для неправильних дієслів) або із закінченням *-ed* (для правильних дієслів):

I/you/we/they + have + V₃ (V_{ed})

He/she/it + has + V₃ (V_{ed})

Наприклад:

You **have** just **cleaned** the flat.

He **has** already **come** home.

Неправильні дієслова мають спеціальні форми (третя форма неправильних дієслів у таблиці (Past Participle)): *go — gone, fly — flown*.

Обставини часу, характерні для теперішнього доконаного часу: *just* (щойно), *already* (вже), *ever* (коли-небудь), *never* (ніколи), *recently* (нещодавно, останнім часом), *lately* (нещодавно, останнім часом), *yet* (ще), *since* (з того часу як), *for* (протягом), *today* (сьогодні), *this week (month, year)* (цього тижня (місяця, року)), *so far* (поки що).

Обставини часу в реченні, як правило, стоять між допоміжним дієсловом та дієсловом-присудком (*just, already, ever, never...*) або в кінці (*today, yet, so far, this week...*). *Yet* вживається тільки в заперечних та питальних реченнях.

Наприклад:

I **have** already **been** there.

She **has** never **seen** this film.

We **have** **met** her today.

He **hasn't** **finished** his work yet.

Прийменник *since* в обставинах часу вживається для позначення початку дії в минулому:

I **have** **worked** in this shop *since* last month.

Прийменник *for* в обставинах часу вживається для позначення періоду, протягом якого відбувалася дія до теперішнього часу:

He **has** **known** my brother *for* three years

20. *Make up sentences using the Present Perfect Tense.*

1) We/to return/from the journey/just.

2) I/to see/my boss/today.

- 3) Helen/to decorate/her room/already.
- 4) My cousins/to be/to this cinema/never.
- 5) Max/to buy/a magazine/today.
- 6) You/to spend/a lot of money/this month.
- 7) Ian and Peter/to repair/the radio/already.
- 8) I/to drive/a car/never.
- 9) We/to get/some letters/this week.
- 10) The dog/to run away/just.

Заперечна форма теперішнього доконаного часу утворюється додаванням допоміжного дієслова *to have* та заперечної частки *not* до дієслова-присудка (у третій формі для неправильних дієслів або із закінченням *-ed* для правильних):

I/you/we/they + have not (haven't) + (V_{ed})

He/she/it + has not (hasn't) + V (V_{ed})

Наприклад: We **haven't read** this book yet.

She **hasn't corrected** all the mistakes

Складаючи спеціальні запитання у теперішньому доконаному часі, слова розташовують у такому порядку: питальне слово (*Wh-word*), допоміжне дієслово *to have*, підмет, присудок (дієслово із закінченням *-ed* або у третій формі):

Wh-word + have + I/you/we/they + V₃ (V_{ed})?

Wh-word + has + he/she/it + V (V_{ed})?

Наприклад:

Where **have** they **gone**?

What **has** she **done** today?

Запитання до підмета утворюються тільки з допоміжним дієсловом *has*:

Who **has cleaned** the flat?

Запитання зі словом *when* не утворюються в теперішньому доконаному часі.

Натомість використовується минулий неозначений час.

21. Write questions to the sentences using the question words in brackets.

- 1) They have been to Rome. (Who? Where?)
- 2) She has sold her old house. (What to do? What house?)
- 3) He has phoned your sister three times. (Whom? How many?)

- 4) Her parents have gone to the seaside. (Whose? Where?)
- 5) Dolly has bought a nice doll for her younger sister. (What doll? For whom?)
- 6) You have taken my dictionary. (Who? Whose?)
- 7) We have watered the flowers in front of the house. (What to do? Where?)
- 8) Alex has learned two poems. (What? How many?)
- 9) Linda has met her aunt in the park. (Whom? Where?)
- 10) The scientists have discovered a new planet. (Who? What to do?)

22. Translate into English.

- 1) Мама щойно прийшла додому.
- 2) Я ще не прочитав вашу статтю.
- 3) Що вони зробили? - Вони щойно помили посуд.
- 4) Він знає моїх батьків уже десять років.
- 5) Вони живуть у нашому місті з 2020 року.
- 6) Де ти був? - Я щойно повернувся з занятій.
- 7) Хто зателефонував тобі? - Це мій друг. Ми не бачилися вже п'ять років.
- 8) Кому вона залишила записку? - Вона залишила записку батькам.
- 9) Ви коли-небудь були в цьому музеї? - Ні, я ніколи там не був.
- 10) Ти бачив свого двоюрідного брата сьогодні? - Ще ні.

Зверніть увагу на відмінності у вживанні минулого неозначеного й теперішнього доконаного часів.

Минулий неозначений час	Теперішній доконаний час
вживається у таких випадках.	вживається у таких випадках.
1) Якщо дія почалась і завершилась у певний момент у минулому: <i>She came an hour ago.</i>	1) Якщо дія відбулась у минулому, але немає точної вказівки на час: <i>She has come home.</i>
2) Для описання станів у минулому: <i>He left our town when he was a student.</i>	2) Якщо дія завершилась нещодавно і зараз є її наслідки: <i>He has just painted the roof of the house.</i>
3) Якщо дії відбувались у минулому одна за одною: <i>I took the magazine, opened it and found that article.</i>	3) Якщо дія почалась у минулому і триває зараз: <i>I have lived in this house for seven years. (And I still live here).</i>

a) five minutes ago b) just c) recently

10) How long ... in this hotel?

a) were you b) did you be c) have you been

25. Put the verbs in brackets into the Past Simple or Present Perfect Tense.

1) What... he ... (just to tell)? - He ... (to tell) that the group of tourists ... (to leave) our town last night.

2) They ... (already to leave) for Greece. They ... (not to be) there yet.

3) What book ... you ... (to show) me five minutes ago?

4) Where ... they ... (to be) this year? - They ... (already to be) to Poland. They ... (to go) there three months ago.

5) ... Mr. Folly ... (to pay) the bill? - Yes, he He ... (to pay) the bill an hour ago.

6) When ... Polly ... (to come) home? - She ... (not to return) home yet.

7) ... they ... (ever to take) a big sum of money from the bank? - No, they

8) When ... Clara ... (to water) the flowers? - She ... (not to water) them yet.

9) ... the workers ... (to finish) their work? - Yes, they ... (to paint) the walls yesterday.

10) ...you ... (ever to take) Tommy to the zoo? — Yes, we We ... (to go) there last Sunday.

МИНУЛИЙ ДОКОНАНИЙ ЧАС (THE PAST PERFECT TENSE)

Минулий доконаний час вживається, якщо дія завершилась до певного моменту або до початку іншої дії в минулому. Стверджувальна форма минулого доконаного часу утворюється за допомогою дієслова *had* та дієслова-присудка у третій формі (для неправильних дієслів) або із закінченням *-ed* (для правильних).

I/you/he/she/it/we/they + had + V₃(V_{ed})

She **had written** an essay before five o'clock yesterday.

They **had done** the home task before their parents came home (First action: they did the flat, second: the parents came home)

26. Complete the sentences with the verbs from the boxes, using them in the Past Perfect Tense.

to be, to take, to learn, to win, to visit, to take, to teach, to return, to hold, to make

It was the last week of summer holidays. Mike ... from the country two days before. He ... his grandparents. Mike's life in the country ... really ... exciting that summer. He ... to do a lot of useful things. His uncle ... Mike to drive a car. Mike's grandfather ... Mike hunting. Mike was very happy because he ... never ... the hunting rifle before. Mike even ... part in the horse-racing competition and ... the third place. Mike's friend Pete ... a photo of Mike holding the prize on the horse back. It was a pleasure to remember all the events that had happened in the village. Now Mike wanted to tell his classmates about the summer holidays.

Заперечна форма минулого доконаного часу утворюється додаванням допоміжного дієслова *had* та заперечної частки *not* до дієслова-присудка у третій формі (для неправильних дієслів) або із закінченням *-ed* (для правильних).

I/you/he/she/it/we/they + had not (hadn't) + V₃ (V_{ed})

Наприклад: She **hadn't seen** this monument before.

We **hadn't read** this text by the last lesson.

Складаючи спеціальні запитання у минулому доконаному часі, слова розташовують у такому порядку: питальне слово (*Wh-word*), допоміжне дієслово *had*, підмет, дієслово-присудок (із закінченням *-ed* або у третій формі).

Wh-word + had + I/you/he/she/it/we/they + V₃ (V_{ed})?

Наприклад:

What **had** they **read** by last Monday?

What places **had** she **visited**?

27. Put the verbs in brackets into the correct form.

1) What time ... the participants ... (to arrive) at the conference last Wednesday? - They ... (to arrive) by nine o'clock in the morning.

2) How many clients ... he ... (to serve) by the end of the day? - He ... (to serve) twelve clients.

3) ... the performance ... (to finish) by nine o'clock yesterday? - No, it

4) Unfortunately Samantha ... (never to use) this computer program before.

- 5) Whom ... Robert ... (to see) during his last visit to our town? - He ... (to meet) some of his friends and relatives.
- 6) What hotel ... you ... (to choose) to stay at during your last trip? - I ... (to stay) at the Hilton Hotel.
- 7) Pam ... (to have) such an experience before.
- 8) ... Steve ... (to be) to our Theme Park before this visit? - Yes, he
- 9) Which street... they ... (to live) before they moved? - They ... (to live) in Oak Street.
- 10) By what time ... your grandparents ... (to finish) their work in the garden yesterday? - They ... (to finish) their work by six o'clock.

Зверніть увагу на відмінності у вживанні минулого неозначеного, минулого тривалого та минулого доконаного часів.

Минулий неозначений час вживається у таких випадках.

1) Коли дія відбулась (і завершилась) у певний момент у минулому:

He phoned me at 2 o'clock yesterday.

2) Коли дві та більше дій відбулись одна за одною послідовно та без великих інтервалів у часі:

We played a game of tennis and went home.

3) Якщо присудком у реченні виступають дієслова, які не вживаються у минулому тривалому часі, то вони вживаються у минулому неозначеному часі:

You **believed** my story.

Минулий тривалий час вживається у таких випадках.

1) Коли дія тривала у певний момент у минулому:

I **was speaking** on the phone at two o'clock yesterday.

2) Коли дві та більше дій тривали одночасно у минулому:

While we **were cleaning** the flat Tom **was repairing** the bike.

3) Коли одна дія тривала у минулому, а інша її перервала:

She **was reading** a book when I **came** home.

Минулий доконаний час вживається у таких випадках.

1) Якщо дія завершилася до певного моменту в минулому:

They **had cleaned** the flat by five o'clock yesterday.

2) Якщо дія завершилася до початка іншої дії в минулому:

They **had cleaned** the flat before we **arrived** home, (first action: had cleaned the flat; second action: arrived home)

Порівняйте:

We **got** to school and the lesson **began**, (дії відбувалися послідовно)

The lesson **had begun** before we **got** to school, (first action: the lesson had begun; second action: we got to school)

28. *Circle the correct item.*

- 1) When Frank entered the room, his sister was watering/had watered the flowers.
- 2) When Frank entered the room, his sister was already watering/had already watered the flowers.
- 3) They packed/had packed the suitcase by six o'clock yesterday.
- 4) While she was speaking/had spoken to her friend her son was watching/had watched the football players.
- 5) Anna took/had taken her mobile phone and put/had put it into her handbag.
- 6) We left/had left before the postman delivered/had delivered the newspaper.
- 7) Willy had/had had his dinner before Dick came/had come.
- 8) Jane was vacuuming/had vacuumed the carpet at four o'clock yesterday.
- 9) You came up/were coming up to the armchair and sat down/had sat down.
- 10) We wanted/ were wanting to go there by bus but it already departed/had already departed.

29. *Put the verbs in brackets into the Past Simple or Past Perfect Tense.*

- 1) When I ... (to return) home I ... (to find) a note from my friend on the front door.
- 2) My friend ... (to phone) me after I ... (to leave) the house.
- 3) The train ... (to arrive) before we ... (to buy) the tickets.
- 4) Angela ... (to say) that she ... (already to meet) that woman at some party.
- 5) Eric ... (to remember) that he ... (not to tell) his friend about the changes in the school timetable.
- 6) Mrs. Adams ... (to put) the presents under the New Year Tree after her children ... (to fall) asleep.
- 7) The performance... (to begin) when they ... (to enter) the hall.
- 8) Den ... (to tell) me that he ... (not to find) any information on the subject yet.
- 9) Sally ... (to switch off) the TV set and ... (to go) to bed.
- 10) The children ... (to eat) all the sweets before their parents ... (to return) from work.

30. Put the verbs in brackets into the Past Simple, Past Continuous or Past Perfect Tense.

- 1) Helen ... (to wash) the dishes when I ... (to come) into the kitchen.
- 2) When we ... (to get) your message you ... (already to leave) our town.
- 3) Tony ... (to listen) to the latest news while his wife ... (to make) a cup of tea for him.
- 4) Sam ... (to walk) home when he ... (to hear) a cry for help.
- 5) When Pete ... (to turn off) the computer he ... (to realize) that he ... (not to save) his work.
- 6) Mr. Ricks ... (to drive) a car when he ... (to remember) that he ... (not to take) his driving license.
- 7) Vicky ... (to walk) the dog after she ... (to write) an essay.
- 8) When I ... (to meet) Fred he ... (to choose) a present for his friend who ... (to have) a birthday the day before.
- 9) While Alice ... (to read) the article she ... (to notice) that the author ... (not to mention) some historical facts.
- 10) When Mark ... (to look) through the instruction one more time he ... (to understand) that he ... (to press) the wrong button of the gadget.

CONTROL TEST

1. By the time the train finally ... in L'viv, I had come to several conclusions.
a) had arrived; b) was arriving; c) has arrived; d) arrived
2. I ... to talk to you now.
a) wanted; b) am wanting; c) have wanted; d) want
3. Excuse me, ... for somebody?
a) do you wait; b) have you waited; c) were waiting; d) are you waiting
4. It's only a short trip. I ... back in two days.
a) will, b) was; c) will be; d) have been
5. When we decrease the amount of TV violence, we ... to see a decline in crime.
a) would begin; b) will begin; c) wouldn't begin; d) won't
6. Michaels ... this movie two times.
a) sees; is seeing; c) has seen; d) saw
7. Jane and Eugene ... along the country road when they saw a deer over there.
a) were driving; b) drove; c) had driven; d) have driven
8. Pete ... it's unlikely that John has passed the exam.
a) thinks; b) doesn't think; c) think; d) thought
9. Sorry, I don't know this word. What...?

a) does mean it; b) does it mean; c) means it; d) is it meaning

10. My family loves this house. It ... the family home ever since my grandparents built it 80 years ago.

a) was; b) has been; c) is; d) will be

11. The teacher ... the lesson at that time.

a) gives; b) gave; c) was giving; d) has given

12. It wasn't raining but a strong wind... .

a) blows; b) was blowing; c) blew; d) has blown

13. What ... to do at the end of the lesson?

a) do you go; b) are you go; c) are you going; d) have you go

14. When you ... home, I ... all the housework.

a) come, finish, b) came, shall have finished; c) come, shall finish; d) come, finishes

15. You ... the books for a month. When will you return them?

a) kept; b) have kept; c) had been keeping; d) keep

16. He was happy. His dream ... true.

a) came; b) was coming; c) had come; d) is coming

17. The quality of these recordings ... not very good.

a) is; b) were; c) are; d) has

18. Were you driving home when you ... that accident?

a) had seen; b) saw; c) have seen; d) see

19. I hope he ... this report by the end of the day.

a) finish; b) shall have finished; c) will finish; d) finished

20. Sit down and fasten your seat belts. We ... in a few minutes.

a) take off; b) shall take off; c) took off; d) are taking off

21. Ukrainian people traditionally ... colored eggs at Easter.

a) prepare; b) have prepared; c) are preparing; d) were preparing

22. I ... in a hotel until I ... where to live.

a) will stay, find; b) am staying, find; c) stayed, will find; d) will stay, will find

23. When we lived in Kyiv we... in the park every day.

a) walked; b) were walking; c) was walking; d) have been walking

24. The life of John and Peter ... considerably since they both got new jobs.

a) have improved; b) improved; c) has improved; d) had improved

25. Look at the time. I think ... the train.

a) am listening; b) am hearing; c) hear; d) hear to

26. When I ... my school in a year, I ... continue my studies at the University.

a) finish, continue; b) will finish, continue; c) finish, will continue; d) will finish, am continuing

27. The population will continue to increase but natural resources... .

a) wouldn't; b) won't; c) will continue to; d) shan't

28. Do you see the man over there? I'm sure he ... to take this bus.

a) is planning; b) planned; c) plans; d) would plan

29. Hello, Ann. What ... in this part of Odessa?

a) do you do; b) is you doing; c) are you doing; d) have you done

30. Tom ... dinner when his friend called.

a) was having; b) had; c) has had; d) has having

ПРИКМЕТНИК (THE ADJECTIVE)

Прикметники в англійській мові мають три ступені порівняння (Degrees of Comparison): звичайний (Positive), вищий (Comparative) і та найвищий (Superlative).

Односкладові прикметники, двоскладові з наголосом на другому складі та ті, що закінчуються на *-y*, *-ow*, *-er*, *-e*, утворюють ступені порівняння шляхом додавання до них суфіксів *-er*, *-est*.

Звичайний ступінь (Positive Degree)	Вищий ступінь (Comparative Degree)	Найвищий ступінь (Superlative Degree)
<i>warm</i>	<i>warmer</i>	<i>the warmest</i>
<i>clever</i>	<i>cleverer</i>	<i>the cleverest</i>
<i>narrow</i>	<i>narrower</i>	<i>the narrowest</i>

Прикметники у найвищому ступені порівняння завжди вживаються з артиклем *the*.

Більшість двоскладових та багатоскладових прикметників утворюють вищий ступінь за допомогою слова *more* (більш), а найвищий ступінь — за допомогою слова *the most* (найбільш, най-).

Звичайний ступінь (Positive Degree)	Вищий ступінь (Comparative Degree)	Найвищий ступінь (Superlative Degree)
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<i>interesting</i>	<i>more interesting</i>	<i>the most interesting</i>
<i>horrible</i>	<i>more horrible</i>	<i>the most horrible</i>

Деякі двоскладові прикметники (*clever, stupid, narrow, gentle...*) утворюють ступені порівняння як шляхом додавання суфіксів, так за допомогою слів *more, the most*:

stupid — *stupider/more stupid* — *the stupidest/the most stupid*.

1. Write the adjectives from the box into the correct column.

more careful, the brightest, fluent, hotter, intelligent, tastier, bitter, the most violent, faster, full, more boring, serious, the richest

Positive Degree	Comparative Degree	Superlative Degree

Запам'ятайте прикметники, що утворюють ступені порівняння від іншого кореня.

Звичайний ступінь (Positive Degree)	Вищий ступінь (Comparative Degree)	Найвищий ступінь (Superlative Degree)
<i>good</i>	<i>better</i>	<i>the best</i>
<i>bad</i>	<i>worse</i>	<i>the worst</i>
<i>little</i>	<i>less</i>	<i>the least</i>
<i>old</i>	<i>older (старіший)</i> <i>elder (старший)</i>	<i>the oldest (найстаріший)</i> <i>the eldest (найстарший)</i>
<i>far</i>	<i>farther (більш далекий)</i> <i>further (подальший)</i>	<i>the farthest (найдальший у відстані)</i> <i>the furthest (подальший, найдальший)</i>
<i>much/many</i>	<i>more</i>	<i>the most</i>

2. Find the odd adjective in every line.

- 1) Wise, fast, good, nice, long;
- 2) heavy, silly, pretty, ordinary, tiny;
- 3) hot, thin, fat, bad, wet;
- 4) practical, patient, little, suspicious, exciting;
- 5) old, young, bad, little, good.

3. Put the adjectives in brackets into the correct degree and learn the proverbs.

- 1) Half a loaf is ... (good) than no bread.
- 2) Blood is ... (thick) than water.
- 3) Actions speak ... (loud) than words.
- 4) The ... (high) tree has the ... (great) fall.
- 5) False friends are ... (bad) than open enemies.
- 6) A chain is no ... (strong) than its ... (weak) link.
- 7) It's ... (easy) to pull down than to build.
- 8) Forbidden fruit is the ... (sweet).

4. Translate into English.

- 1) Ця книга цікавіша за фільм.
- 2) Собака розумніший за папугу.
- 3) Це найсмачніше морозиво, яке я коли-небудь куштував.
- 4) Результати його тесту зараз кращі, ніж були минулого року.
- 5) У неї є молодша сестра та старший брат.
- 6) Цей шлях до річки найкоротший.
- 7) Це була найбільш захоплююча пригода в моєму житті.
- 8) Торт смачніший, ніж цукерки.
- 9) Вітальня — найзручніша кімната в нашій квартирі.
- 10) Твоя валіза важча, ніж моя.

Прикметники можна порівнювати за допомогою структур *as ... as* -який ... як), *not so ... as* (не такий ... як):

Your room is as light as my room.

The dolphin isn't so big as the whale

5. Complete the sentences with *as...as*, or *so...as*.

- 1) I'm ... hungry ... a wolf.
- 2) Ben doesn't have ... comfortable a car ... your parents.
- 3) My story isn't ... long ... yours.
- 4) Ron's dog is ... big ... yours.
- 5) Today the weather isn't ... cold ... it was yesterday.
- 6) The black dress isn't ... expensive ... the red dress.

- 7) This pizza is ... tasty ... the pizza you made last week.
- 8) She is always ... busy... a bee.
- 9) Her hotel room isn't ... large ... yours.
- 10) This pupil is ... clever ... her cousin.

CONTROL TEST

1. The rooms are ___ than they used to be.
a) more clean; b) cleaner; c) cleanest; d) the cleaner.
2. Peter is ___ of them all.
a) oldest; b) the oldest; c) elder; d) the eldest.
3. His answer was ___ than I thought.
a) badder; b) worse; c) the worst; d) more bad.
4. I Ann ___ than Nina?
a) the most intelligent; b) more intelligent; c) intelligenter; d) most intelligent.
5. The Nile is ___ than Dnipro.
a) longest; b) more long; c) longer; d) as long as.
6. It's ___ here than in Kyiv.
a) colder; b) not so...as; c) the coldest; d) more cold.
7. Her son is the ___ student in the class.
a) younger; b) youngest; c) the youngest; d) more young/
8. The weather is not ___ bad ___ I had expected.
a) as...as; b) so...as; c) so...so; d) more ...as.
9. This scientist thinks of a ___ method.
a) worse; b) better; c) gooder; d) the worst.
10. Nowadays computers are ____.
a) complicated; b) more complicated; c) most complicated; d) the most complicated.
11. These exercises are ___ in the textbook.
a) easier; b) the easiest; c) more easy; d) the most easy.
12. She is ___ student in the group.
a) attentive; b) more attentive; c) the most attentive; d) attentiver.
13. My essay is not ___ long ___ yours.
a) as...as; b) so...as; more...than; d) more...so.
14. Which is ___: The United States or Canada?
a) larger; b) largest; c) more large; d) the largest.
15. The London Underground is the ___ in the world.
a) eldest; b) the oldest; c) oldest; d) the most old.

16. Nick's English is ...good ...his friend's.
a) as...as; b) so ...as; c) no so...as; d) more...as.
17. It's ___ mistake I've ever made.
a) worse; b) the worst; c) the baddest; d) worst.
18. January is ___ month of the year.
a) the coldest; b) coldest; c) more cold; d) colder.
19. Nick swam to the ___ of the lake.
a) further; b) farther; c) far; d) more farther.
20. My sister speaks English ___ than I do.
a) best; b) worst; c) worse; d) the best.
21. ___ than never.
a) better; b) best; c) worse; d) the worst.
22. Is the word "newspaper" ... than the word "book"?
a) longer; b) more long; c) longest; d) the longest.
23. Give me the ___ information, please.
a) far; b) farther; c) further; d) furthest.
24. The results of the experiment were ___ bad ___ they had expected.
a) as...as; so...as; c) not so...as; d) more...than.
25. The English Channel is ___ than the Strait of Gibraltar.
a) wider; b) the wider; c) more wide; d) most wide.
26. - Please, give me this bouquet of flowers. I think it is ___ than the rest ones.
- But it's ___. Never mind. I'll buy it.
a) beautiful/expensive; b) more beautiful/ more expensive; c) the most beautiful/most expensive; d) most beautiful/most expensive.
27. I make ___ mistakes than last year.
a) few; b) fewer; c) the fewer; d) the fewest.
28. You won't find ___ than this. They'll all be ___ expensive ___ than this one.
a) the cheapest/as/as; b) a cheaper/as/as; c) a cheaper/as more; d) the cheapest/as/more.
29. Your translation was ___ than Jim's, but it was ___ than Mary's.
a) better/worse; b) gooder/badder; c) better/worst; d) best/worse.
30. A: They look the same size to me. B: No. This one ___ than the other.
a) slightly is bigger; b) is slight bigger; c) is slightly bigger; d) slight is bigger.

**МОДАЛЬНІ ДІЄСЛОВА
(MODAL VERBS)**

The Verb 3 англійській мові є такі модальні дієслова: *can* (можти, вміти), *could* (міг), *must* (повинен, потрібно), *may* (можеш, може), *should* (слід), *have to* (повинен, потрібно) та ін.

Модальні дієслова (крім *have to*) мають одну форму для всіх осіб і чисел та самотійно (без допоміжних дієслів) утворюють питальні та заперечні форми.

Після модальних дієслів (крім *have to*) інфінітив вживається без *to*:

Can your friend **skate**? I'm afraid he **can't skate**, but he **can ski**.

Дієслова *have to*, *ought to* є винятками: після них інфінітив вживається з *to*, а питальні та заперечні речення потребують відповідних допоміжних дієслів.

Наприклад:

Do they **have to come** at five? — No, they **don't**. They **have to come** it six.

Модальні дієслова мають відповідні форми у минулому та майбутньому часах.

Present	Past	Future
can	could	will be able to
must	had to	will have to
may	might	will be allowed to

Наприклад:

She **will be able to meet** you tomorrow.

We **had to take** a taxi because we **couldn't miss** the train.

I hope my parents **will allow** me **to go** fishing.

1. Complete the sentences with the verbs in brackets.

1) Jane ... play the violin a year ago, but now she ... play well. She ... play in the concert in two months, (can, could, be able to)

2) You ... watch this film yesterday. I ... you to go for a walk when you finish your homework. Your friend ... visit you today. (may, might, will allow)

3) Oscar ... take aspirin an hour ago. He ... go to bed right now. He ... visit the doctor in three days. (must, had to, will have to)

4) My friend ... speak French very well. He ... speak French when he was twelve. I think he ... go to university in France in his future, (can, could, will be able to)

5) We ... clean the flat now. We ... clean the flat yesterday, but we had a lot of homework to do. We ... go shopping tomorrow- evening, (must, had to, will be able to).

6) Tony and Den ... go to the cinema yesterday. If they have already had dinner, they ... play computer games. Their parents ... the boys to go to the river next Saturday, (may, might, will allow).

2. Choose the correct modal verb from brackets to complete the proverbs.

- 1) A cat ... look at a king, (must, may)
- 2) Don't bite off more than you ... chew, (must, may, can)
- 3) The leopard ... change his spots, (can't, mustn't, may not)
- 4) No man ... serve two masters, (must, may, can)
- 5) Never put off till tomorrow what you ... do today, (must, may, can)
- 6) The wolf ... lose his teeth but never his nature, (must, may)
- 7) You ... make an omelet without breaking eggs, (mustn't, can't, may not)
- 8) You never know what you ... do till you try. (must, may, can)

Модальне дієслово *must* вживається для вираження обов'язків (obligation) та вказує на необхідність щось зробити (necessity).

Must вживається, коли людина приймає рішення самостійно:

You **must do** it now.

Must not виражає заборону:

You **must not make** a noise in the hospital.

Модальне дієслово *have to* вживається у теперішньому, минулому, майбутньому часах і також вказує на необхідність щось зробити та виражає обов'язки, але, на відміну від дієслова *must*, воно вживається, коли людина має виконувати чужі, а не свої рішення чи змушена щось робити під впливом обставин:

I don't want to walk the dog, but I **have to**.

My doctor says I **have to take** vitamins. Дієслово *have to* потребує відповідних допоміжних дієслів для утворення питальних та заперечних речень:

Does she have to get up early? - Yes, she **does**.

Did he have to meet you? - No, **he didn't**.

Will they have to take part in the conference? - No, they **won't**.

3. Complete the sentences with *must* or *have to*.

- 1) I'm very tired. I ... go to bed earlier today.
- 2) My parents think I ... go to bed early to have a good sleep.

- 3) I ... buy bread. My mother asked me about it.
- 4) I have got a terrible headache. I ... take an aspirin.
- 5) My teacher says I ... pay more attention to my pronunciation.
- 6) We have nothing to eat. We ... go shopping.
- 7) Paul's coach says he ... exercise more to get good results at the competition.
- 8) Vicky's room is a mess. She ... tidy it.
- 9) The weather is so wonderful today! We ... go out for a picnic.
- 10) Jane's boss thinks she ... speak to the clients more politely.

4. Complete the sentences with the correct form (positive, negative or interrogative) and tense (present, past or future) of *have to*.

- 1) Sam has got a toothache so he ... visit his dentist today.
- 2) ... we ... prepare all the documents yesterday? — No, you
- 3) It's my day off tomorrow so I ... go to the office.
- 4) It was raining yesterday so Frank ... take his umbrella.
- 5) Sally has recovered so now she ... stay in bed any more.
- 6) Sheila and Marion can't come to our party because they ... study for the test tonight.
- 7) ... you ... type all these letters today? — Yes, I
- 8) My aunt arrives tomorrow so I ... meet her at the railway station.
- 9) It was very warm yesterday and Jessie ... put on her warm sweater.
- 10)... Clara ... fill in this report right now? — No, she
- 11) Let's go shopping now so that we ... do it tomorrow.
- 12) ... Mike ... book the hotel room yesterday? — Yes, he

Здатність щось робити (ability) виражається за допомогою дієслів *can, could, be able to*.

Can виражає вміння щось робити тепер:

She **can swim** very well.

She can teach you to swim.

Could/was able to виражає вміння щось робити у минулому:

He **could/was able to ride** a bike when he was five.

Was able to виражає здатність щось робити у минулому в результаті особливих обставин (у значенні «вдалося зробити»):

He **was able to help** me in spite of his tiredness.

Will be able to виражає здатність щось зробити у майбутньому:

She **will be able to meet** you tomorrow.

5. Circle the correct item.

- 1) My little brother can/could count when he was six.
- 2) I will be able/was able to send the invitations tomorrow.
- 3) We can/ could order a taxi right now.
- 4) She won't be able/wasn't able to understand the rule because she had a headache.
- 5) Alan could/was able to win the competition because his leg didn't hurt.
- 6) I'm afraid Sue can't/won't be able to take you to the exhibition because she'll be very busy next Friday.
- 7) It was snowing hard and we can't/weren't able to drive fast.
- 8) Olga can't/couldn't say a word in English two years ago but now she can/could speak English fluently.

6. Complete the dialogue with *can*, *could* or *be able to* in the correct tense and form.

- You are a champion skater now, but ... you skate in your childhood?
- No, I I even ... think about skating because I was afraid of this kind of sport. But I ... play the violin very well then and my teacher thought I ... become a famous musician.
- But how did you manage to learn to skate?
- Well, my father was fond of skating. One day he took me to the skating-rink to teach me skating. When I went on the ice for the first time I felt very excited. I ... think of anything else. But suddenly I fell down and broke my arm. After that accident I ... become a musician. So I had nothing to do but learn to skate.
- ... you play the violin now?
- Unfortunately I
- Do you go in for other kinds of sport?
- Well, I ... ski and swim. And I ... play computer games. I hope one day I ... take part in some computer-gaming competition.
- I wish you luck then.

Для висловлювання можливості чи вірогідності (possibility/ probability) використовуються такі дієслова.

1) *May* (можливо, дуже вірогідно): She **may return** home before dinner.

2) *Might* (можливо, дуже вірогідно): It **might rain** in the evening.

Хоча *might* — це форма минулого часу дієслова *may*, вона може вживатися для описання ситуацій у теперішньому часі.

3) *Could* (можливо): He **could still be** in the office.

- 4) *Must* (майже впевнений): I often see them together. They **must be** good friends.
5) *Can't* (не думаю, що це можливо): You **can't be** thirty-five. You look much younger.

7. Rewrite the sentences using *may/might, must, can't, could* as in the example.

Example: I don't think this film is interesting.

This film **can't be** interesting.

- 1) He usually phones me. I think he will phone me today.
- 2) I don't know if we meet our cousins.
- 3) I hope your little brother is near the sandpit.
- 4) I don't think the plane arrives on time in such bad weather.
- 5) I'm not sure if our teacher is still at school.
- 6) Perhaps your parents will give you some good advice.
- 7) It's quite possible that Nick will buy the cake.
- 8) It's certain that they are of the same age.
- 9) I don't think that the situation is so bad.

8. Translate into English.

- 1) Наші сусіди мають бути на роботі зараз.
- 2) Ми запізнюємось. Наш учитель може розсердитись.
- 3) Це не може бути її номер телефону. Вона нещодавно змінила номер.
- 4) Мій брат може забути про зустріч.
- 5) Ти можеш думати, що це питання не таке вже й важливе.
- 6) Вона не може бути здивованою. Вона знала про це заздалегідь.
- 7) Твої однокласники можуть мати інші завдання.
- 8) Цей журнал має бути у твого брата. Я давав його йому тиждень тому.
- 9) Ці дівчата можуть бути сестрами.
- 10) Я гадаю, може піти дощ.

У запитаннях з метою отримання дозволу (*permission*) використовуються такі модальні дієслова.

- 1) *Can* (дружнє звертання): **Can I use** your pencil?
- 2) *Could* (ввічливе звертання): **Could we have** a break, please?
- 3) *May* (ввічливе звертання): **May I talk** to you?
- 4) *Might* (дуже ввічливе звертання): **Might I ask** you some questions, please?

Для вираження дозволу/заборони (refusing, permission/prohibition) використовуються такі модальні дієслова.

1) *Can* (дозволити по-дружньому): You **can take** a piece of cake if you want.

2) *May* (дати дозвіл більш офіційно): She **may leave** her recommendation letter.

Для вираження заборони використовуються такі модальні дієслова.

1) *Mustn't* (категорична заборона): You **mustn't walk** your dog here.

2) *Can't* (заборона): He **can't swim** too far from the shore.

9. Complete the dialogues with *can, may, could, can't, mustn't*.

1) — ... I watch TV a little longer today, Mum?

— I'm sorry, you Little children ... watch TV late at night.

2) — ... I talk with the manager, please?

— One moment, please. Sorry, the manager is out at the moment but you ... leave a message for him.

3) — ... I use your camera, Dad?

— Of course, you But be careful with it.

4) — ... I see your passport, please?

— Here you are. ... I go now?

— Yes, please. Good luck.

5) — You ... smoke here. There is a special sign.

— Excuse me, please.

6) — ... I ride a bike after dinner?

— Of course you ... But you ... ride too fast because it's very dangerous.

7) — Excuse me. ... I make a call from your phone, please?

— Sorry you The line is engaged at the moment.

Для вираження поради (advice), використовуються модальні дієслова *should* та *ought to* без відмінностей у значенні:

You **should/ought to in for** sport to stay healthy.

You **shouldn't/ oughtn't to eat** a lot of sweets.

What **should** we **do** in this case!

10. Complete the dialogue with *should/shouldn't* or *ought/oughtn't*, using the following word-combinations.

to stay in bed, to call the doctor, to go out, to drink cold lemonade/warm tea or milk with honey, to take an aspirin, to eat an ice cream, to go to school, to take vitamins

— My family has just moved to another town and I have no friends here yet. What ... I do to make friends?

— I think you ... try to make friends among your new classmates. First, you ... to be rude. You ... to smile when you speak to people. Then you ... try to be helpful. Remember, a friend in need is a friend indeed!

— But school isn't the only place to meet new friends.

— Of course not. You ... to be confined to school and home only. You ... join some club or a gym. Hobby is a wonderful chance to meet interesting people and new friends. You ... be afraid of communicating. If you are a sociable person it isn't a problem for you to make friends with somebody. give advice to Bobby.

11. Circle the correct item.

1) I ... feed my dog now.

a) has to b) must c) should

2) ... we leave our luggage here?

a) would b) will c) can

3) You ... smoke in the hospital.

a) can't b) mustn't c) won't

4) ... we have supper together?

a) shall b) will c) could

5) My parents say I ... eat more vegetables.

a) must b) have to c) has to

6) ... you like to look at this ring?

a) will b) shall c) would

7) You ... to sleep more.

a) ought b) should c) must

8) It's rather late now and they ... be at home.

a) were able to b) will c) must

9) ... you bring me the bill, please?

a) could b) would c) should

10. She looks very young. She ... be forty.

a) can't b) mustn't c) couldn't

CONTROL TEST

1. You ___ open the window. I'm cold.

a) shouldn't; b) can't; c) mustn't; d) needn't.

2. Shoes ___ either black or brown.
a) don't; b) might; c) may; d) need.
3. A: My car has been stolen. B:
a) You should ring the police.; b) Will you phone the police.;
c) Could you ring the police.; d) You needn't phone the police.
4. He ___ faster three years ago.
a) can; b) could; c) might; d) must.
5. A horse ___ go twice as fast as elephant.
a) used to; b) can; c) is used to; d) is able.
6. ___you speak Spanish?
a) may; b) are; c) can; d) need.
7. A: ___ I go? B: yes, you can.
a) could; b) must; c) ought to; d) need
8. ___ you help me with my homework?
a) must; b) need; c) can; d) should
9. A: I've got a toothache. B: You'd ___ go to the dentist.
a) better; b) should; c) need; d) must.
10. I ___ like to listen to guitar music.
a) am able; b) should; c) could; d) would.
11. His illness got worse and worse. In the end, he ___ to the hospital for the operation.
a) will have to; b) must; c) had to; d) ought to have.
12. You ___ any more aspirins; you've had four already.
a) mustn't; b) needn't have taken; c) shouldn't have taken; d) had better not take.
13. I've searched everywhere for Bob but I ___ to find him.
a) wasn't able; b) am not able; c) haven't been able; d) couldn't
14. He felt he ___ carry out his promise.
a) can; b) must; c) could; a) may
15. They didn't even want to listen to him, but in the end he ___ explain everything.
a) could; b) was able to; c) might; d) needn't.
16. It's getting dark, so we ___ go.
a) must; b) need; c) have to; d) may.
17. "Doctors are supposed to help sick people" means: ___
a) they help sick people; b) they should help sick people; c) they must be helping sick people; d) they might have helped sick people.
18. We can't wait any longer! Something ___ immediately.
a) should have been done; b) had to be done; c) ought to do; d) must be done.

19. Children ___ taught to respect their elders.
a) should be; b) had better; c) has to be; d) must have.
20. All the lights in Tom's room are turned off. He ___ sleeping.
a) must have been; b) had to be; c) must be; d) must not be.
21. I ___ go now. I have a lecture in 5 minutes.
a) had better; b) have got; c) must; d) should.
22. You ___ hurry. We have plenty of time.
a) shouldn't; b) needn't; c) need; d) must.
- 23 ___ I borrow your pen for a moment?
a) need; b) should; c) can; d) have to.
24. ___ solve this problem before he explained it to me.
a) am not able to; b) wasn't able to; c) can't; d) oughtn't.
25. Where have you been ___ I ask?
a) should; b) could; c) need; d) may
26. Why didn't you tell me that I ___ buy the books?
a) have to; b) has to; c) had to; d) was able to.
27. You ___ this rule to me, I have already known it.
a) needn't; b) need; c) could; d) should.
28. Alex ___ spend more time studying, but the other boy ___; he has successfully passed the exam.
a) must, need; b) should, mustn't; c) need, could; d) must, could.
29. Peter ... return the book to the library. We all want to read it.
a) must; b) can; c) could; d) needn't.
30. Shall I write a letter to him? – No, you ___ not, it is not necessary.
a) should; b) could; c) need; d) must

ПАСИВНИЙ СТАН (PASSIVE VOICE)

Пасивний стан дієслів в англійській мові вживається, коли дія більш важлива, ніж її виконавець; коли виконавець невідомий; коли ми звертаємо увагу на виконавця дії. Також пасивний стан вживається для підкреслення ввічливості та офіційності ситуації:

The post-office is closed at 20.00. (**Виконавець дії невідомий та неважливий**).

The novel is written by Walter Scott. (**Звертаємо увагу на виконавця дії**).

The applications are accepted from 3 p.m. to 5 p.m. (**Підкреслюємо офіційність**).

ситуації).

Пасивний стан дієслів англійської мови утворюється додаванням допоміжного дієслова *to be* у відповідному часі до основного дієслова у третій формі (для неправильних дієслів) або із закінченням *-ed* (для правильних).

to be + V₃ (V_{ed})

Для утворення пасивного стану дієслів у теперішньому неозначеному часі (Present Simple Passive) вживається форми допоміжного дієслова в теперішньому часі (*am, is are*).

I + am + V₃ (V_{ed})

He/she/it + is + V₃ (V_{ed})

We/you/they + are + V₃ (V_{ed})

Наприклад:

Dinner **is cooked** every day.

The films **are shown** in the evening.

Заперечна та питальна форми речень з дієсловами пасивного стану утворюються з використанням відповідних форм допоміжного дієслова *to be*.

I + am not + V₃ (V_{ed})

Am + / + V₃ (V_{ed})?

He/she/it + is not + V₃ (V_{ed})

Is + he/she/it + V₃ (V_{ed})?

You/we/they + are not + V₃ (V_{ed})

Are + you/we/they + V₃ (V_{ed})?

Наприклад:

The room **is cleaned** every day.

The room **isn't cleaned** every day.

Is the room **cleaned** every day?

What **is cleaned** every day?

Пасивний стан дієслів у реченнях минулого неозначеного часу (Past Simple Passive) утворюється за допомогою форм минулого часу допоміжного дієслова *to be* (*was, were*).

I/he/she/it + was + V₃ (V_{ed})

I/he/she/it + was not + V₃ (V_{ed})

You/we/they + were + V₃ (V_{ed})

You/we/they + were not + V₃ (V_{ed})

Was + I/he/she/it + V₃ (V_{ed})?

Were + you/we/they + V₃ (V_{ed})?

Наприклад:

This film **was shown** yesterday.

This film **wasn't shown** yesterday.

Was this film **shown** yesterday?

When **was** this film **shown**?

Пасивний стан дієслів у реченнях майбутнього неозначеного часу (*Future Simple Passive*) утворюється за допомогою форми майбутнього часу допоміжного дієслова *to be* (*will be*).

I/you/he/she/it/we/they + will be + V₃ (V_{ed})

I/you/he/she/it/we/they + will not (won't) be + V₃ (V_{ed})

Will + I/you/he/she/it/we/they + be + V₃ (V_{ed})?

Наприклад:

The letters **will be typed** tomorrow.

The letters **won't be typed** tomorrow.

Will the letters **be typed** tomorrow?

When **will** the letters **be typed**?

<p>Пасивний стан дієслів у теперішньому неозначеному часі вживається, якщо дії є регулярними чи повторюваними або йдеться про загальновідомі факти. Характерні обставини часу: <i>always, usually, often, every, sometimes, seldom, rarely, never</i>. Наприклад: Fresh fish is always sold in the market.</p>	<p>Пасивний стан дієслів у минулому неозначеному часі вживається, якщо дії відбулись і закінчились у визначений момент у минулому або йдеться про події чи загальновідомі факти, що мали місце у минулому. Характерні обставини часу: <i>yesterday, last month (year), a week ago</i>. Наприклад: This gadget was invented some years ago.</p>	<p>Пасивний стан дієслів у майбутньому неозначеному часі вживається, якщо дії відбудуться у визначений час у майбутньому. Характерні обставини часу: <i>tomorrow, next week (month), in a week</i>. Наприклад: The news will be reported in an hour.</p>
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1. Circle the correct item.

1) The Sphinx is/was constructed 4000 years ago.

2) The invitation cards were/will be printed in three days.

3) The Tower of London is/will be visited by thousands of tourists every year.

- 4) The medicine for cancer was/will be developed in the near future.
- 5) The tape recorder is/was invented in 1899.
- 6) The articles of this journalist are/will be sometimes published in this newspaper.
- 7) A new song by this pop group is/was recorded a week ago.
- 8) Some new tours will be/were developed by this tourist agency next year.
- 9) A huge shopping center is/ will be opened in two weeks in our town.
- 10) This hotel is/will be seldom chosen by Americans.

2. Put the verbs in brackets into the Present Simple Passive, Past Simple Passive or Future Simple Passive.

- 1) The room ... (to clean) yesterday.
- 2) New houses ... (to build) in our city every year.
- 3) The book of this writer ... (to publish) in a month.
- 4) The trees ... (to whitewash) by our pupils every spring.
- 5) Tea ... (to grow) in Ceylon and India.
- 6) America ... (not to discover) by James Cook. It ... (to discover) by Christopher Columbus.
- 7) Pizza ... (to deliver) in half an hour.
- 8) Thousands of new cars ... (to produce) at this plant every year.
- 9) Ink ... (to use) for writing many years ago.
- 10) Some new technologies ... (to introduce) to the industrial companies at the end of the following month.

3. Put the verbs in brackets into the Present Simple Passive, Past Simple Passive or Future Simple Passive.

England and France ... (to separate) by the English Channel. In the past people and goods ... (to transport) from one country to another by ferries only. This way of transporting wasn't convenient enough so the idea to build a channel under the sea ... (to offer) in 1802 by a French engineer. Work started at the end of the 19th century but ... (to interrupt) by different political and practical problems. The building ... (to resume) in the 1980s, and the tunnel ... (to open) on May 6, 1994. It ... (to name) The Channel Tunnel and at that time it ... (to recognize) as the longest tunnel and one of the Seven Wonders of the Modern World. Today the travel from France to England takes about three hours and 35 minutes of this time ... (to spend) in the underwater tunnel. But the engineers of both countries develop different ideas so that the work of the tunnel ... (to improve) in the nearest future.

Утворюючи речення з присудком пасивного стану з модальними дієсловами, слова розташовують у такій послідовності:

modal verb + be + V₃ (V_{ed}).

Наприклад:

The book **must be read**.

The car **can be repaired**.

The film **may be watched**.

4. *Make up sentences using the Passive Voice.*

- 1) The homework/must/do.
- 2) The ball/can/use/in the gym.
- 3) The dishes/must/wash.
- 4) The essay/should/write.
- 5) The dog/should/feed.
- 6) This question/could/discuss/yesterday.
- 7) The things/must/pack.
- 8) The documents/couldn't/sign/yesterday.
- 9) Mobile phones/can't/use/during the lesson.
- 10) Loud music/shouldn't/play/here.

У реченнях з дієсловами пасивного стану часто вживаються прийменники *by* та *with*. *By* вживається, коли йдеться про виконавця дії, *with* — коли йдеться про знаряддя, яким виконується дія:

The novel is written **by** a famous writer.

This picture was drawn **with** a pencil.

5. *Circle the correct item.*

- 1) The note was written with/by a pencil.
- 2) The dinner will be cooked with/by my aunt.
- 3) This story was told with/by a famous traveler.
- 4) Meat is eaten with/by a fork and a knife.
- 5) The report will be prepared with/by our manager.
- 6) The carpets are cleaned with/by a vacuum cleaner.
- 7) The rooms in the hotel are cleaned with/by maids.

Для утворення пасивного стану дієслів теперішнього (Present Continuous Passive) та минулого тривалого часу (Past Continuous Passive) вживаються форми допоміжного дієслова *to be* в теперішньому (*am, is, are*) чи в минулому часі (*was, were*), дієслово *to be* із закінченням *-ing* та основне дієслово у третій формі (для неправильних дієслів) або із закінченням *-ed* (для правильних дієслів). Питальні та заперечні речення утворюються за допомогою відповідних форм дієслова *to be*.

I + am being + V₃ (V_{ed})

He/she/it + is being + V₃ (V_{ed})

You/we/they + are being + V₃ (V_{ed})

Наприклад:

The film **is being watched** now.

The film **isn't being watched** now.

Is the film **being watched** now?

What **is being watched** now?

I/he/she/it + was being + V₃ (V_{ed})

You/we/they + were being + V₃ (V_{ed})

Наприклад:

The story **was being told** then.

The story **wasn't being told** then.

Was the story **being told** then?

What **was being told** then?

Пасивний стан дієслів теперішнього тривалого часу вживається, якщо дія відбувається над об'єктом у момент мовлення. Пасивний стан дієслів минулого тривалого часу вживається для вираження дії, яка відбувалася над об'єктом у певний момент у минулому чи протягом певного часу в минулому.

6. Complete the answers to the questions using the Past Continuous Passive and the verbs from the boxes.

to listen to, to bake, to check, to wash, to type, to discuss, to vacuum

- 1) Did she return you the CD yesterday? — No, it
- 2) Why didn't you put that black shirt on? — It
- 3) Why didn't he hear the doorbell? — The carpet
- 4) Did the teacher check your test yesterday? — No, it

- 5) Did they find a solution to that problem? — No, it....
- 6) Why didn't you try the cake? — It
- 7) Could he take the documents yesterday? — No, they

7. *Translate into English.*

- 1) Цим комп'ютером зараз не користуються.
- 2) Кімнату зараз прибирають.
- 3) Доповідь учора слухали півгодини.
- 4) Ваш костюм учора прасували двадцять хвилин.
- 5) На нього чекають?
- 6) Вашу кімнату вчора довго фарбували? — Так, її фарбували три години.
- 7) Обід ще готують.
- 8) Запрошення зараз пишуть? — Так.
- 9) Мою машину вчора ремонтували весь день.
- 10) Її зараз запитують.

Для утворення пасивного стану дієслів теперішнього та минулого доконаного часу (Present Past Perfect Passive) вживаються форми допоміжного дієслова *to have, had* у теперішньому часі (*have, has, had*), дієслово *to be* у третій формі (*been*) та основне дієслово у третій формі або із закінченням *-ed*. Питальні та заперечні речення утворюються за допомогою відповідних форм дієслова *to have*.

I/you/we/they + have been + V₃ (V_{ed})

He/she/it + has been + V₃ (V_{ed})

Наприклад:

The book *has been read* by Monday.

The book *hasn't been read* by Monday.

Has the **book been read** by Monday?

What *has been done* by Monday?

The book *had been read* by last month.

Пасивний стан дієслів теперішнього та минулого доконаного часу вживається, якщо дія над об'єктом завершилася нещодавно та наявний результат або завершилася до конкретного часу в минулому.

8. *Put the verbs in brackets into the Present or Past Perfect Passive.*

- 1) This collection of science fiction stories ... (already to publish).

- 2) Our director ... (just to inform) about the accident.
- 3) The burglars ... (not to arrest) yet.
- 4) The curtains ... (already to put up).
- 5) The construction of the bridge ... (to finish) by the end of the year.
- 6) When he entered the classroom the lecture ... (to begin) already.
- 7) What poem ... (to learn) by heart for today?
- 8) What souvenirs ... (to prepare) for the foreign guests?
- 9) How ... the information ... (to use)?
- 10) Which picture ... (already to exhibit)?

9. Make up sentences in the Passive Voice using the correct grammar tense.

- 1) Loud music/to hear/from the living-room/now.
- 2) The festival/to hold/in our city/every year.
- 3) The lecture/to attend/by all the students/yesterday?
- 4) A taxi/not to call/yet.
- 5) The room/must/to air/every day.
- 6) By the evening/I/ to finish/translation/of the article.
- 7) The essays/to hand/tomorrow?
- 8) The show/to perform/at five o'clock yesterday.
- 9) The suitcases/to bring/to the hotel room/yet?
- 10) When/this university/to found?
- 11) Whose car/to repair/now?
- 12) What pizza/just/to order?
- 13) The message/not to receive/yesterday.
- 14) This invitation/should/to accept.
- 15) What questions/to discuss/tomorrow?

10. Translate into English.

- 1) Цю подію не часто згадують у нашому місті.
- 2) Її запросили до театру вчора.
- 3) Завтра полагодять мій комп'ютер.
- 4) Учора в музеї їм показали багато прекрасних картин.
- 5) Цю вазу не слід ставити на полицю.
- 6) їм щойно розповіли про історію нашого міста.
- 7) Коли розбили тарілку?
- 8) Де можна залишити записку?

- 9) Що приготують на обід завтра?
10) Цю статтю зараз перекладають.

CONTROL TEST

1. Several problems ... the government.
a) were considered by; b) considered were by; c) considered by; d) considers;
2. The city ... by the soldiers.
a) is defended; b) is being defended; c) are defended; d) are being defended
3. The amendment ... by the other members.
a) have been repeated; b) has been repeated; c) is being repeated; d) were repeated
4. In ancient Greece the Olympic Games ... once in four years.
a) were held; b) are being held; c) are held, d) was held
5. Look! The bridge
a) are being repaired; b) is being repaired; c) is been repaired; d) has being repaired.
6. The rule must ... to everyone.
a) have known; b) be known; c) know; d) be knowing
7. The Guinness Book of Records ... in the 50's.
a) first published; b) has first been published; c) was first published; d) were published first
8. It... to us how the accident had happened.
a) is explaining; b) was explained; c) was explaining; d) had explained
9. I had an unpleasant feeling that I ...
a) watched; b) was watched; c) have been watched; d) was being watched
10. New sources of energy ... developed nowadays.
a) is being) has been; c) are being; d) have been
11. Everything ... before you came.
a) is done; b) was done; c) has done; d) had been done
12. We can't wait any longer. Something ... immediately.
a) should have been done; b) had to be done; c) ought to do; d) must be done
13. They had not done any damage to it. No damage ... to it.
a) was done; b) had done; c) hadn't be done; d) had been done
14. People do not bring up children properly these days. Children ... properly these days.
a) didn't bring up; b) aren't bringing up; c) aren't brought up; d) weren't brought up
15. You can't come in. She ... for the TV.
a) is interviewed; b) interviews; c) is being interviewed; d) was interviewed

16. There's someone behind us. I think...

a) were are following; b) we are followed; c) we were followed; d) we are being followed

17. The World Cup at football ... in 2006.

a) was won by Italy; b) has been won by Italy; c) won by Italy; d) won

18. The new equipment ... the company.

a) ordered; b) ordered by; c) was ordered; d) had been ordered

19. The next meeting ... on June 10th.

a) will hold; b) holds; c) will be held; d) held

20. Action must ... at once.

a) take; b) have taken; c) be taken; d) took

21. Bicycles ... in the city instead of public transport.

a) widely used; b) are widely using; c) are widely used; d) used

22. I hope that the truth ... very soon.

a) will find out; b) will be finding out; c) is found out; d) will be found out

23. The delegation ... at the station yesterday.

a) meet; b) is met; c) have been met; d) was met

24. Long ago, people thought that the earth was flat. Long ago, the earth... flat.

a) was thought to be; b) was thinking to be; c) thought to be; d) is thought to be

25. The authorities will make him to pay all his debts. He ... pay all his debts.

a) is going to be; b) will be made; c) was made to; d) will be made to

26. Children ... taught to respect their elders.

a) should be; b) had better; c) has to be; d) must have

27. Who's going to meet him at the airport. He ... by our ambassador.

a) is going to be met; b) is met; c) will have been met; d) has gone to be met

28. A police car came when the injured man ... off the road.

a) was being carried; b) was been carrying; c) has been carried; d) was carried

29. The event ... before they arrived home.

a) reported; b) had been reported; c) was being reported; d) has been reported

30. Your food

a) is still being prepared; b) is being prepared; c) has still been prepared; d) will prepare yet

**НЕПРЯМА МОВА
(REPORTED SPEECH)**

Непряма мова (Reported Speech) — це слова людини, передані іншою людиною. У реченнях з непрямою мовою лапки не вживаються, на відміну від речень із прямою мовою (Directly Speech). При трансформації речень з прямої мови у непряму особові та присвійні займенники змінюються відповідно до змісту:

He says, «I have got a computer». — He says that he has got a computer.

She says, «This is my book». — She says this is her book.

У реченнях з непрямою мовою вживаються дієслова *say* та *tell*.

Say вживається, якщо ми не вказуємо людину, до якої звертаємось.

Tell вживається тоді, коли ми вказуємо людину, до якої звертаємось:

She said to me, «I have no time». — She said that she had no time.

She told me that she had no time.

У реченнях з непрямою совою часто вживається сполучник *that*, але його можливо випустити:

He said, «I watch TV every evening». — He said that he watched TV every evening.

He said he watched TV every evening.

1. Complete the sentences with said or told.

- 1) Susan ... us about this film yesterday.
- 2) Our teacher ... that we would have an extra lesson of History.
- 3) The doctor ... him to stay in bed.
- 4) Samantha ... her mother that she had already fed the dog.
- 5) She ... me her phone number.
- 6) The policeman ... the woman not to worry.
- 7) My parents ... that I should go to bed.
- 8) Bob ... them that he was packing his suitcase.
- 9) You ... that you could speak French fluently.
- 10) Alan ... her that he didn't know about the accident.

Якщо у словах автора в реченнях із прямою мовою дієслово-присудок стоїть у теперішньому часі, то після перетворення прямої мови на непряму час дієслів не змінюється:

They say, «We are going to the supermarket». — They say (that) they are going to the supermarket.

She says, «I was at school yesterday». — She says (that) she was at school

yesterday.

Якщо у словах автора в реченнях із прямою мовою дієслово-присудок стоїть у минулому часі, то після перетворення прямої мови на непряму час дієслів змінюється таким чином:

Direct Speech	Reported Speech
Present Simple: She said, «I go to school at eight o'clock».	Past Simple: She said that she went to school at eight o'clock.
Present Continuous: He said, «I am reading a book».	Past Continuous: He said he was reading a book.
Past Simple: He said, «I lost the wallet».	Past Perfect: He said he had lost the wallet.
Present Perfect She said, «I have washed the dishes».	Past Perfect: She said she had washed the dishes.
Future Simple: She said, «I will help you».	Future-in-the-Past: She said she would help me.

Модальні дієслова та дієслово *to be* змінюються на відповідні форми минулого часу (окрім дієслів *should, could, might*):

He said, «I **can swim**». — He said he **could swim**.

She said, «I **am thirsty**». — She said she **was thirsty**.

The teacher said, «You **should learn** the poem by heart». — The teacher said I **should learn** the poem by heart.

Минули тривалий час не змінюється у непрякій мові:

They said, «We **were working** in the garden». — They said that they *were working* in the garden.

2. Circle the correct item.

- 1) Mark says that he has/had six lessons every day.
- 2) My friend said that he is/was in a hurry.
- 3) She told him that she can/ could drive a car.
- 4) My Granny says she is/was baking a cake.
- 5) They said they have/had seen that film.
- 6) The doctor said I must/had to take a cold shower.
- 7) Eric told me that we will/ would receive the invitations in some days.
- 8) The manager says that he has/had already prepared all the documents.

- 9) The shop-assistant told me that she can/could give me another pair of gloves.
10) Helen said that she has/had already had lunch.

3. Report the statements.

- 1) Jack said, «I'm repairing the radio».
- 2) Fred said, «My cousin usually goes to the gym after school».
- 3) Ann said, «I have never been to the Theme Park».
- 4) Andrew said, «I can't remember the number of his flat».
- 5) We said, «We returned home at five 205 o'clock».
- 6) I said, «I'm hungry».
- 7) She said, «My aunt will take me to the exhibition».
- 8) Our teacher said, «I know about this fact».
- 9) My father said, «You may play the computer a bit longer».
- 10) Sally said, «We were discussing the play at that time».
- 11) Tony said, « I have just finished my report».
- 12) The waiter said, «The taxi is waiting for you».
- 13) I said, «I don't agree with you, Paul».
- 14) Henry said, «I have ordered a cup of hot chocolate».
- 15) Tim said, «Our trip won't be long».
- 16) Jane said, «I didn't buy the magazine».
- 17) A little girl said, «I can't ride a bike».
- 18) The policeman said to the driver, «Your car was moving too fast».
- 19) Julia said, «Your boots are very dirty, Ken».
- 20) Den said, «The doctor hasn't come yet».

Якщо в реченнях з прямою мовою йдеться про загальновідомі факти, то після перетворення прямої мови на непряму граматичний час дієслів не змінюється:
The teacher said, «There **are** seven days in a week». — The teacher said that there **are** seven days in a week.

4. Report the statements.

- 1) Sally said, «People can't live without air».
- 2) Mark said, «I will be in time for the meeting».
- 3) Johnny said, «My father can sail a yacht».
- 4) The teacher said, «The planets of the Solar System move around the Sun».
- 5) Dolly said, «Mothers always take care of their children».

- 6) Sam said, «Athens is the capital of Greece».
- 7) A little boy said to us, «I didn't touch your dog».
- 8) Mother said to her child, «There are thirty-one days in December».
- 9) Ben said happily, «We'll celebrate Christmas in a week».
- 10) Jessica said, «I have just read a very interesting article, Vicky».

За допомогою непрямої мови також можна передавати накази, прохання, пропозиції тощо. Для їх передачі використовуються слова (introductory verbs) order, ask, tell, suggest, beg, advise, forbid, warn, insist, promise, agree, refuse, remind etc., після яких вживається інфінітив дієслова. У реченнях з непрямою мовою не вживається слово please:

She said, «**Give** me your book, please». — She **asked** me **to give** her my book.

He said, «**Open** the door! » — He **ordered** **to open** the door.

She said, «**Don't take** my bag». — She **asked not to take** her bag.

He said, «**Let's have** a cup of tea». — He **suggested having** a cup of tea.

5. Report the statements, using the reporting verbs from the box.

*to suggest, to remind, to explain, to beg, to ask, to forbid,
to refuse, to agree, to advise, to promise*

- 1) Helen said, «Let's go to the park, Molly! »
- 2) Daniel said to his mother, «I really will tidy my room in the evening».
- 3) The woman said to her son, «You should help your friend».
- 4) Andy said, «Don't forget to send the e-mail, Ted».
- 5) Nora said, «Help me with the luggage, please, Nick».
- 6) A little girl said to her parents, «I will not stay at home alone».
- 7) Jane said to her mother, «Please, let me go to the party! »
- 8) Frank said to his friend, «OK, I'll give you my camera for a day».
- 9) The teacher said to the pupils, «The Moon is smaller than the Earth».
- 10) Mrs. Sunders said to her daughter, «No, Sue, you mustn't take the jam from the fridge! »

Для того щоб передати непрямою мовою запитання, використовуються слова *ask, wonder, want to know*. У питальних реченнях із непрямою мовою

(загальних запитаннях) підрядна та головна частини поєднуються за допомогою слів *if* чи *whether* і граматичні часи змінюються відповідно до правил. У підрядних реченнях такого типу порядок слів прямий (як у розповідному реченні). Знак питання в кінці речень з непрямою мовою не ставиться:

Nick said, «Do you get up early, Ben?» — Nick asked if/whether Ben got up early.
Liz said, «Did you go to school, Ann?» — Liz wondered if/whether Ann went to school.

6. *Report the questions.*

- 1) Molly said to Vicky, «Do you often visit your aunt? »
- 2) Martin said, «Does your friend play table tennis, Den? »
- 3) Mother said to her daughter, «Will you help me with the washing up? »
- 4) Helen said to her Granny, «Did you buy any apples for me? »
- 5) Sam said, «Have you written an essay, Mike? »
- 6) The doctor said to the patient, «Do you often have headaches? »
- 7) George said to his father, «Have you repaired my bike? »
- 8) The shop-assistant said to the customer, «Have you tried the shoes on? »
- 9) The waiter said to us, «Will you have anything for dessert? »
- 10) Mother said to Pam, «Are you watching TV? »
- 11) Angela said, «Is anything wrong, Emmy? »
- 12) Ted said to his parents, «Are you going to the theatre? »
- 13) The guide said to the tourists, «Do you understand English? »
- 14) The child said to his mother, «May I play football with my friends? »
- 15) Granny said to Sally, «Can you go shopping for me? »
- 16) The teacher said to the pupils, «Should I speak louder? »
- 17) Alice said to her friend, «Did you see this film? »
- 18) Jane said to the conductor, «Must I show you my ticket? »
- 19) Granny said to Tommy, «Are you hungry? »
- 20) The professor said to the student, «Did you learn French at school? »

7. *What did the tourists ask the guide about! Report the questions.*

- Did you plan our tour beforehand?
- Are we going to the museum?
- Do you speak Spanish?
- Will you tell us about the history of the castle?

- Have you ever been inside the tower?
- Will you show us the best shop to buy souvenirs?
- Can you speak a bit louder?
- May we take some photos?

Для того щоб передати непрямою мовою спеціальні запитання, головна та підрядна частини речення поєднуються за допомогою відповідного питального слова (*when, what, where, which, how*), граматичний час у підрядній частині змінюється за правилами. У підрядних реченнях такого типу порядок слів прямий (як у розповідному реченні). Знак питання в кінці речень з непрямою мовою не ставиться:

Eddy said, «How old is your brother?» — Eddy asked how old my brother was.
Jane said, «What have you done, Ben?» — Jane wondered what Ben had done.

8. Report the questions.

- 1) Robert said, «What time do you come back from the swimming-pool, John? »
- 2) The shop assistant said to the lady, «What size of dress do you need? »
- 3) A man said to the policeman, «How can I get to the railway station? »
- 4) The teacher said to the boy, «What exercise did you write? »
- 5) Helen said to her sister, «Where are you going? »
- 6) A woman said to a little girl, «Why are you crying? »
- 7) Frank said, «What time is it, Bob? »
- 8) A man said to his wife, «What have you cooked for supper? »
- 9) A manager said to the secretary, «Who is waiting for me? »
- 10) Pam said, «Where will we go after the lecture, Mark? »
- 11) Henry said, «Where is my shirt, Mum? »
- 12) Vicky said, «What present have you bought for Mary, Den? »
- 13) Jim said to Victor, «When did you buy your car? »
- 14) Granny said to the children, «Who has broken my cup? »
- 15) Joe said, «How much are the tickets? »
- 16) Margaret said to the driver, «What time does the bus arrive to L'viv? »
- 17) The secretary said to the man, «What can I do for you? »
- 18) Dick said, «Why are you so angry, Paul? »
- 19) Jessica said, «Why have you cut your hair, Liz? »
- 20) Amanda said to her classmate, «What time will the lesson begin? »

9. Write the exact words of the teacher.

The teacher asked the students what they had prepared for the lesson. She wondered if all the students had done their homework. She wanted to know what questions the students wanted to ask her about the grammar rules. The teacher asked the students which exercise had been the most difficult. She told the students to open their books and to revise the grammar rule. Then she invited Mary to the blackboard and asked him to write a sentence. She wondered if Mary could explain the spelling of the words in the sentence. The teacher gave Mary a good mark for his answer.

Обставини місця та часу в реченнях із непрямою мовою змінюються таким чином:

here — there;

this — that;

these — those;

now — then,

at that time;

today — that day;

tonight — that night;

yesterday — the day before, the previous day;

tomorrow — the next day, the following day;

last week/month, etc. — the week/month before, the previous week/ month;

next week/month, etc. — the next week/month, the following week/ month;

an hour ago — an hour before/earlier.

Наприклад:

Bill said, «*I bought this book in the supermarket yesterday*». — Bill said *that he had bought that book in the supermarket the day before*.

10. Report the sentences.

1) Kate said, «I haven't seen Roy today».

2) Vicky said, «Where are we going tonight, Jane? »

3) The teacher said to the pupils, «You'll pass your exam next month».

4) Philip said to his friend, «My mother bought me these trainers a week ago».

5) Pam said, «I'll bring you this magazine tomorrow, Jane».

6) The baby-sitter said to the woman, «The children are playing on the playground now».

7) Andy said, «I spoke to my coach an hour ago».

- 8) Henry said to his sister, «I only had a sandwich for breakfast today».
- 9) Beth said, «I'm happy to be here again».
- 10) The policeman said to the woman, «I didn't see your car here five minutes ago».
- 11) The teacher said, «Why weren't you at school yesterday, Bob? »
- 12) Angela said, «Will you go shopping tomorrow, Mary? »
- 13) Laura said, «What are you reading now, Nina? »
- 14) Andrew said, «Can you find any mistakes here, Paul? »
- 15) Rachel said, «Are you leaving tomorrow, Sam? »

11. Report the sentences.

- 1) Greg said, «Can you meet me at two tomorrow, Ron? »
- 2) Pamela said, «I'm ironing your trousers, Jim».
- 3) Tony said, «What time does the bus depart? »
- 4) The policeman said, «Go out of the car! »
- 5) Susan said, «Let's go to a cafe, Betty».
- 6) Tracy said, «I have already fed the cat».
- 7) Mrs. Jones said, «Where do you live, little girl? »
- 8) Patrick said, «Don't open the window, Nick».
- 9) Elsa said, «I haven't been to this shopping center yet».
- 10) Paul said, «What are you going to do today, Julia? »
- 11) Helen said, «What will you cook for supper, Mum? »
- 12) Tom said, «This film was really exciting».
- 13) The secretary said, «Mr. Grey will sign the contract tomorrow».
- 14) My neighbor said, «How did you like the concert, Fred? »
- 15) Little Beth said, «We have never been to the circus, Daddy».
- 16) Mary said, «Penguins can't fly».
- 17) Brian said, «Don't phone me too late».
- 18) Ronald said, «Where have you been, Dick? »
- 19) Sue said, «What newspaper are you reading, Irma? »
- 20) Eric said, «May I have a piece of cake? »

CONTROL TEST

1. She asked me when I ... to work.
a) had to go; b) will go; c) have gone; d) will have to go
2. My parents decided that we ... my birthday on Sunday.
a) would celebrate; b) celebrated; c) shall celebrate; d) celebrate

3. During the interview they asked John if he ... a job before.
a) has had; b) had had; c) would have; d) was having
4. The teacher explained that the classes ... the week before.
a) would start; b) started; c) had started; d) have started
5. He said that he ... to Oxford University in the 90-s.
a) had been; b) will be; c) has been; d) was gone
6. Nick hoped that his friends ... him with his car.
a) would help; b) will help; c) helped; d) help
7. I thought that Tom ... her that he intended to go to Germany.
a) tells; b) was telling; c) will tell; d) would tell
8. Tom said, "I'm sorry to disturb you, Betty".
a) Tom told that he was sorry to disturb Betty b) Tom told Betty that he was sorry to disturb her.
c) Tom said to Betty he had been sorry to disturb her. d) Tom said Betty he had been sorry to disturb
9. The students said, "We wish our exams were over".
a) The students said they wished their exams had been over.
b) The students said that they wished their exams have been over.
c) The students said they wished their exams were over.
d) The students told they wished their exams were over.
10. "If I were you, I'd stop smoking" Jack said.
a) Jack said that if he were him he would have stopped smoking; b) Jack advised to him to stop smoking.
c) Jack said that if he had been him he would stop smoking; d) Jack advised him to stop smoking.
11. Ann asked: "Is your sister good at English?" Ann asked me.....
a) that my sister is good at English; b) if my sister was good at English
c) whether my sister has been good at English; d) my sister is good at English
12. "Do you go in for sports?". Jack asked me...
a) he went in for sports; b) if I went in for sports
c) if I'll go in for sports; d) I should go in for sports
13. Jane asked Bob: "What did you buy yesterday?" Jane asked Bob what...
a) he would buy the next day; b) he bought the day before
c) he had bought the day before; d) had he bought the day before
14. "Do not play in the street!"
a) My Mother told me do not play in the street; b) My Mother said to play in the street

c) She asked me to play in the street; d) My mother told me not to play in the street
15.” Will Tom help me?” she said. She asked...

a) will Tom help her; b) if Tom would help her;

c) whether he will help her; d) whether would he help her

16. During the interview they asked Ann if she ... to work on Saturdays.

a) will want; b) has wanted; c) was wanting; d) wanted

17. The children were afraid of making any noise – Mom ...

a) was sleeping; b) slept; c) had been sleeping; d) is sleeping

18. He gave me all his money because he ... me.

a) would trust; b) trusted; c) had trusted; d) trusts

19. The weather forecast said that ... in the afternoon.

a) it will rain; b) it would rain; c) it rains; d) it will be raining

20. She said it was a stupid idea and it ...

a) didn't work; b) will have work; c) wouldn't work; d) worked

21. She said she ... help me because she had too much to do.

a) can't; b) will be able; c) is to; d) couldn't

22. James said that he ... a horse before.

a) never rode; b) had never ridden; c) has never ridden; d) would never ridden

23. I doubted if she ... see my point.

a) will; b) would; c) have to; d) shall

24. The doctor asked, “How do you feel?”

a) The doctor asked how did I feel; b) The doctor asked how I felt;

c) The doctor asked how I had felt; d) The doctor asked how I feel

25. He said, “Where is Jane going?”

a) He asked where was Jane going; b) He asked where Jane is going;

c) He asked where Jane was going; d) He asked where Jane went

26. “Will you be free tomorrow?” Peter asked Dick.

a) Dick asked would Peter be free the next day; b) Peter asked Dick if he free tomorrow;

c) Peter asked Dick if he would be free the next day; d) Peter asked Dick if he will be free

27. The teacher said to us, “Be quiet, please”

a) The teacher asked us be quiet; b) The teacher asked us to be quiet;

c) The teacher said us to be quiet; d) The teacher told to us to be quiet

28. “Don't swim too far, dear” asked Mom.

a) Mom asked her not to swim too far; b) Mother asked her don't swim too far

c) Mom said if she would swim too far; d) Mother told her if she wouldn't swim too far

29. Peter said, "Alice, are you busy now?" Peter asked Alice...

- a) she was busy; b) if she was busy then;
- c) she would be busy; d) if she wasn't busy then

30. "Why hasn't he locked the car door?" the police said.

- a) The policeman asked why he hadn't locked the car door;
- b) The policeman asked why hadn't he locked the car door;
- c) The policeman asked why he didn't lock the car door;
- d) The policeman asked why didn't he lock the car door

УМОВНІ РЕЧЕННЯ (CONDITIONAL SENTENCES)

Умовні речення вживаються для вираження дій, які відбудуться чи відбулися б за певних умов. Умовні речення складаються з двох частин: головної (*Main Clause*) та підрядної (*If-clause*). Умовні речення нульового типу (*Zero Conditionals*) виражають реальні або вірогідні ситуації у теперішньому. У таких реченнях вживається теперішній неозначений час як у головній частині, так і у підрядній.

<i>Main Clause</i>	<i>If-clause</i>
Present Simple Tense	Present Simple Tense

Chocolate **melts if** you **heat** it.

If I have a bad mood, I always **listen** to music.

Умовні речення першого типу (*First Conditionals*) виражають реальні чи вірогідні ситуації у майбутньому. Граматичні часи в таких реченнях вживаються так.

<i>Main Clause</i>	<i>If-clause</i>
Future Simple Tense Modal verb + bare Infinitive	Present Simple Tense

She **will finish** the work if you **help** her.

He **can give** you this book if he **has** it.

В умовних реченнях не обов'язково головна частина стоїть першою.

Головна та підрядна частини можуть поєднуватися сполучниками *if* (якщо),

when (коли), *till* (поки), *until* (поки не), *unless* (якщо не), *as soon as* (як тільки):

As soon as he finishes his work, he will join us.

She won't go shopping **unless** you give her a list of purchases.

В умовних реченнях нульового типу *if* та *when* вживаються в одному значенні, але в умовних реченнях першого типу *if* вживається для вираження умови, а *when* — для вираження дій, які відбудуться у певний час. Порівняйте:

If/when I meet my friends, I always greet them. (Якщо/коли я зустрічаю друзів, я завжди їх вітаю.)

He will phone you **if** he has time. (Він зателефонує тобі за умови, що матиме час.)

He will phone you **when** he has time. (Він зателефонує тобі тоді, коли матиме час.)

1. Match two parts of the sentences.

1) When she comes to our town,	a) if the weather is hot.
2) He will pass the exams successfully	b) when our lessons are over.
3) If it gets dark,	c) if you want to lose weight.
4) They always go to the country	d) you shouldn't drink it.
5) You should keep to the diet	e) she always stays in the hotel.
6) We drink a lot of water	f) when they are on holidays.
7) If milk isn't fresh,	g) we will turn on the light.
8) We will go to the gym	h) if he studies hard.

2. Circle the correct item.

1) When we need/will need food, we usually go/will go to the supermarket.

2) If this exercise is/will be too difficult for you, you should/will should ask your friend to help you.

3) If/when the weather is rainy tomorrow, we won't go boating.

4) She will find a good job if/when she graduates from university.

5) If Alex finishes/will finish his work early, he comes/will come to our party.

6) Jane will return you the book if/when she finishes reading it.

7) We miss/will miss the train if we don't/won't catch a taxi.

8) Sue always helps/will help me with cooking when she has/will have time.

9) When they have/will have enough money, they buy/will buy a new car.

10) If the film is/will be interesting, I always watch/will watch it up to the end.

Якщо підрядне речення (*If-clause*) стоїть першим, воно відокремлюється комою. Порівняйте:

He will give you this disc if you ask him.

If you ask him, he will give you this disc.

3. Put the verbs in brackets into the Present Simple or Future Simple Tense.

- 1) If you ... (to come) to see me tomorrow, I ... (to be) very glad.
- 2) We ... (to visit) the Tower of London when we ... (to go) on a tour next summer.
- 3) She ... (to prepare) dinner as soon as she ... (to finish) cleaning the flat.
- 4) If you ... (to do) your homework properly, you ... (not to get) a bad mark.
- 5) The baby ... (not to fall asleep) if you ... (to make) so much noise.
- 6) Frank ... (to have) a stomachache if he ... (not to eat) so much.
- 7) My parents ... (to be) angry if I ... (to fail) the exam.
- 8) Pam always ... (to talk) to her mother when she ... (to need) a piece of advice.
- 9) I usually ... (to go) to bed early when I ... (to be) tired.
- 10) If Tony ... (to manage) to buy the tickets, we ... (to go) to the concert tonight.

Unless часто вживається у реченнях замість *if not*. У цьому випадку заперечна частка *not* не потрібна. Але не можна вживати *unless* у питальних реченнях.

We won't watch TV unless we finish (if we don't finish) our project.

What will he do if he doesn't find a job? (Not: unless he finds a job.)

4. Use the sentences to make up a chain story as in the example.

a) E x a m p l e: If Vicky studies hard, she will pass her school final exams successfully.

If she passes her school final exams successfully. she...

Vicky will study hard.

She will pass her school final exams successfully

She will enter university. She will get good education.

She will graduate from the university.

She will find a good job.

She will earn a lot of money.

She will travel a lot.

She will meet a handsome and clever young man.

They will have a happy family.

b) Use the sentences of part **a** and write what happens if Vicky doesn't study hard.

Умовні речення другого типу (Second Conditionals) вживаються, якщо дія неможлива чи нереальна у теперішньому чи майбутньому. Граматичні часи в цих реченнях вживаються так.

Main Clause	If-clause
would/could/might + bare Infinitive	Past Simple
We would go to the seaside if we had holidays. (But we have no holidays.)	We would go to the seaside if we had holidays. (But we have no holidays.)

5. Put the verbs in brackets into the correct tense. (Use the second conditional.)

- 1) If Amanda ... (to listen) to news, she ... (to know) about the accident.
- 2) We ... (to have) a snack if we ... (to be) hungry.
- 3) If Peter ... (can) to play the guitar, he ... (to take) part in the concert.
- 4) Our parents ... (not to be) so angry if you ... (not to return) home so late.
- 5) If Sam ... (to listen) to the teacher's explanation, he ... (to understand) this rule.
- 6) I ... (to come) to their wedding if I ... (to get) the invitation.
- 7) If Mark ... (to have) a car, he ... (to give) us a lift.
- 8) What ... you ... (to buy) if you ... (to have) a lot of money?
- 9) What country ... they ... (to visit) if they ... (to plan) their travel beforehand?
- 10) What musical instrument ... Diana ... (to learn) to play if she ... (to want) to become a musician?

Умовні речення другого типу вживаються для висловлювання порад:

If I were you, I would buy a new mobile phone. (На вашому місці я би купив новий мобільний телефон.)

Форма were вживається для всіх осіб в умовних реченнях.

6. Give advice in the following situations as in the example. Use the word combinations from the table.

to see the dentist, to look for a highly paid job, to take some driving lessons, to tidy, to go to the hairdresser's, to ask parents for advice, to go shopping, to use the dictionary, to leave the house earlier, to have an early night

Example: — I'm afraid, I will be late for the meeting.

— If I were you. I would leave the house earlier,

- 1) I don't like my hairstyle.
- 2) My room is a mess.
- 3) I don't have enough money to pay for my flat.
- 4) Our fridge is empty.
- 5) I have got a terrible toothache.
- 6) I can't translate these words.
- 7) I'm so tired!
- 8) I don't know how to solve this problem.
- 9) I can't drive a car.

Для висловлювання побажань використовується конструкція **I wish** з дієсловами у таких граматичних формах.

I wish (if only)	+ Past Simple Наприклад: I wish I were younger. (Я би хотів бути молодим. /На жаль, я не молодий.) I wish I won the competition. (Я би хотів виграти змагання./На жаль, я не виграю змагання.)	Коли йдеться про бажання змінити теперішню ситуацію.
I wish (if only)	I wish (if only) + subject + could + bare Infinitive Наприклад: I wish she could come to the concert. (Я би хотів, щоб вона прийшла на концерт./На жаль, вона не може прийти на концерт.)	Коли йдеться про бажання, які не можуть реалізуватися через певні теперішні обставини, висловлюється жаль із цього приводу.
I wish (if only)	+ subject + would + bare Infinitive Наприклад: I wish we would buy a new house. (Я би хотів, щоб ми купили новий будинок./На жаль, ми не купимо	Коли висловлюється бажання щодо майбутнього.

Запам'ятайте! У реченнях такого типу *were* вживається для всіх осіб.

7. *Circle the correct item.*

- 1) If I do/will do my homework quickly, I will/would play on computer.
- 2) Witty showed/would show you her picture if she finish/ finished it.
- 3) He always wants/will want to eat when he feels/would feel nervous.
- 4) My parents don't/wouldn't buy me a present if I didn't/ wouldn't get a good mark for the test.
- 5) He won't/didn't repair the car if you didn't/don't help him.
- 6) If Helen wouldn't/didn't eat a dirty apple she wouldn't/ didn't have a stomachache.
- 7) We will/would leave the town today if he manage/managed to buy the train tickets.
- 8) If I have/has some eggs and butter I will/would bake a cake.
- 9) If he take/took his camera, we will/would make wonderful photos.
- 10) I will/would buy this dress if it was/were the right size.

8. *Put the verbs in brackets into the correct tense. Decide if it is the first or the second conditional.*

- 1) Your parents will be upset if you ... (not to get) the diploma.
- 2) She would be happy if we ... (to bring) her flowers.
- 3) I wish my sister ... (to lend) me her new hat tonight.
- 4) Ann always ... (to shout) when she sees a mouse.
- 5) I wish my friends ... (to be) here now!
- 6) Ron ... (to take) the cat off the tree if he could climb it.
- 7) If they paint all the rooms in the flat next week, they ... (to move) there soon.
- 8) If I were you, I ... (to visit) this museum.
- 9) If you saw the firework display, you ... (to be) surprised.
- 10) John will catch the idea when he ... (to read) this article up to the end.

9. *Match two parts of the sentences.*

1) If you leave meat on the table, 2) You will catch a cold 3) If I were you, 4) She would buy a new computer 5) If he didn't miss the lessons, 6) I will phone you 7) He would improve his English 8) If I need advice, 9) I wish my brother	if she saved money, when I come home, if he attended language courses. your cat will eat it. would take me on the tour with him. I'll talk with my mother, if you don't put your warm coat on. he would pass the exams successfully. I would join some sport club.
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10. Translate into English.

- 1) Якщо він буде приймати ліки, він швидко одужає.
- 2) Якби вона не отримала повідомлення, вона б зателефонувала.
- 3) На вашому місці я би не обіцяв цього.
- 4) Якби мама зараз купила мені нові джинси!
- 5) Якщо ви назбираєте яблук, я спечу яблучний пиріг.
- 6) Ми би швидко закінчили роботу, якби ви нам допомогли.
- 7) Якби ми завтра купили квитки на концерт!
- 8) Том з братом поїдуть рибалити завтра, якщо не буде дощу.
- 9) На вашому місці я не їв би так багато.
- 10) Я приніс би тобі цю книжку, якби ти мене попросив.

CONTROL TEST

1. If you ___ faith in something, you ___ in something you cannot prove.
a) have/believe; b) will have/will believe; c) had/believe; d) have/will believe
2. I ___ my work in time if you ____.
a) will do/help; b) do/will help; c) should do/helps; d) have done/help
3. If I you, I ___ it.
a) am/regretted; b) am/regrets; c) were/wouldn't; d) is/didn't.
4. If you ___ wisely, you ___ cheerfully.
a) command/will obey; b) had commanded/would be obeyed; c) commanded/would have been obeyed; d) command/will obey.
5. If I ___ you, I ___ learning French next year.
a) am/start; b) was/will start; c) am/should start; d) were/should start.
6. They are waiting for us. They will be disappointed if we ____.

a) won't come; b) haven't come; c) didn't come; d) don't come.

7. I wish ___ more responsible at studies.

a) she were; b) here were; c) she will be; d) she is.

8. If you ___ water, it ___ a solid.

a) will freeze/will become; b) freeze/will become; c) will freeze/becomes; d) freeze/become.

9. He ___ the picture if it ___ him.

a) will buy/impress; b) would buy/impresses; c) will buy/impresses; d) will buy/will impress.

10. If he ___ generous, he ___ help the poor.

a) would be/would help; b) is/would have helped; c) was/will help; d) was/would help.

11. I wish ___ laughing at him.

a) stop; b) would stop; c) stopped; d) will stop.

12. If you ___ the Prime Minister what ___ you ___?

a) are/would/have done; b) were/would/do; c) will be/will/do; c) were/would/do; d) have been/are/doing.

13. I wish I ___ in time yesterday evening. I have missed the beginning of the performance.

a) had come; b) have come; c) came; d) did come.

14. ___ you really ___ if I ___ away.

a) Would/follow/go; b) Will/follow/am going; c) Would/follow/went; d) Will/follow/would have gone.

15. If it ___ this winter, we ___ skiing.

a) snow/go; b) snowed/went; c) snows/shall go; d) snowed/had gone

16. If public transport ___ efficient, people ___ using their cars.

a) is\will reduce; b) will be\will reduce; c) is\reduce; d) will be\reduce.

17. If you ___ till half past six, you ___ dinner at about eight.

a) are working\will have; b) will be working\will have; c) will working\ will have; d) working\will be having.

18. If you ___ Oxford, you ___ some interesting buildings.

a) will visit\will see; b) visit\see; c) visited\will see; d) visit\will see.

19. He wishes he ___ a celebrity.

a) is; b) was; c) will be; d) has been.

20. She wishes they ___ making quarrels.

a) they would stop; b) them would stop; c) they will stop; d) they stopped.

21. If only I ___ to help you.

- a) was able; b) am able; c) will be able; d) have been able.
22. If you ___ ice, it ____.
- a) will heat\will melt; b) will heat\melts; c) heats\melts; d) heat\will melt.
23. We ___ if they ____.
- a) won't know\come; b) don't know\will come; c) didn't know\will come; d) haven't known\come.
24. If you ___ foreign language, you ___ a better job.
- a) speak\have; will speak\will have; c) will speak\have; d) would speak\will have.
25. If I ___ at the office, please ___ a message.
- a) am not\will leave; b) won't be\leave; c) am not\leave; d) won't be\will leave.
26. If our competitors___ about our new product, they ___ to copy it.
- a) find out\will want; b) will find out\want; c) will find out\will want; d) finds out\will want.
27. We won't leave the house ___ we find the key.
- a) if; b) unless; c) when; d) after.
28. What shall we do ___ don't find any information in the Internet?
- a) if; b) unless; c) whether; d) before.
29. Your friend won't speak to you ___ you tell him the truth.
- a) whether; b) unless; c) ___; d) or.
30. If he ___ about this fact he ___ his opinion.
- a) knew\would change; b) had known\will change; c) knew\will change; d) knew\changed.

ТАБЛИЦЯ НЕПРАВИЛЬНИХ ДІЄСЛІВ З ТРАНСКРИПЦІЄЮ ТА
ПЕРЕКЛАДОМ

1. arise [ə'raɪz]	arose [ə'rouz]	arisen [ə'ri:zn]	піднімати (ся)
2. be [bi:]	was [wɒz], were [weə]	been [bi:n]	бути
3. bear [beə]	bore [bɔ:]	born [bɔ:n]	нести, народжувати
4. become [bɪ'kʌm]	became [bɪ'keɪm]	become [bɪ'kʌm]	ставати кимось, чимось
5. begin [bɪ'gɪn]	began [bɪ'gen]	begun [bɪ'gʌn]	починати(ся)
6. bend [bend]	bent [bent]	bent [bent]	гнути
7. bind [baɪnd]	bound [baʊnd]	bound [baʊnd]	зв'язувати
8. bite [baɪt]	bit [bɪt]	bitten [bɪtn] (bit [bɪt])	кусати
9. bleed [bli:d]	bled [bled]	bled [bled]	сходити кров'ю
10. blow [bləʊ]	blew [blu:]	blown [bləʊn]	дути
11. break [breɪk]	roke [brɔ:k]	broken ['brɔ:kn]	ламати, повідомляти
12. breed [bri:d]	bred [bred]	bred [bred]	виросувати
13. bring [brɪŋ]	brought [brɔ:t]	brought [brɔ:t]	приносити
14. build [bɪld]	built [bɪlt]	built [bɪlt]	будувати
15. burn [bɜ:n]	burnt [bɜ:nt]	burnt [bɜ:nt]	горіти, палити
16. buy [baɪ]	bought [bɔ:t]	bought [bɔ:t]	купувати
17. cast [kɑ:st]	cast [kɑ:st]	cast [kɑ:st]	розкидати
18. catch [kætʃ]	caught [kɔ:t]	caught [kɔ:t]	ловити
19. choose [tʃu:z]	chose [tʃəʊz]	chosen ['tʃəʊzn]	вибирати
20. come [kʌm]	came [keɪm]	come [kʌm]	приходити
21. cost [kɒst]	cost [kɒst]	cost [kɒst]	коштувати
22. cut [kʌt]	cut [kʌt]	cut [kʌt]	різати
23. dig [dɪg]	dug [dʌg]	dug [dʌg]	рити, копати
24. do [du:]	did [dɪd]	done [dʌn]	робити, виконувати
25. draw [drɔ:]	drew [dru:]	drawn [drɔ:n]	малювати, притягувати
26. dream [dri:m]	dreamt [dremt]	dreamt [dremt]	мріяти, снитися
27. drink [drɪŋk]	drank [draeŋk]	drunk [drʌŋk]	пити
28. drive [draɪv]	drove [drəʊv]	driven [drɪvn]	керувати авто
29. eat [i:t]	ate [et]	eaten [i:tn]	їсти
30. fall [fɔ:l]	fell [fel]	fallen [fɔ:ln]	падати
31. feed [fi:d]	fed [fed]	fed [fed]	годувати
32. feel [fi:l]	felt [felt]	felt [felt]	почувати (себе)
33. fight [faɪt]	fought [fɔ:t]	fought [fɔ:t]	битися, боротися
34. find [faɪnd]	found [faʊnd]	found [faʊnd]	знаходити
35. flee [fli:]	fled [fled]	fled [fled]	тікати, рятуватися
36. fly [flaɪ]	flew [flu:]	flown [fləʊn]	літати
37. forget [fə'get]	forgot [fə'gɒt]	forgotten [fə'gɒtn]	забувати
38. get [get]	got [gɒt]	gotten [gɒtn] (got [gɒt])	отримувати, розуміти,

39. give [gɪv]	gave [geɪv]	given ['gɪvən]	давати
40. go [gəʊ]	went [went]	gone [ɡɒn] іти,	їхати .
41. grow [grəʊ]	grew [gru:]	grown [grəʊn]	виростити
42. hang [hæŋ]	hung[hʌŋ]	hung [hʌŋ]	висіти
43. have[hæv]	had [hæd]	had [hæd]	мати (щось)
44. hear [hɪə]	heard [hə:d]	heard [hə:d]	чути
45. hide[haid]	hid [hɪd]	hidden ['hɪdn]	ховатися
46. hit [hɪt]	hit [hɪt]	hit [hɪt]	вдарити
47. hold[həʊld]	held [held]	held [held]	тримати
48. keep [ki:p]	kept [kept]	kept [kept]	тримати, зберігати
49. know [nəʊ]	knew [nju:]	known [nəʊn]	знати
50. lead [li:d]	led [led]	led [led]	лідити, вести
51. learn [lɜ:n]	learnt [lɜ:nt]	learnt [lɜ:nt]	вчити(ся)
52. leave [li:v]	left [left]	left [left]	залишати, покидати
53. lend [lend]	lent [lent]	lent [lent]	позичати
54. let [let]	let [let]	let [let]	дозволяти, здавати
55. light [laɪt]	lit [lɪt]	lit [lɪt]	світити
56. lose [lu:z]	lost [lɒst]	lost [lɒst]	втрачати
57. make [meɪk]	made [meɪd]	made [meɪd]	робити руками
58. mean [mi:n]	meant [ment]	meant [ment]	означати
59. meet [mi:t]	met [met]	met [met]	зустрічати, знайомитися
60. put [put]	put [put]	put [put]	класти
61. read [ri:d]	read [red]	read [red]	читати
62. ride [raɪd]	rode [rəʊd]	ridden ['rɪdn]	кататися
63. rise [raɪz]	rose [rəʊz]	risen ['rɪzn]	підніматися
64. run [rʌn]	ran [ræn]	run[rʌn]	бігти, їхати
65. say [seɪ]	said [sed]	said [sed]	сказати
66. see [si:]	saw [sɔ:]	seen [si:n]	бачити
67. sell[sel]	sold [səʊld]	sold [səʊld]	продавати
68. send [send]	sent [sent]	sent [sent]	посилати
69. set [set]	set [set]	set [set]	налаштувати
70. shake [ʃeɪk]	shook [ʃʊk]	shaken [ʃeɪkn]	трясти
71. shine [ʃaɪn]	shone [ʃɒn]	shone [ʃɒn]	світити
72. shoot [ʃu:t]	shot [ʃɒt]	shot [ʃɒt]	стріляти
73. shut [ʃʌt]	shut [ʃʌt]	shut [ʃʌt]	закривати
74. sing [sɪŋ]	sang [sæŋ]	sung [sʌŋ]	співати
75. sink [sɪŋk]	sank [sæŋk]	sunk [sʌŋk]	потонути
76. sit [sɪt]	sat [sæt]	sat [sæt]	сидіти

77. sleep [sli:p]	slept [slept]	slept [slept]	спати
78. smell [smel]	smelt [smelt]	smelt [smelt]	пахнути, нюхати
79. speak [spi:k]	spoke [spəuk]	spoken ['spəukn]	говорити, розмовляти
80. spend [spend]	spent [spent]	spent [spent]	тратити, проводити (час)
81. spoil [spɔil]	spoilt [spɔilt]	spoilt [spɔilt]	псувати
82. spread [spred]	spread [spred]	spread [spred]	поширювати
83. spring [sprɪŋ]	sprang [spræŋ]	sprung [sprʌŋ]	стрибати
84. stand [stænd]	stood [stud]	stood [stud]	стояти
85. steal [sti:l]	stole [stəul]	stolen ['stəuln]	красти
86. stick [stk]	stuck [stʌk]	stuck [stʌk]	приклеювати
87. sting [stɪŋ]	stung [stʌŋ]	stung [stʌŋ]	жалити
88. stride [straɪd]	strode [strəud]	stridden ['strɪdn]	крокувати
89. strike [straɪk]	struck [strʌk]	struck [strʌk]	бити, страйкувати
90. strive [straɪv]	strove [strəuv]	striven ['strɪvn]	старатися
91. swear [sweə]	swore [swɔ:]	sworn [swɔ:n]	присягатися
92. sweep [swi:p]	swept [swept]	swept [swept]	підмітати
93. swim [swɪm]	swam [swæm]	swum [swʌm]	плавати
94. swing [swɪŋ]	swung [swʌŋ]	swung [swʌŋ]	гойдатися, мінятися
95. take [teɪk]	took [tuk]	taken ['teɪkn]	брати
96. teach [ti:tʃ]	taught [tɔ:t]	taught [tɔ:t]	навчати
97. tear [teə]	tore [tɔ:]	torn [tɔ:n]	рвати на шматки
98. tell [tel]	told [təuld]	told [təuld]	розповідати
99. think [θɪnk]	thought [θɔ:t]	thought [θɔ:t]	думати
100. throw [θrəu]	threw [θru:]	thrown [θrəun]	кидати
101. thrust [θrʌst]	thrust [θrʌst]	thrust [θrʌst]	штовхати
102. tread [tred]	trod [trɒd]	trodden ['trɒdn]	ступати
103. understand	understood	understood	розуміти
[,ʌndə 'staend]	[,ʌndə'stu:d]	[,ʌndə'stu:d]	
104. upset [ʌp 'set]	upset [ʌp'set]	upset [ʌp'set]	засмучуватися
105. wake [weɪk]	woke [wəuk]	woken [wəukn]	прокидатися
106. wear [weə]	wore [wɔ:]	worn [wɔ:n]	носити, одягатися
107. weave [wi:v]	wove [wəuv]	woven ['wəuvn]	ткати
108. weep [wi:p]	wept [wept]	wept [wept]	плакати
109. win [wɪn]	won [wʌn]	won [wʌn]	перемагати, вигравати
110. wind [waɪnd]	wound [waund]	wound [waund]	заводити
111. withdraw	withdrew	withdrawn	брати назад, відкликати
[wɪ'ddrɔ:]	[wɪð'dru:]	[wɪð'drɔ:n]	
112. wring [rɪŋ]	wrung [rʌŋ]	wrung [rʌŋ]	скручувати

113. write [raɪt]

wrote [rəʊt]

written [rɪtɪn]

писати

REFERENCE

1. Longley, Paul A., Michael F. Goodchild, David J. Maguire, and David W. Rhind. *Geographic Information Systems and Science*. Chichester, UK: John Wiley & Sons. 2021.580p.
2. Iliencko O. L. English for Geodesy and Land Management Students: tutorial. *O. M. Beketov National University of Urban Economy in Kharkiv. Kharkov: O. M. Beketov NUUE*. 2019. 160 p.
3. M. Hooijberg. *Practical Geodesy. Using Computers*. Springer. Springer-Verlag Berlin and Heidelberg GmbH & Co. KG. 2018.319p.
4. Jenny Dooley, Adrian Hanson PhD. *Career Paths Civil Engineering. Student's Book*. Express Publishing. 2018
4. ABBY Lingvo.Pro [Electronic resource]. – Mode of access: <http://lingvopro.abbyonline.com/ru>.
5. SMW [Electronic resource]. – Mode of access: <http://www.smweng.com/smw-land-surveying-defined/>.
6. The Centre for Digital Scholarship journals [Electronic resource]. – Mode of access: <https://journals.lib.unb.ca/index.php/ihr/article/.../27285>.
7. Johnson [Electronic resource]. – Mode of access: <http://www.johnsonlevel.com/News/TheodolitesAllAboutTheodo>.
8. Origin [Electronic resource]. – Mode of access: <http://originlandsurveying.com/land-surveying/>.
9. Thoughtco [Electronic resource]. – Mode of access: www.thoughtco.com/forest-surveying-methods-distances-and-angles-1343236.
10. CR [Electronic resource]. – Mode of access: <https://constructionreviewonline.com/2018/02/modern-survey-equipment/>.
11. The Centre for Digital Scholarship journals [Electronic resource]. – Mode of access: <https://journals.lib.unb.ca/index.php/ihr/article/.../27285>.
12. Microdrones [Electronic resource]. – Mode of access: <https://www.microdrones.com/en/content/how-do-i-get-started-with-usingdrones-for-surveying> the work but would also save considerable time and money.
13. О.М.Павліченко. Англійська мова. Граматичний практикум. II рівень / за заг.ред. І.О.Князевої – 8-е видання., випр. і доповн. – Х.: Вид-во «Ранок», 2014. – 304с.

14. Посібник для підготовки до ЄВІ з англійської мови до магістратури / [уклад.: О.П.Лисицька, С.С.Микитюк, Т.В.Мельнікова та ін.; за заг.ред. В.П.Сімонюк] – Харків : Право 2021. - 236 с.
15. Англійсько-український геодезичний словник. English-Ukrainian dictionary of geodesy: [понад 20 тис. слів] / уклад. Федір Заблоцький, Олександра Заблоцька ; за ред. Богдана Рицара. *Вид-во Львівської політехніки*, 2018. 360 с.
16. Геодезичний енциклопедичний словник / П. І. Баран, А. Л. Бондар, Х. В. Бурштинська, Б. І. Волосецький, І. М. Гудз, П. Д. Двудіт, Ю. П. Дейнека, О. Л. Дорожинський, А. Т. Дульцев, Ф. Д. Заблоцький; За ред. В. Літинського; *Нац. ун-т «Львів. політехніка»*. *Євровіт*. 2001. 668 с.